February 1997 Version: Ethiopia

Participants' Sourcebook

Africa Regional Environmental Assessment Training Course

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SRCBOOK.* August 19, 1996

List of Acronyms

ADB	African Development Bank
DFA	Development Fund for Africa
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EMEMP	Environmental Monitoring, Evaluation, and Mitigation plan (or program)
ESA	Eastern and Southern Africa
FAA	Foreign Assistance Act
GIS	Geographic Information System
ICDP	Integrated Conservation and Development Project
IEE	Initial Environmental Examination
LOP	Life of Project
M&E	Monitoring and Evaluation
MEO	Mission Environmental Officer (USAID)
NEAP	National Environmental Action Plan
NGO	Non-Governmental Organization
NPA	Nonproject Assistance
NRM	Natural Resources Management
PAAD	Program Assistance Approval Document
PEA	Programmatic Environmental Assessment
PSA	Pesticide Sector Assessment
PVO	Private Voluntary Organization
REDSO	Regional Economic Development Support Office (USAID)
REO	Regional Environmental Officer (USAID)
RFP	Request for Proposals
SD/PSGE	Office of Sustainable Development/Division of Productive Sector Growth and the Environment (USAID)
SO	Strategic Objective
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WCA	West and Central Africa
WRI	World Resources Institute
WWF	World Wildlife Fund

COURSE PROGRAM AND OBJECTIVES

Course Objectives

The Africa Regional Environmental Assessment Training has four primary objectives, assisting PVOs, NGOs, USAID Missions, contractors, host governments and other entities to:

1) Design and implement environmentally-sound activities. This is the overriding goal of the course, as well as of the environmental methods and procedures that will be taught. The course will help participants develop deeper understanding and awareness of how environmental concerns can affect the sustainability of development programs and activities, and thus to appreciate the role for environmental assessment, monitoring and evaluation.

2) Identify and assess reasonably foreseeable environmental impacts. The course will familiarize participants with the basic principles and practice of environmental assessment, and provide them with practical experience in the application of simple assessment tools and approaches.

3) Mitigate, monitor, and thereby avoid unnecessary adverse environmental impacts. USAID's *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities* and other reference materials will be introduced to participants for use in identifying options to minimize negative environmental impacts.

4) Follow USAID procedures in the context of evolving local policies and needs, using local expertise where possible to do so, and thereby avoiding unnecessary delays in project approval and implementation.

The bulk of USAID projects in Africa require only an Initial Environmental Examination, with follow-up reviews and monitoring arrangements, rather than more sophisticated Environmental Impact Assessments and detailed Environmental Mitigation, Evaluation, and Monitoring Plans. For some larger USAID "umbrella projects", it is likely that an "umbrella-type IEE" will have already been prepared. In such cases, specific grants or sub-grants will not require a full IEE, but rather a more brief environmental review or screening of the specific, proposed activities.

Therefore, the course will focus on developing participants' capability to: a) prepare an environmental review and relevant supporting material; and b) designing a mitigation, monitoring and evaluation process for activity components with potential negative impacts. While participants will gain knowledge of the other procedural requirements of Reg.16 and the logical progression of required documentation and analysis, less emphasis will be placed on more complex environmental procedures and documents.

The course relies heavily on case studies and participant working group exercises to achieve these objectives.

Agenda
Environmental Assessment Training Course - February 24 - 28, 1997
Food Aid and the Environment: Doing Better at Doing Good
Mekelle, Ethiopia

Feb 23	*Arrival and Registration*
2:00-5:00	Registration and Logistical Arrangements, Tigray Education Bureau
6:00-7:30	Facilitators Meeting

Feb 24	*Introductory Issues and Environmentally-Sound Project Design*
8:00-8:30	Welcome: Ato Zemechael Medhin, Tigray Regional Council
8:30-9:30	Course Agenda, Participant Introductions, and Group Goals *(Tab 1)*
9:30-10:30	Keynote Address and Presentation on Ethiopia's Environmental Policies Ato Kifle Lemma, Director National Conservation Strategy, National Environmental Protection Authority *(Tab 3 and Tab 8)*
10:30-10:45	*Break*
10:45-11:45	Overview of Ethiopia's Natural Resources and Trends and Issues Surrounding Their Protection *(Tab 3)*, Dr. Shibru Tedla, Manager, ECO-Consult and Chairman, Ethiopian Wildlife and Natural History Society
11:45-12:15	Environment, Development and Sustainability: Regional and Cross-Sectoral Issues *(Tab 2)*
12:15-1:30	***Lunch***
1:30-2:30	Social and Institutional Issues Affecting USAID/Ethiopia's Title II Activities and Environmentally Sound Management *(Tab 3)* Dr. Yeraswork Admassie, Assistant Professor, Addis Ababa University
2:30-3:00	Environmentally-Sound Project Design: Principles and Practice *(Tab 4)*
3:00-3:30	Environmentally Sound or Unsound? Participant Experiences in Project Design and Implementation *(Tab 5)*
3:30-3:45	*Break*
3:45-4:30	Water and Watershed Management *(Tab 3)* Jean Gaillard, Rural Engineer
4:30-5:30	Assessing Environmental Impacts: Basic Concepts *(Tab 7)*
6:00-7:00	Facilitators Meeting
7:00	***Welcome Reception at Axumawite Hotel, 2nd floor*** ***Participants: Read Case Study Descriptions -- Determine 1st & 2nd Choices*** ***Start Evaluation Forms (Tab 22)***

Feb 25	*USAID Procedures, EA Methods, IEE, Debate and Introduction to M & E*
8:00-8:15	Review of Day 1 and Sign Up Procedures for Field Trips
8:15-9:00	USAID Environmental Procedures *(Tab 9)*
9:00-9:30	Q&A on USAID Environmental Procedures
9:30-10:00	Pesticides: Special Considerations and Procedures *(Tab 19)*
10:00-10:15	*Break*
10:15: 11:00	Simple Tools and Methods for Environmental Assessment *(Tab 10)*
11:00-11:30	What is an Initial Environmental Examination (IEE)? *(Tab 11)*
11:30-12:00	Using the Environmental Screening Form and Preparing an Environmental Review *(Tab 11)*
12:00-12:15	Explanation and Formation of Breakout Groups for Debate on Food Aid and Natural Resources Management *(Tab 12)*
12:15-1:15	***Lunch (in Breakout Groups to discuss issues)***

1:15-1:45	Continued Discussion in Breakout Groups *(Tab 12)*
1:45-3:00	Discussion and Debate: Food Aid and Natural Resources Management Thomas Catterson and Thomas Remington
3:00-3:15	Wrap-Up
3:15-3:30	*Break*
3:30-4:15	Introduction to Environmental Mitigation and Monitoring *(Tab 13)*
4:15-4:45	Introduction to Field Trip and Working Groups for Case Studies *(Tab 14)*
4:45-5:30	Meet in Working Groups: Preparations for Field Trip Activities *(Tab 14)*
6:00-7:30	Facilitators Meeting

Feb 26	***Case Study Field Trip***
	Field Trips to Case Study Sites -- Working groups travel to separate sites and each interdisciplinary team group conducts environmental assessments in the field
7:30	Assembly in Groups for Distribution of Lunches at Seti Hotel and Departure
8:00	Departure
3:30	Return (Plan return to arrive in Mekelle no later than 5:30 pm) Working Groups: Prepare 3-5 minute Field Trip Summary for morning of 2/27
6:00-7:30	Facilitators Meeting

Feb 27	***Case Study Environmental Reviews and Monitoring & Evaluation Plans***
8:00-8:45	Participant Working Groups' Reactions to Field Trip
8:45-12:00	Working Groups: Develop Draft Environmental Reviews for Case Studies (including break at 10:00) *(Tab 15)*
12:00-1:15	***Lunch***
1:15-3:00	Working Groups: Present Environmental Reviews
3:00-3:15	Discussion of Environmental Review Process
3:15-3:30	*Break*
3:30-4:15	Environmental Mitigation, Monitoring and Evaluation: More on Issues and Methods *(Tab 16)*
4:15-5:30	Working Groups: Develop Draft Mitigation and Monitoring Plans for Case Studies *(Tab 17)*
6:00-7:00	Facilitators Meeting
7:15	***Traditional Ethiopian Night at the Tukul (Enderassie Hotel)***

Feb 28	***Monitoring & Mitigation Plans, More on EIA Tools and New Directions***
8:00-8:15	***Bring Your Luggage to the Education Bureau and Assemble in Meeting Room***
8:15-10:00	Working Groups: Continue to Draft Mitigation and Monitoring Plans
10:00-10:15	*Break*
10:15-12:00	Working Groups: Present Mitigation and Monitoring Plans
12:00-1:00	***Lunch -- Make Sure Your Evaluation Form is Nearly Complete***
1:00-1:30	Additional Issues or Discussion of Participants Projects *(Tab 18 and Tab 20)*
1:30-2:00	USAID And New Directions in Environmental Procedures and Natural Resource Management *(Tab 21)*
2:00:-2:15	Complete Course Evaluation Forms (Tab 22)
2:15-2:30	Recommendations for Follow-Up Activities
2:30-2:45	Closing Comments, Dr. Margaret P. Bonner, Director, USAID/Ethiopia
2:45-3:15	Award of Certificates and Special Commendations, Dr. Margaret P. Bonner, Director, USAID/Ethiopia
3:30	Prompt Departure for Airport -- Bus Departs Education Bureau

1. Introductory Session

The introductory session will cover the following topics:

- Opening Statements (see Course Program)
- Overview of Course Program and Objectives (Facilitators)
- Participant Introductions: Be prepared to describe yourself briefly in one minute or less, noting your professional background, institutional affiliation, and experience with environmental assessment.
- Facilitator and Resource Person Introductions
- Discussion of Group Goals for the Week (Group)
- Logistical Details (Course Organizers) Finally, the course organizers will briefly explain important logistical considerations related to the course venue and the week's activities.

Notes for Participants (adapted from Jawara Lumumba and John Petit, REDSO/WCA, 1995)

The following tips for participants are useful in maximizing the success of the course:

1. Participate actively.
2. Ask questions.
3. Respect different points of view.
4. Share many thoughts & ideas.
5. Build upon the ideas presented by others.
6. Join in problem-solving.
7. Make "I" statements.
8. Abide by confidentiality.
9. Have fun!

Notes on Working Groups

The working groups comprise the core of the course. The purposes of the working group sessions include:

1. To conduct group/team work exercise;
2. To provide the opportunity for detailed discussions among participants in small groups;
3. To gather up lessons learned, innovative experience, country experiences and other information cost-effectively; and,
4. To conclude with a series of specific findings and suggestions to improve the design, implementation and monitoring of projects, programs and other development activities.

Working Group Chairs

For working group sessions, the chair is a neutral servant of the group. The chair can be a course facilitator or participant. The chair should not evaluate the ideas or contributions of others, but try to focus the energy of the group on the common task. The chair should protect individuals and their ideas from attack and encourage participation. It is the chair's role to orchestrate and assist the group to function creatively, energetically, democratically and productively in the time allotted.

The chair must manage time to assure that the tasks the group is assigned are accomplished. When appropriate, the chair tries to achieve agreement or consensus on recommendations. (Consensus is not required for these sessions.) If agreement is lacking, areas of convergence and divergence may be reported.

During the working group

- Assemble the group in the assigned location and set a climate for open discussion,

e.g., welcome the group; say something to help them be comfortable.

- Open the session. Introduce yourself. Identify the topic to be discussed and link it to previous or upcoming sessions. Set the ground rules. Keep these remarks brief- not more than two or three minutes.
- Clarify your role to the group. Tell them you may make periodic interventions to help move things along, keep the group focused on the assigned objective, assure that everyone gets to participate and that no one dominates. Tell them you may raise questions of clarity and encourage full use of the resources in the room.
- Introduce the rapporteur and clarify her/his role: to capture key points on the flip chart to assist them in their discussion and also to assist with the reporting out.
- Assure the group task and the expected results are clear. State how much time is available and how you plan to allocate it. Then invite discussion.
- Manage the time. Allocate time for various parts of the task (e.g. brainstorming, discussion, synthesis). Ask the rapporteur or a participant to help keep the group on time.
- Manage the task. Keep discussion focused on the objective of the session. Encourage broad participation (limit overactive participation) and keep discussion moving. Point out areas of consensus. Note unresolved questions, information needed or assumptions made. If useful, break into sub-groups and assign sub-groups or individual participants the responsibility for writing or synthesizing. Press for decisions. Ensure that decisions are recorded for sharing in large group sessions and that minority views are recognized.
- In general, the chairs are responsible for maintaining pace, diversity and relevance. Every effort should be made to encourage participation by all members of the group. On the other hand, the chair should ensure that the discussion does not diverge from the overall objectives of the conference and the theme under discussion.
- Make sure recommendations or initial work plans are clear. For example, recommendations should say <u>who</u> is to do <u>what</u> and <u>when</u>.
- Toward the end of the discussion time be sure to allow a wrap-up summary period.
- Have the group designate the person reporting to the general session, which can but does not need to be the rapporteur. Give the rapporteur (and presenter, if separate) time to summarize and clarify important points, assist in preparations for reporting out the group's deliberations. The presentations should generally be 5-15 minutes in length; this should be clarified with the course facilitators in relation to each working group session.
- Thank everyone for their participation when the time is up. Make sure they know where they are to go next, i.e., to the main room, lunch, or whatever.
- Close the session by making a brief summary statement. Thank the participants. Reconfirm who will present the group's work. If further meetings is planned, clarify where and when. Making announcements regarding the next session and the time it begins.

<u>After the working group</u>

- Assist the rapporteur/presenter in the synthesis of key points to be reported.

- Follow up to be sure participants carry through on assigned tasks. Assist them, if necessary.

Notes for Rapporteurs

The rapporteur is responsible for accurately and succinctly reporting the results of group discussion. Specific responsibilities include:

- Assure flip chart paper, markers and tape are available in the small group meeting room and that chairs are arranged. Organizers can make an effort to have this done, but please check to assure it is done with enough advance time to find an administrative staff person to assist you in getting it set up if it is not.
- Position yourself near the flip chart and capture important points.
- Use your judgment about how best to assist the group by recording during the session. Publicly recording important points made during the discussion helps the group know visually what it has covered and provides a visual memory of the proceedings. It can assist in clarifying points; it allows participants to correct statements that inaccurately reflect their views. If people are having a hard time getting into conversation, you may record a few key phrases and then ask questions about them to promote discussion. Or, if someone seems intent on making a point more than once (even if it seems unimportant to you), you can write it down and then refer back to it as having been said and ask someone else for additional points.
- The rapporteur will be responsible for capturing all key points related to the specific theme, and noting comments on cross-cutting themes as appropriate. Recording notes on a flip chart will help participants respond to points made and remind them of what has been said.
- Record highlights of what is said on a flip chart. However, in order not to slow people down by recording points they are making: use phrases (using their words) rather than complete sentences.
- Make sure notes and charts are legible, understandable, and turned in to a facilitator (after reporting out).

TWELVE ESSENTIALS OF TEAMWORK

(Adapted from Rees, "How to lead work teams in facilitation skills")

VALUING DIVERSITY	COMFORTABLE ATMOSPHERE	ACTIVE PARTICIPATION OF ALL MEMBERS	SHARED GOALS AND OBJECTIVES
BALANCED APPROACH TO PROCESS AND CONTENT	**WHAT EFFECTIVE TEAMS NEED**		EFFECTIVE COMMUNICATION
SHARED LEADERSHIP			CONSTRUCTIVE CONFLICT MANAGEMENT
ACTION ACCOUNTABILITY RESPONSIBILITY	MUTUAL TRUST	CRITICAL ANALYSIS AND PROBLEM-SOLVING	CONSENSUS DECISION-MAKING PREFERENCE

2. Environment, Development and Sustainability: Regional & Cross-sectoral Issues

Description/Objectives

How are food security, the environment and conflict resolution linked? What does it mean in practice to link relief and development?

Should you be concerned about global warming? Who benefits from biodiversity? How can international rivers and water bodies be managed to ensure adequate supply and quality for all?

This module introduces the broad trends and issues affecting the environment globally, regionally, and locally. These issues help to shape donor policy, national strategies, and the overall setting in which projects and programs are developed and implemented. You are encouraged to reflect upon on your perspective on these issues, and how they might affect the projects you work on.

Readings

Module Backgrounder

Thrupp, L.A. 1997(draft). *The Critical Link: Food Security, the Environment, and Conflict Resolution in the Greater Horn of Africa.* World Resources Inst. Feb. 1997 draft.

In Appendix C: Keating, M. 1993. *Agenda for Change*: *A plain language version of Agenda 21 and the other Rio Agreements*, Centre for Our Common Future, Geneva. pp. vi-34.

In Appendix C: "Global and Cross-Sectoral Issues in Environmental Review", excerpts from World Bank, 1991, *in Appendix C.*

TRANSITIONING ALONG THE "RELIEF TO DEVELOPMENT CONTINUUM"

Some preliminary thoughts on what this means in practical terms:

Operational Modality: Relief -----> Rehabilitation-----> Development

Peoples' Role: Targets-----> Participants-----> Clients

Implementation Capacities: Donors-----> Govt./NGOs-----> Communities

Resource Requirements: Food-----> NFI/T.A.-----> integrated programs
(Non Food Inputs/ Technical Assistance

Time Frame: immediate-----> medium-term-----> long-term

Targeting: hungry-----> poorest-----> community

Participatory Mode: top-down(receive)-----> collective(plan/decide)-----> bottom-up(draw-down services)

Impact: transitory-----> durable-----> sustainable

Implementation Modality: activities-----> objectives-----> results

Agricultural Programs: seed banks-----> raising productivity-----> sustainable farming systems

3. Environment, Development and Sustainability: Presentations on National Issues

Description/Objectives

This module comprises several lectures that address the principal and pressing issues affecting the environment, environmental management, and environmental impact assessment in your country. You will likely hear about resource ecology issues, social dimensions of environmental issues, and national policies and initiatives to build environmental capability and achieve sustainable development. Your perceptions and experiences in this regard are important:

- What do you perceive as the most important environmental issue where you live and work?
- Are there fragile resources and ecosystems in need of protection or rehabilitation?
- Is development in your region occurring in a sustainable manner, from both an economic and environmental standpoint?
- Are national policies helping to address these concerns, and if not, what more should be done?
- How do social and cultural norms affect how natural resources are managed?

While you listen to the speakers, jot down questions and comments for discussion.

Readings

Presenters' papers.

REGIONAL ENVIRONMENTAL ASSESSMENT TRAINING COURSE

(February 24-28, 1997 in Mekelle, Tigray)

Sponsored by USAID/Ethiopia

Overview of Ethiopia's Natural Resources and The Trends and Issues Surrounding Their Protection, Management and Use.

by

Shibru Tedla
ECO-Consult

February 1997
Addis Ababa

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1. Introduction

- Global Background
- Environmental Impact Assessment

2. Basic Ecological Principles

3. The State of the Environment in Ethiopia

- Brief Desription of the Natural Environment of the Country
- What are the major environmental problems in Ethiopia

4. Consequences of Environmental Mismanagement

5. Enviromental/ Resource Information Source

6. Bibliography

7. Annexes

7.1 Energy Issues

7.2 Population Issues

7.3 Socio-Economic and Health Status Indicators

7.4 Status of National Parks and Protected Areas

7.5 Endangered Animal and Plant Species in Ethiopia

1. INTRODUCTION

Rising material consumption multiplied by unprecedented growth in human numbers has translated into mounting stress on local, regional, and global life-support systems.

At a time when demand for various biological products is rising rapidly, the earth's biological production is shrinking. The ever greater annual additions to the population further reduces the land's ability to supply the needed food and raw materials. Experience over the last few decades has amply demonstrated that the carrying capacity of the environment has been declining rapidly resulting in an increasing scarcity of important resources including wood for fuel, soil, water, etc.

Many African countries, including Ethiopia, will enter into the next century confronted by multiple crises in major areas of concern and public policy such as food security, education, public health, housing, employment, energy, industrial production and international trade, debt and environment. The several and critical problems include: declining soil fertility and erosion; deforestation; desertification; loss of biological diversity; inadequate water supplies and sanitation; fuel shortages; pollution of land, air and water; and growth of iformal settlements.

These problems and the prospects of growing poverty and further economic decline have pressurized governments to continue the pursuit of short term development policies and remedies. This has shifted the ecological and economic costs to the next generation.

In order to minimise the ecological debt we pass to the next generation, we need to assess environmental impacts of all our actions.

First of all we need to appreciate the necessity of environmental impact assessment as well the issues addressed in the process. Raising a few questions and responding to them do have pedagogical advantages in clarifying issues.

Environmental Impact Assessment
What is EIA?

It is a process to predict and consider both positive and negative environmental and social consequences of a proposed development project. The main objective is to promote ecological and social balance within such development.

Why EIA?

EIA is undertaken for the following reasons:

(a) To integrate environmental considerations in development planning.
(b) To ensure that potential negative impacts are foreseen and addressed at an early stage in the planning process.

(c) To identify and enhance the positive impacts of the proposed development activities.
(d) To examine the trade-offs and the possible alternatives.
(e) To ensure that all the affected and interested groups (grassroots communities, government authorities, developers, investors, NGOs, etc.) participate in the process.
(f) To promote social and economic equity and the empowerment of people at grassroots level to participate in decision-making.
(g) To ensure that development projects promote sustainable livelihoods.
(h) To provide an eco-friendly and people-centred management tool.
(i) To set up a machinery to carry out mitigation measures and monitoring.
(j) To promote inter-sectoral linkages.

Essential elements in the EIA process:

(a) The EIA process should be open and involve all affected and interested groups (i.e. it should be transparent). All developers must be compelled to publicize their project proposals to concerned parties.
(b) Focus on the major positive and negative impacts of the project to facilitate decision-making, based on the range of alternative courses of action. It is essential that both social and technical issues are considered in the decision-making process.
(c) Identification of different affected and interested groups. It should be recognised that groups with different vested interests will identify and perceive major issues differently.
(d) Creating effective coordination and communication avenues amongst planners, project proponents, government, private sector, NGOs, community groups, etc.
(e) In-built environmental monitoring and auditing to ensure adherence to the selected options and performance standards.
(f) Quantification and valuation of identified impacts, where possible, for resource accounting purposes.

Major players in the EIA process

For EIA to be meaningful, it must allow for the participation of all affected and interested parties.

These parties include, but not limited to:

- Project proponents
- Investors
- Government ministries and departments
- Private sector
- Local communities and community groups
- NGOs
- Politicians
- Traditional leaders and institutions

- General public
- Consultants.

In Ethiopia currently there is no formal system requiring environmental impact assessments on policies, programmes or projects. Present requirements for the incorporation of environmental concerns in developmental planning and implementation are ad hoc and not coordinated. Thus developers in urban areas may be called upon to give details of industrial processes under the town planning legislation. Ethiopian Valleys Development and Study Agency (EVDSA) now incorporated environmental and social impact assessments in the River Basin Master Plans. The Ministry of Mines and Energy has draft mining regulations which include environmental protection requirements as does the draft Water Code. However there is no overall coordination or supervision of environmental impact assessment, and no logical requirements for environmental impact statements or for environmental audits.

Increasingly international and bi-lateral funding and development agencies are requiring some formal environmental impact assessment as part of the project cycle.

Experience from other countries where environmental impact assessment is a formal requirement indicates that the usefulness of EIA is considerably enhanced if it adequately involves the private sector and local community participation.

In Ethiopia Environmental Impact Assessment is in the process of being intituted. Envornmental Protection Authority (EPA) will soon require Environmental Impact Statements (EIS) on any major project intended for implementation at all levels.

Monitoring

In environmental monitoring one may need to use ecological variables. For the proper evaluation of monitoring results it is sometimes necessary to know the natural or original condition. In most cases progressive change of the variable itself will constitute both the reference base-line and test variables: new measurements are compared with previous ones.

One common way of monotoring is referred to as geographical monitorig. The strategy will be to distribute a minimum number of sampling points or areas. To this category belongs the geographical pattern of vegetation and soil types, classification and quality assessment of lakes and water courses and determination of changes in the distribution of plant and animal species. The monitoring of changes in landuse practices will be closely connected with these activities; also a number of chemical and physical variables e.g. geographical distribution of different levels of pollution at small number of representative sites.

The two major criteria for variable selection are (a) relevancy and (b) feasibility.

(a) Relevancy

- Is the problem important?
- Is the proposed activity properly designed to solve the problem or to reach the goal?

b) Feasibility

- Monitoring should not be started until a careful feasibility analysis is carried out.
  Where? The geographical location of measurements or observations.
  When? The temporal location for the measurements or observations.
  How? Definition of a standard method or procedure for obtaining and treating the data.
  Costs? On the basis of the answers to the previous three questions the costs for implementing and running the programme can be established.

2. BASIC ECOLOGICAL PRINCIPLES

Ecology may be defines as "the study of ecosystems". An ecosystem in turn is an integrated unit, consisting of interacting plants and animals whose survival depends upon the maintenance of abiotic (physio-chemical environment and gradients such as moisture, wind and solar radiation, with its concomitants of light and heat) as well as biotic structures and functions. It can also be defined as a community of interacting organisms and its environment functioning as reasonably self-sufficient unit. Soils, plants, animals and micro-organisms form an ecosystem such as a tropical forest. It could also be defined as the living communities, together with their non-living associated factors, physically constrained or defined in space.

The word can be used in relation to a distinctive landscape with geographical and geological continuity, e.g. lakes, woodlots, estuaries. Smaller examples are hot springs; very large ecosystems are the biomass, e.g. the tropical rain forest ecosystem; the tundra ecosystem. The largest ecosystem is the biosphere - defined as all living materials of the earth together with non-living associated factors.
The biosphere depends for its existence on

a) the atmosphere, which includes air;
b) the hydrosphere, which included lakes, rivers and oceans; and
c) the lithosphere, from which the soil has been derived.

These three spheres are intimately interwoven and it is this whole complex which is necessary for he well-being of life on the biosphere. If any of the three spheres (air, water and soil) is abused, insulted or destroyed, the resulting damage is likely to be transmitted to the other two elements also. Cleaning or improving one element, followed by dumping the refuse into another cannot solve our problems since this only means shifting of the problem from one element to another.

The basic and most important concept of an ecosystem is that everything is some how or other related to everything else, and such relationship include interlocking functioning of organisms among themselves as well as with their environment. Many ecologists regard **interdependence** as the first basic theme of ecology. Ecosystems include interacting and interdependent components that are open and linked to each other.

A second basic theme is **limitation**, which means limits are ubiquous and that no individual or species goes on growing indefinitely. Various species control and limit their growth in response to overcrowding or other environmental signals and the total numbers keep pace with the resource available. Not only are the resources limited but there are limits both to the rates at which the environment can receive and recycle wastes and to its capacity for storing them in a suitable form.

Complexity is a third characteristic of any ecosystem. It is because of such complexity that human interventions in an meddling with a balanced ecosystem with the objective of producing some desirable effect, also often brings forth some additional, unexpected and undesirable side effect. e.g. in a river ecosystem, fishermen catch fish, otters also catch fish. Fishermen kill otters - their competitors. Fishermen had eroniously expected to have more fish available for catching snince their competitors, the otters, were eliminated. The actual result was a drastic fall in the catch of fish. The reason being that otters were catching old and diseased fish - now that the otters are gone the diseased fish spread their disease and caused high mortalities of fish, as a result the fish population dwindled.

Two important dimensions of ecosystems are time and space. The main component processes of the ecosystem are **production**, **consumption** and **decomposition**.
In summary :

(a) An ecosystem is a community or organisms functioning together and interacting with their physical environment through (1) a flow of energy and (2) a cycling of materials (Figures 1-6) (adapted from Baker, 1992; Kumar, 1990 and Colinvaux, 1986).

(b) Photosynthetic autotrophs are the energy fixation base and the nutrient concentration base for almost all ecosystems.

(c) Ecosystems are open systems, with energy and nutrient inputs and outputs. The following variables affect the degree of input and output: the ecosystem size and age, the overall rate of metabolism of its organisms and the ratio of producer to consumer organisms

(d) Ecosystems are generally more open for inputs and outputs of water, carbon, and energy, whereas nutrients such as nitrogen are mostly recycled within the ecosystem (Figures 4-6).

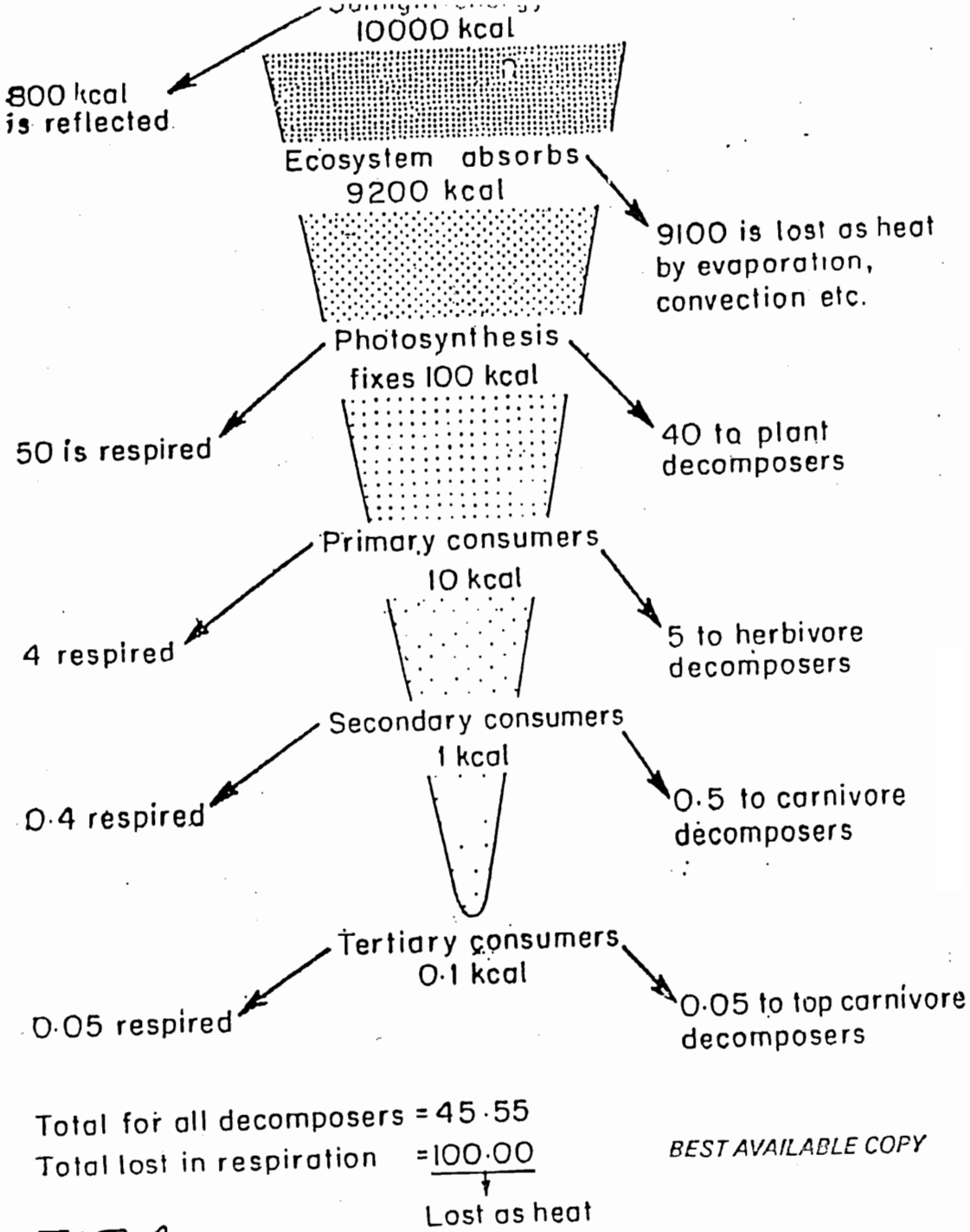

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FIG.1

Loss of energy at different trophic levels. At each trophic level,

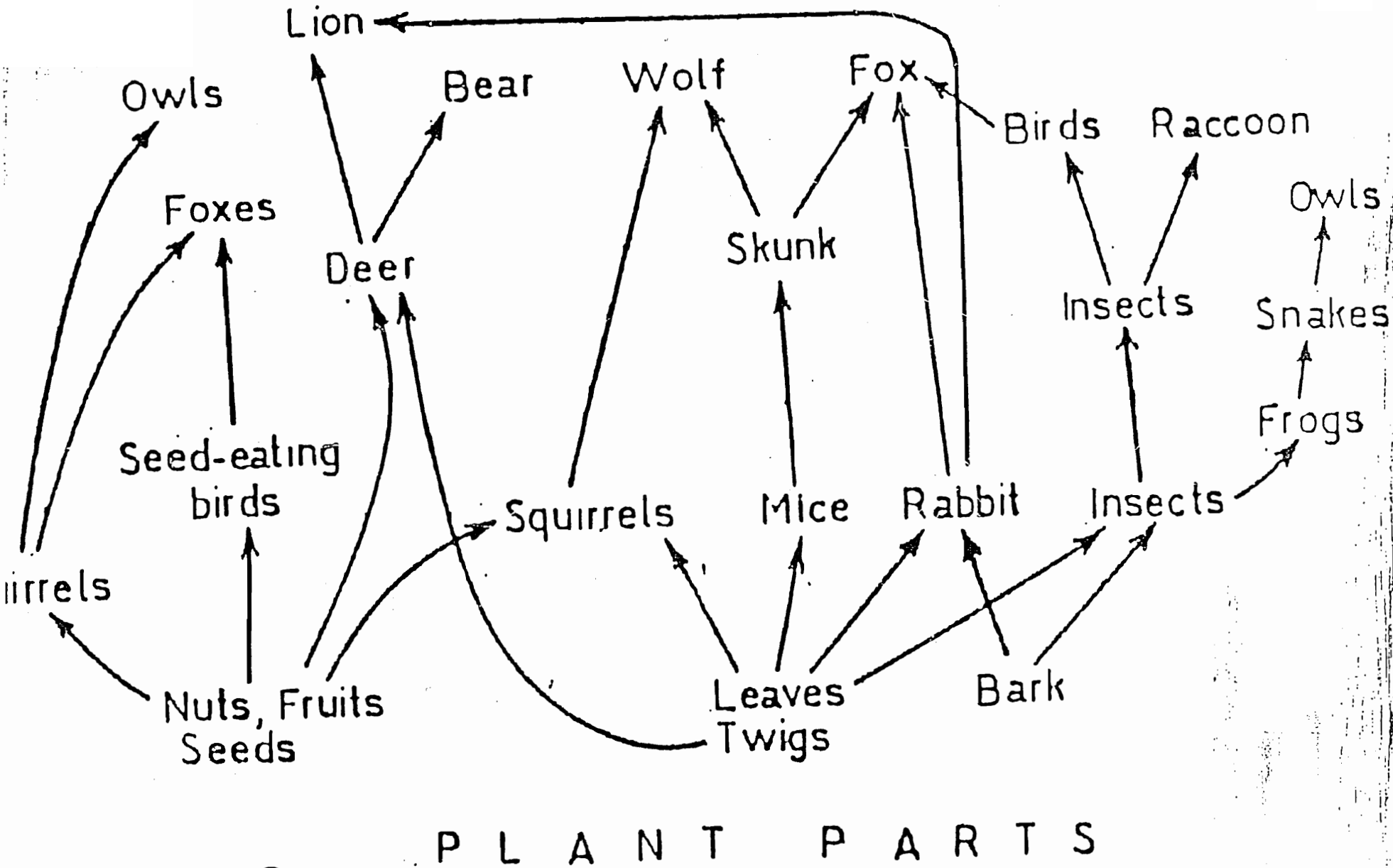

FIG. 2

An example of a food wed in a forest.

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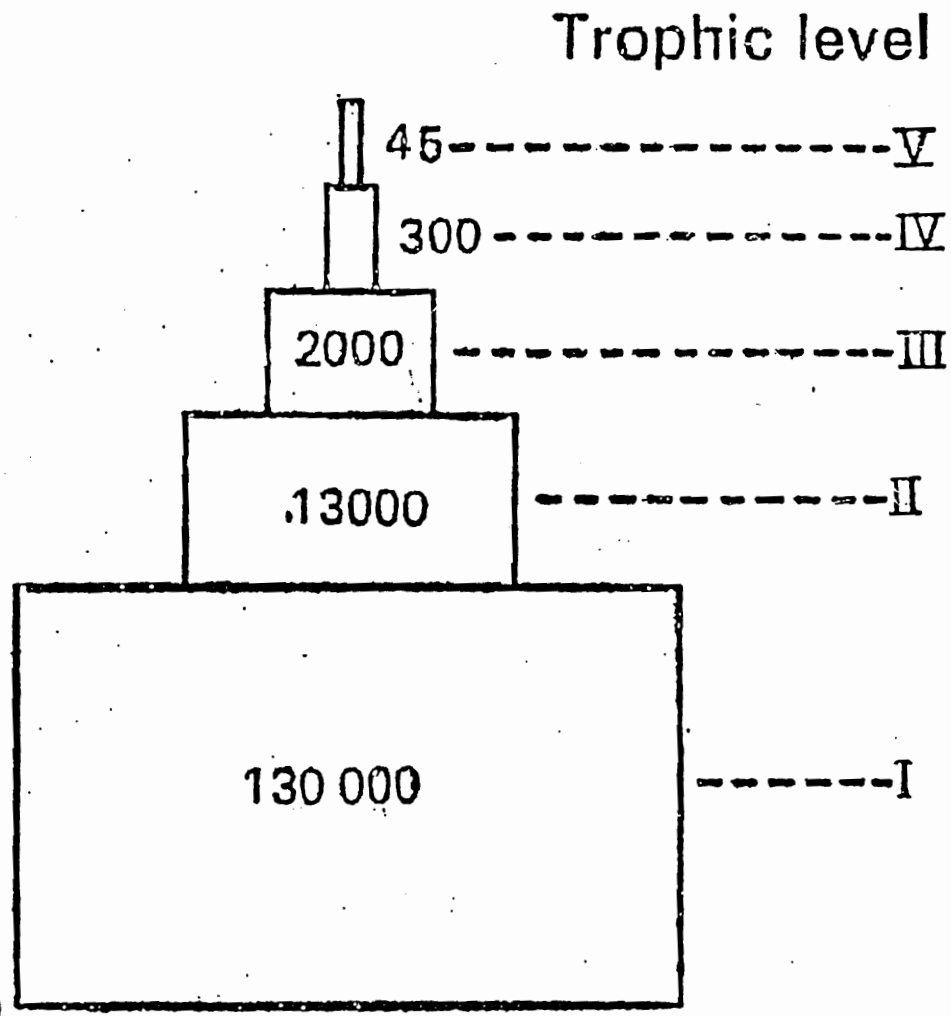

FIG. 3

Biomass production pyramid, showing the approximate annual production at various trophic levels in the world's oceans. (Figures denote milloins of metric tonnes). (After *Resources and Man: A Study and Recommendations.* Report of the National Academy of Sciences—National Research Council, USA, 1969).

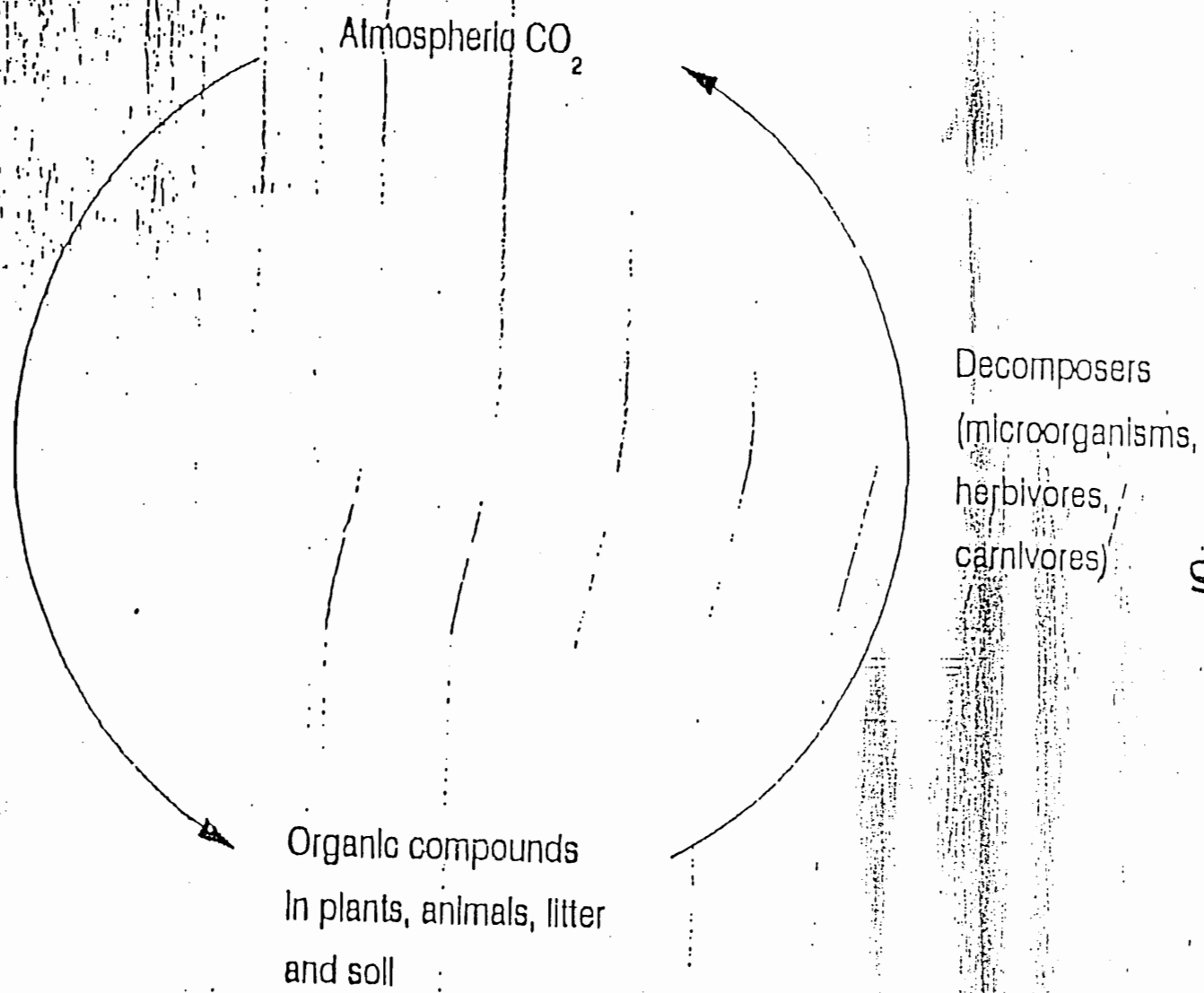

FIG.4

The carbon cycle in the atmosphere–plant–soil ecosystem.

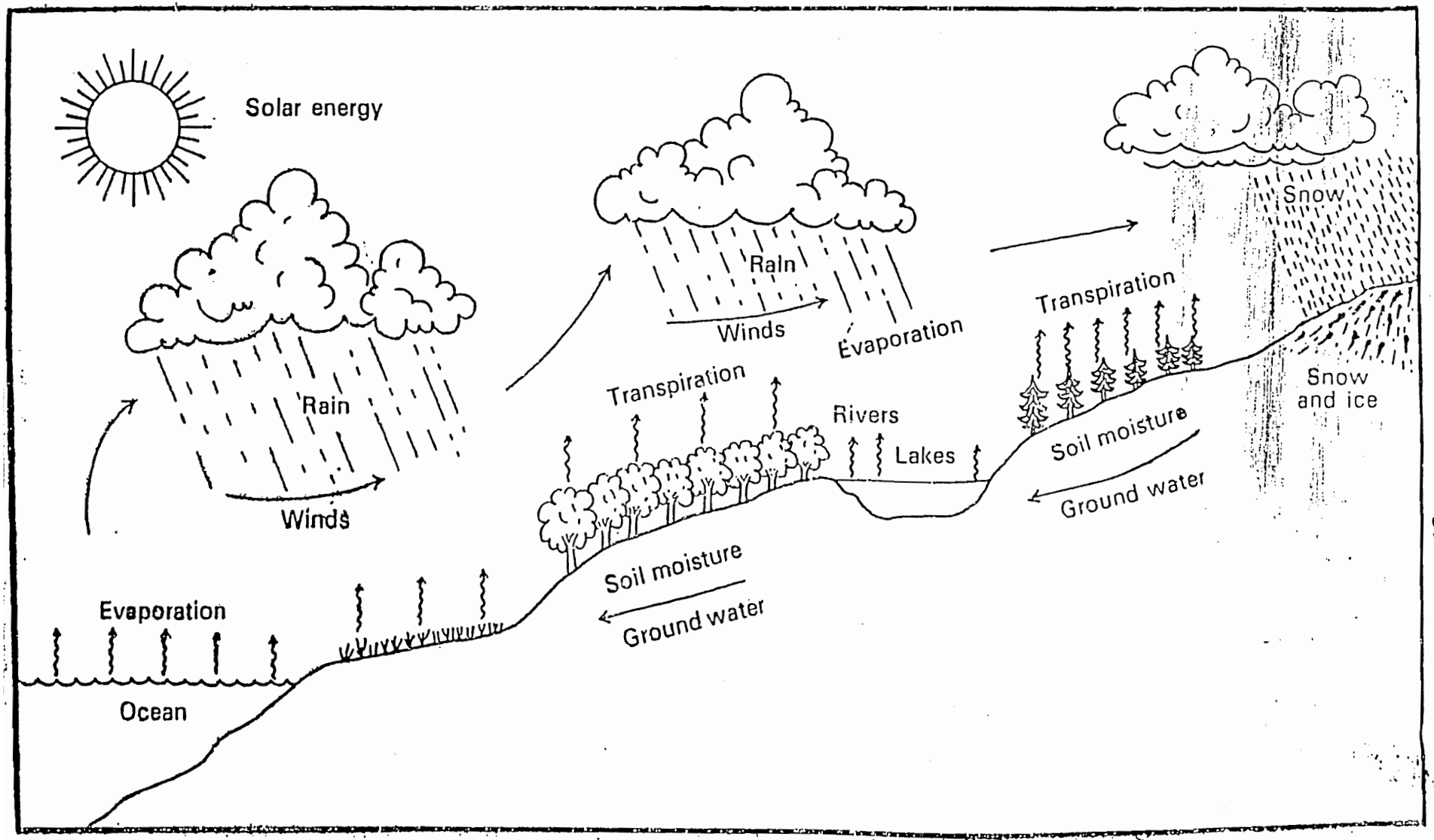

FIG.5 Water-cycles.

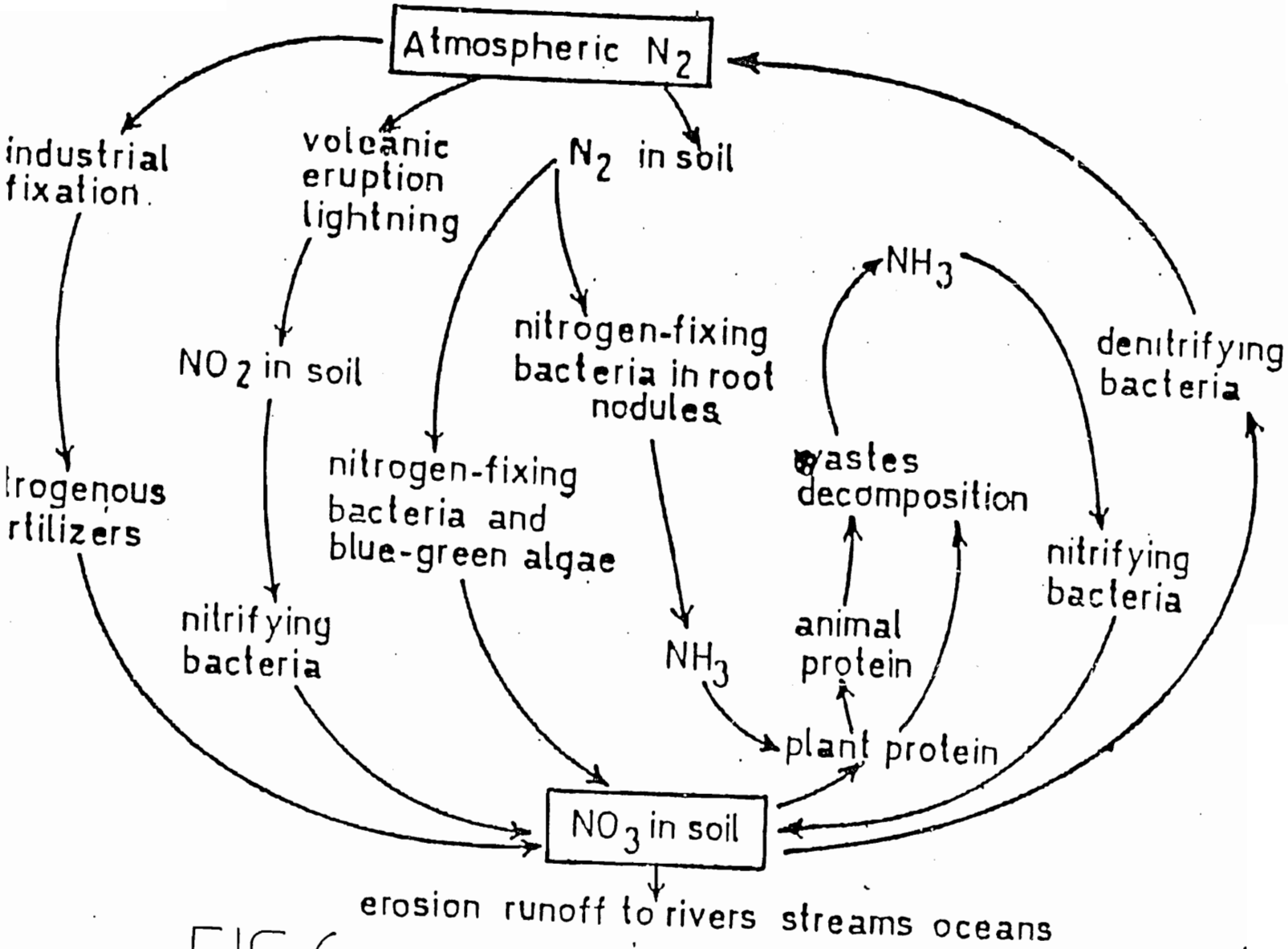

FIG.6

The nitrogen cycle.

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(e) Energy fixed by photosynthesis passes through grazing food webs and detrital food webs before being lost (as low-grade heat) through respiration.

(f) Biogeochemical cycles include the movement of water, nutrients, and other elements and compounds from the physical environment, to organisms, then back to the environment.

(g) Undistributed ecosystems have predictable rates of water and nutrient losses. The rates are altered when the ecosystem is disturbed, as by fires or clear-cutting.

(h) The integrated effect of fossil fuel burning and conversion of natural ecosystems to cropland or grazing land can be measured in terms of an increased carbon dioxide concentration in the atmosphere.

(i) Nitrogen availability is often a limiting factor for the total net primary productivity of ecosystems. Although gaseous nitrogen (N_2) is abundant in the atmosphere, it must first be converted to forms such as ammonia and nitrates before it can be used by the primary producers (mostly plants). A few species of bacteria, volcanic action and lightning can cause the conversion.

3 THE STATE OF THE ENVIRONMENT IN ETHIOPIA

3.1 Brief Description of the Natural Environment of the Country

Environmental Baseline Data

Ethiopia, situated in the horn of Africa, has a total land area of 1.126 million km^2. It's population is about 57 million with a density of about 90 persons per square kilometre in the highlands and about 10 person/km^2 in the lowlands.

Land Ecosystem

The main physical feature of the country is the diversity in altitude and accompanying climatic and ecological variations. The altitude ranges from 110 meters below sea level at Kobar sink in the Afar depression to a peak of 4610 masl at Ras Dejen. The climate in the highlands (areas more than 1800 masl) is mild and the annual precipitation ranges from 800 to over 2200 mm. The low lands are hot with annual rainfall varying from less than 200 mm to 800 mm. Of the total area 60 percent is reported to be suitable for agricultural purposes. The natural forest covers is 2.4 percent of the total area.

Soils of Ethiopia

Classification of soils is a very tricky business and no one classification system is found acceptable by experts in the field; hence we shall not indulge into the classification debate.

Generally soils in the hilly highlands of Ethiopia are Lithosols which are young soils (newly formed from the basement) and shallow. These young soils are pre-disposed to erosion if they do not have vegetation cover. Human activity in the highlands pre-disposed them to erosion further.

Even older soils in the low semi-arid lands are erosion prone as a result of human activity expressed in removal of vegetation cover or overgrazing of domestic stock in the area. Cattle tracks leading to water point turn into gullies after 3-4 years. The soil is loosened by cattle and exposed to wind erosion during the dry season and water erosion during the rainy season.

Climatic Conditions

Climate and altitude are interrelated, the higher the altitude, the lower the temperature and vice versa.

Ethiopia's climatic regions could be classified as:

(i) dry climate,
(ii) tropical rainy climate and
(iii) temperate rainy climate.

The three climatic regimes (Figure 7, adapted from NCS, 1994) are each sub-divided into three more regimes (details are available in Natural Conservation Strategy Vol. II; TGE, 1994).

About 75% of the land surface of Ethiopia is classified as arid or semi-arid and prone to desertification. Land degradation is a continium getting worse as we move from more humid to more arid regions and vice versa.

In climatic change models that predict future climatic changes, the rainforests will get more rain while the arid and semi-arid regions will get less and less rain. In this model most of Tigray (east) the whole of Wollo, eastern Shoa, Harar in its entirety will turn into areas incapable of supporting cultivation.

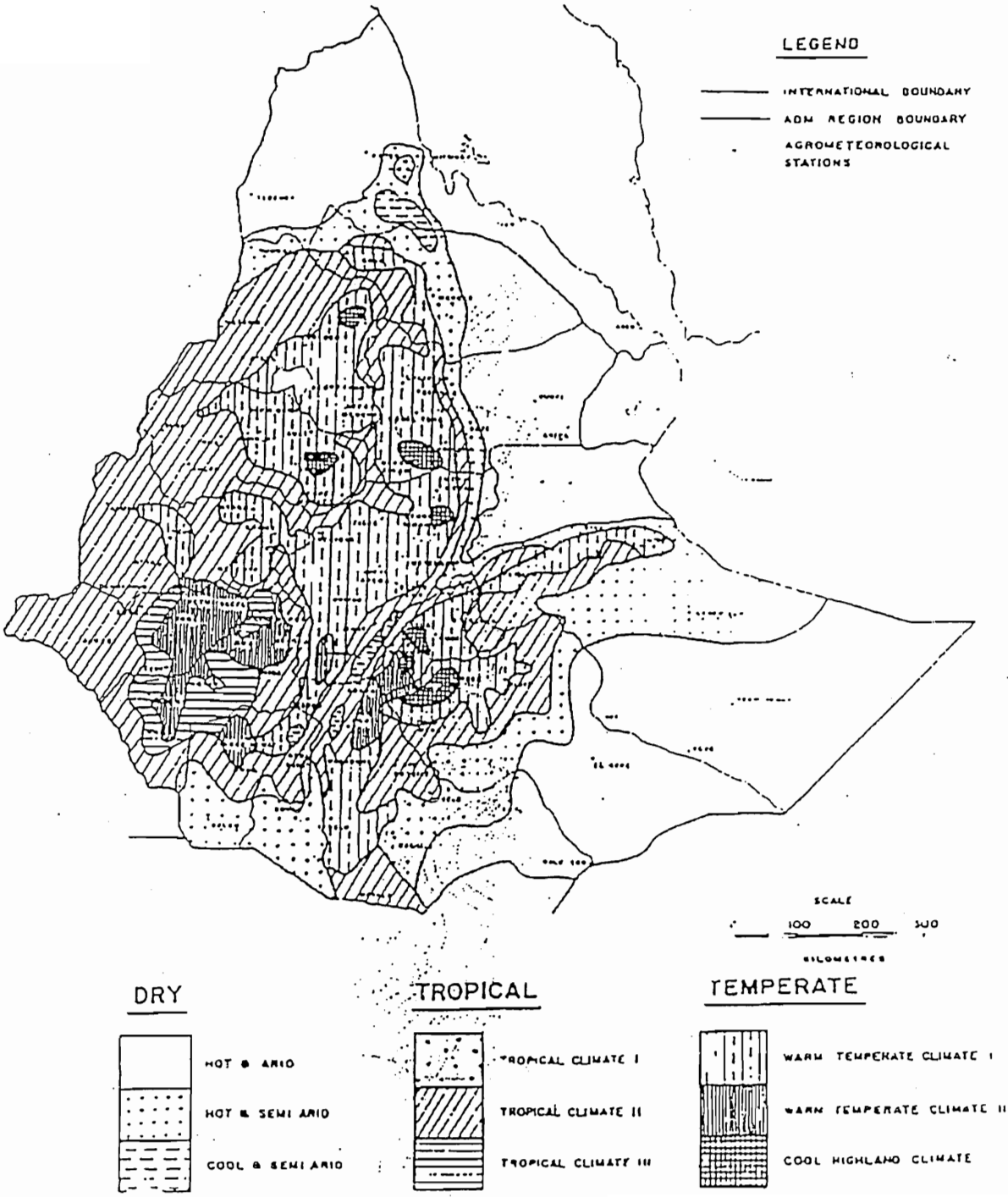
If we take temperature and moisture which combined determine biomass production and soil conditions, we could generally divide the land into four regimes.

(i) Moist with high temperature - heavily leached soils, deep but poor soil.
(ii) Little rain (moisture) and high temperature - desert conditions prevail.
(iii) High moisture and low temperature - high organic matter deposition, highly acidic soil condition.
(iv) Low rainfall and low temperature - very little soil development.

It is in the intermediate condition that we find good soils, good enough for productive cultivation and most of these are in the highlands.

It is because of these conditions that it is only the highlands that are good for cultivation in Ethiopia. Even the highlands have their constraints for cultivation since they are broken by valleys and hills.

ETHIOPIA: CLIMATIC ZONES
(Modified after Köppen)



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One is tempted to use lush green areas for agriculture purposes, e.g. the southwest Bebeka coffee plantation is a good example. The lush green area has very few nutrients in the soil; it is heavily leached. It will require agriculture input to increase its fertility. It misleads people because of the high biomass prevailing under natural conditions because of long period of rain. The vegetation in such areas keeps nearly all the nutrients in its biomass. During cycling of nutrients, the nutrients are immediately absorbed from the soil by the plants. When the biomass vegetation cover is removed, most of the nutrients are removed with it. Hence when crop production is put in place, the soil can only support production (low level of nutrients in the soil) only for a few years, hence the need for fertilizer input.

Floristic and Faunistic Resources

The large diversity of ecological conditions determined by topography have created diverse and conducive environments for the development of a wide variety of fauna and flora.

Flora

The flora of Ethiopia is very heterogeneous and has a rich endemic element. It is estimated to contain between 6500 and 7000 species of higher plant, of which about 12 percent are endemic . Endemism is particularly high in the high mountains and in the Ogaden. Ethiopia reortedly has the fifth largest flora in tropical Africa.

The Semien and Bale Mountains have been identified as areas of plant endemism of continental importance and provide the best examples of high altitude vegetation in Ethiopia. Their flora is diverse and the Afromontane representatives show affinities to South African, Eurasian and Himalayan elements. The southwestern broad-leaved evergreen forests show affinities to the Congolian forests of western Africa . The Ogaden region characterised by a high diversity in Acacia, Boswellia and Commiphora species and contains about 25 percent of the plant species in the country.

Important as this natural flora is, in the diversity of plants which have been manipulated by humans that Ethiopia stands out in the world. Ethiopia is a very important centre of crop genetic diversity and for this reason, it is one of the 12 Vavilov centres (TGE, 1993). It is the sole or the most important centre of genetic diversity for arabica coffee, teff, enset (*Ensete ventricosa*) and anchote *(Coccinia abyssinica*). It is the main centre of genetic diversity for noug (*Guizotia abissinica*) and Ethiopian rape (*Brassica carinata*). It is one of the main centres for sorghum, finger millet, field pea, chick pea, cow pea, perennial cotton, safflower, castor bean and sesame. Because of genetic erosion in other parts of the world, it is now the most important centre of genetic diversity for durum wheat, barley and linseed The Plant Genetic Resources Centre of Ethiopia has been entrusted with safeguarding this crop genetic wealth. To this end, it already (February, 1994) had a collection of 53,625 accessions of 100 crop types in its gene bank (information received from Plant Genetics Resources Centre/Ethiopia). The centre realized that a gene bank cannot preserve all genetic material and it thus keeps *ex-situ* living collections of

arabica coffee and it is involved with a number of farming communities in the *in-situ* conservation of crop germplasm, helping them maintain their traditional genetic pool holdings being propagated free from the genetic erosion imposed by the modernisation of agricultural practices.

Fauna

The faunistic diversity of Ethiopia is also high, reflecting the diversity of climate, vegetation and terrain. Although having fewer species of spectacular game animals than their lowland counterparts and the rest of lowland tropical Africa, the highland regions have, on a unit area basis, a larger number of endemic birds, mammals and amphibians (IUCN, 1989). The eastern low-lying parts of the country have some species in common with Somalia, Kenya, Tanzania and Djibouti. The western and southwestern parts share their fauna largely with southern Sudan. According to information obtained from the Ethiopian Wildlife Conservation Organisation, at present 240 species of mammals and 845 species of birds have been identified of which 22 species of mammals and 24 species of birds are endemic. This makes Ethiopia the richest in avifauna in mainland Africa. The endemic avifauna are dominated by highland species with at least 19 being normally found above 1000 m. Although very little study has yet been done on the groups, 6 reptile and 33 amphibian species are known to be endemic. Even less is known about insects and the other groups of invertebrates, but they are likely to contain at least the same proportion, if not more, of endemic species.

Wildlife Resources

Figure 8 (adapted from Shibru Tedla, 1995) shows the ares designated as National Parks, Wildlife Sanctuaries, Wildlife Reserves and Controlled Hunting Areas. Of these, only two National Parks, i.e. Awash and Semien, have been gazetted. This has at times produced legal ambiguities and problems for protecting the areas. The National Parks are the responsibility of the Ethiopian Wildlife Conservation Organisation, a federal agency forming part of the Ministry of Agriculture. The other protected areas are the responsibility of the Bureaus of Natural Resources Development and Environmental Protection in the Regions.

The exclusion of human activity from these protected areas is imperfect, and often very poor. Since the flora and fauna co-evolved with humans, in fact complete exclusion is not desirable. Nevertheless, with the unstable period towards the end of the civil war and the stabilization of the country by the Transitional Government, much destruction has taken place in these protected areas.

The Afro-Alpine habitats are represented by the Semien and Bale National Parks. These parks provide sanctuary for the threatened Walia Ibex, Semien Jackal (also often called Fox or wolf) and Mountain Nyala. They also contain habitats for high proportion of the endemic birds. The Semien National Park is recognised by UNESCO as a world heritage site.

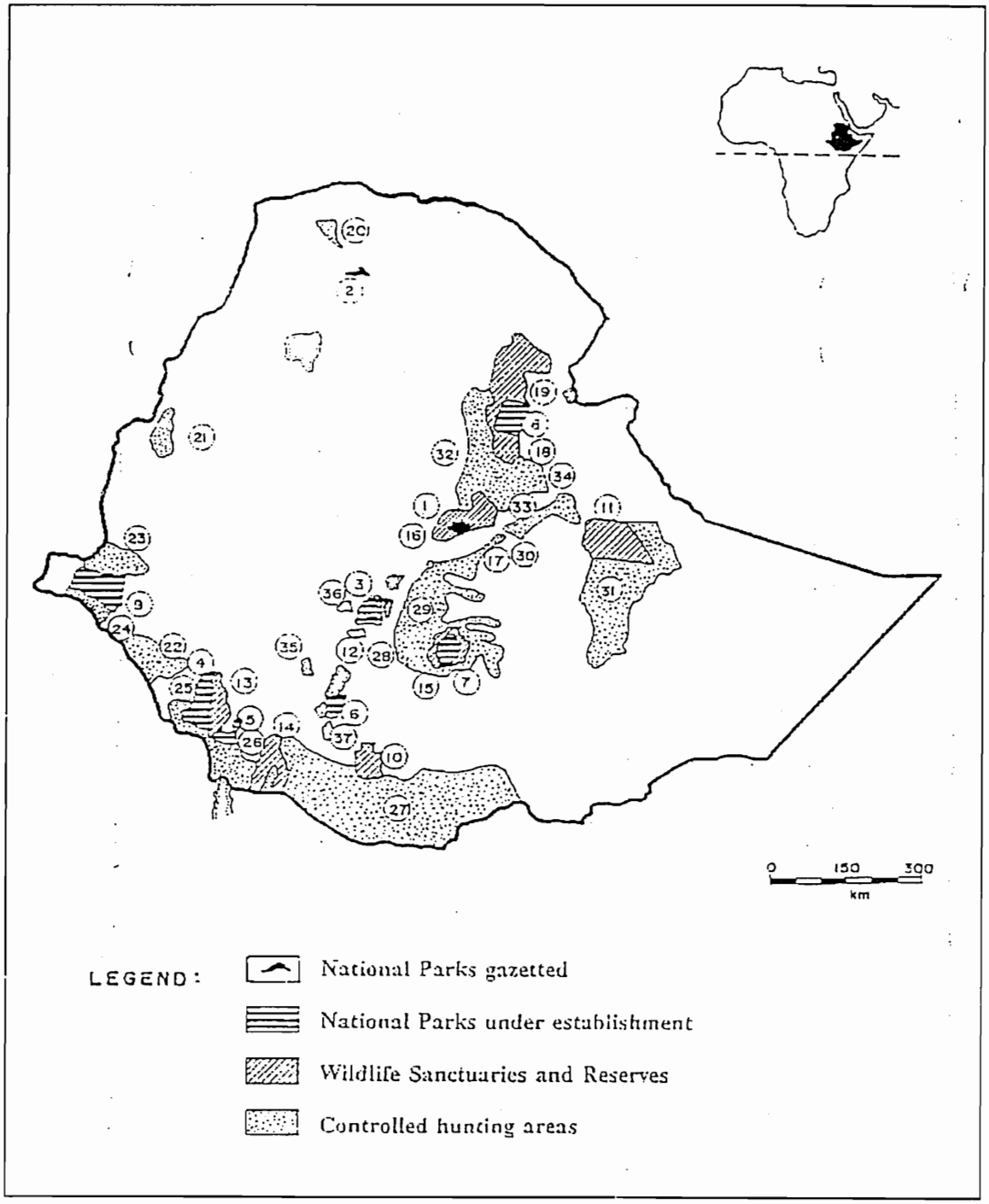

FIG.8

Map showing Ethiopia's Officially Protected Areas

Legend:

National Parks, gazetted: 1 Awash National Park, 2 Semien Mountains National Park.

National Parks under establishment: 3 Abijata-Shalla Lakes, 4 Omo, 5 Mago, 6 Nechisar, 7 Bale Mountains, 8 Yangudi-Rassa, 9 Gambella.

Wildlife Sanctuaries and Reserves: 10 Yabello, 11 Erer, 12 Senkelle, 13 Tama, 14 Chewbahr, 15 Bale, 16 Awash West, 17 Alidege, 18 Gewane, 19 Mille-Sardo, 20 Shire.

Controlled Hunting Areas: 21 Dabus, 22 Akobo, 23 Jikawo, 24 Tedo, 25 Omo West, 26 Murle, 27 Borena, 28 Bale, 29 Arsi, 30 Chercherna-Arbagugu, 31 Harerge-Wabi Shebele, 32 Awash West, 33 Afdem-Gewane, 34 Erergota, 35 Maze, 36 Boye, 37 Segen.

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Lowland habitats, particularly those found in the Rift Valley Lakes regions and the Awash Valley are represented by Abyata-Shalla, Awash, Nechsar and Yangudi Rassa National Parks. These are associated with a number of Wildlife Reserve and Controlled Hunting Areas. The large mammals give sanctuary in these areas are Somali Wild Ass, Grevy's Zebra, Beisa Oryx, Somerring's Gazelle, and Swayne's Hartebeest. Two of these areas are particularly important for birds: breeding colony of great white pelican is found in the Abyata-Shalla National Park and the threatened endemic, Stressman's Bush Crow, in the Yavello Wildlife Sanctuary.

The remaining National Parks and associated designated areas are found in the lowland regions bordering with Northern Kenya and the Sudan. These contain spectacular game animals including those which migrate across these borders, the most remarkable of which is the White-eared Kob. This kob migrates in herd across the border, making it noticeable and vulnerable.

The most striking feature of the distribution of wildlife designated areas in Ethiopia is their complete absence from the most productive, and hence, the most widely used and thus threatened, vegetation types of the country. These are the Moist Evergreen Forest and the Dry Evergreen Fores. Bale National Park contains small patches of both types of forests. Outside this, the only other protected forest area is the very small Menagesha State Forest near Addis Ababa.

The Moist Evergreen Forest areas include the most extensive closed forests still surviving in the country. They are associated with gene pools of arabica coffee and *Aframomum korarima* and contain other important plants and animals.

The Dry Evergreen Forest and its associated grasslands is home to a high number of endemic plants and birds and a few of the mammals. This vegetation type is dominated by agricultural activities and the remaining forests are now reduced to occasional small patches mostly around churches, holy springs and mosques. These are important reservoirs for planting material to help in rehabilitating the highlands of the country.

The Ogaden is floristically the richest part of the country with up to 25 percent of the species and a large proportion of the endemics. Apart from prospecting for petroleum and natural gas, the natural resources of this vast area have not been well studied. Except for two wildlife sanctuaries, there is no protected area in it. Because of the repeated droughts, wars and movements of population, pressure on the environment is high.

The importance of all these ares in the future rehabilitation and conservation of Ethiopia's environment for sustainable use should be recognised and more protected areas selected and designated.

The standard view on wildlife is that it is a foreign-exchange earner attracting tourists, who come nowadays mostly to see and take home trophies in the form of pictures. International tourism for Ethiopia has hardly been developed while internal tourism consists mainly of taking Addis Ababa residents to nearby weekend resorts.

Water Ecosystem

Ethiopia has large water resources potential which include eleven major lakes with a total area of 7,400 km^2, twelve river basins with a total annual surface run-off of about 110 billion m^3 and ground water with estimated capacity of 2.56 billion m^3. Most of the rivers are transboundary with more than 75% of the annual surface run-off draining to neighbouring countries. The water resources provide large potential for hydro-power generation, irrigation and fisheries. Mineral resources such as soda ash are also extracted from lake brine. Water quality in urban areas is poor due to pollution from domestic and industrial wastes.

Wetland

The wetlands of Ethiopia are poorly known. Two major wetlands have been converted into water reservoirs,i.e. the Koka Dam and the Fincha Dam respectively.

Tropical wetlands provide important goods and services for people. These include foodstuffs, thatching reeds and medical products. In addition they fulfill important water management functions, such as flow amelioration, water quality control and groundwater recharge. They are also sources of biodiversity and provide wildlife habitats. In addition the high productivity of wetlands makes them important carbon sinks. It is important that wetland ecosystems are not destroyed as several of their ecological and hydrological roles cannot be replaced through other means.

The sustainable use of wetlands for a variety of function is possible provided appropriate landuse patterns and management systems are established. This is essential if these areas are to continue to fulfill their important ecological, biodiversity and hydrological roles. For example, over the last ten years there has been a major expansion in wetland use in Illubabur zone. Today approximately 1/3 of the wetlands (about 6000 ha out of 15,000 - 20,000 ha) are now in cultivation. The major crop is maize, which is traditionally grown as a "hungry season" food crop at the end of the dry season with minimum drainage. The cultivation of vegetables, especially potatoes, is of growing importance in these areas at other times of the year. This usually involves the construction of major drainage channels to permit longer-term drainage of he wetlands for multi-cropping throughout the dry seasons. This more extensive drainage for multi-crop cultivation is already having serious consequences. In a number of woredas, communities are complaining about falling water tables in wells, the drying up of springs, shortage of thatching reeds, and the failure of valley bottoms to support dry-season cultivation after a number of years of drainage.

In addition it is recognised that there may be other serious ecological and economic impacts from drainage. These include a lowering of water table on the forested slopes of the interfluves where coffee is grown, thereby affecting plant stress and coffee yields. This is specially likely in years when the dry season is prolonged. Drainage of wetlands may exacerbate seasonal fluctuation in river flow, an issue which the Baro-Akobo River Basin Master Plan Project has recently recognised. These changes in river regime could have implications for the small-scale hydro-

power development which is planned in this zone, and for irrigation which is being considered for the neighbouring Gambella region.

Biological Diversity and Renewable Resources

Ethiopia has varied ecological setting which facilitated the evolution of various forms of life. As a result. Ethiopia is one of the twelve Vavilov Centres of primary plant domestication in the world. As stated earlier it has a very high genetic diversity in four of the world's widely grown food crops (wheat, barley, sorghum, peas), in three of the world's most important industrial crops (linseed, castor, and cotton), in the world's most important cash crop (coffee), in food crops of regional or local importance (tef, finger millet, etc.) and in forage plants of world importance (clovers, oats, etc). Ethiopia has a high level of endemicity in its flora and fauna (TGE, 1993).

Genetic variations emanating from local farm and rural community levels continue to have great global significance. The conservation of local landraces is therefore or critical importance, not only to Ethiopia's subsistence farmers, but also to regional and global agriculture.

Agriculture is the main economic activity, accounting for 45% of the GDP. The main products are teff, sorghum, barley, field peas, chick peas, niger seed, linseed, enset, cotton and coffee. Small holders farming is predominant accounting for more than 90% of agricultural production and 95% of total area under crop.

3.2 What are the Major Environmental Problems in Ethiopia

Overview

Ethiopia is a very poor country with 85% of the population earning its livelihood from subsistence agriculture. Per capita income is one of the lowest in the world and 60% of the population live below absolute poverty line.

Prevailing agricultural practices which will be treated in detail later on, are major causes of environmental degradation. The situation is exacerbated by the unabated high population growth.

Drought which claimed the lives of millions of people and caused loss of millions of livestock is another important environmental issue affecting 53% of the land area and 28% of the population. The drought-prone area as are highly degraded and, even in times of good rains, have not been food self sufficient.

Malnutrition, lack of safe drinking water and poor environmental sanitation are major cause of health problems in Ethiopia. Health services are also limited and reach only 46% of the population. As a result infant mortality and overall death rate are high while average life expectancy at birth is 47 years.

Efforts at expanding the infrastructural and industrial base of the country have negative consequences on the environment. The expansion of irrigation schemes lead to the spread of vector borne diseases, displacement of small farming and pastoralist communities. The recent growth of urban areas and industrial establishments have caused the deterioration of the environment through emission of wastes. Lack of urban planning, absence of legally enforceable effluent standards, and weak city waste disposal systems, have worsened the situation. The extensive road construction activities in the rural Ethiopia have also contributed to soil erosion and loss of forest cover.

Land degradation has many expressions including soil removal by sheet and gulley erosion, nutrient depletion due to burning of dung and other forms of biomass, nutrient loss due to crop removals without replacement and the continued loss and degradation of forest areas contributing to all of he above. Some 80 percent of the crop losses due to land degradation result from breaches in the nutrient cycle. Dung and crop residues are burnt because of the lack of wood for fuel. In the past, organic matter management has been relatively neglected in soil and water conservation efforts. There is a rich inventory of indigenous land husbandry and soil conservation technology which in the past has been little studied, let alone used and built upon.

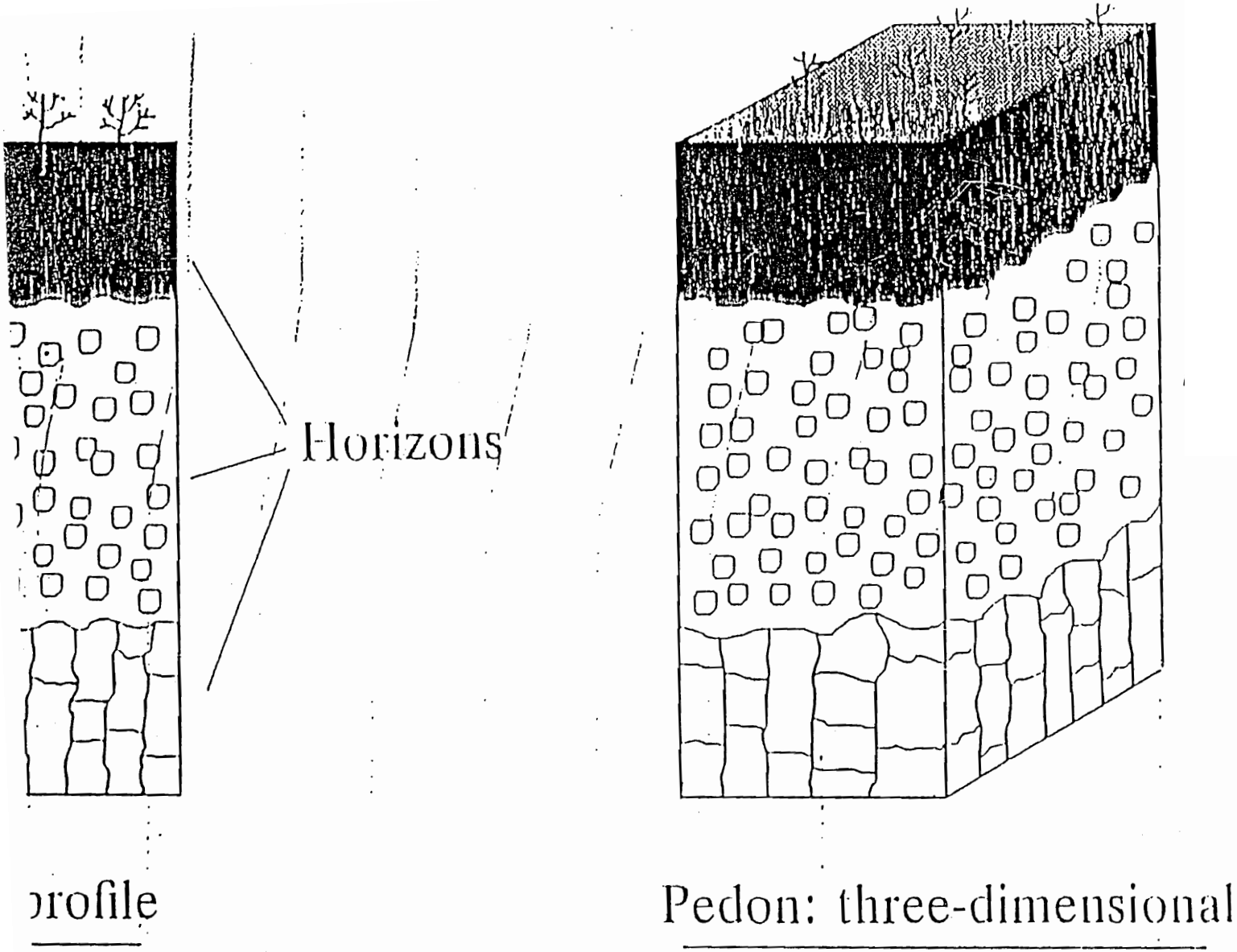
The underlying and deep rooted causes of land degradation have been to a very large degree the result of government and policy failures over the millennium with particular respect to natural resource tenure and use rights.

Soil Erosion

Soil may be defined as the loose material composed of weathered rock and other minerals, and also partly decayed organic matter, that covers large parts of the land surface of the earth (Figures 9 and 10, adapted from Coineaux, 1986).

A main reason for land degradation is the excessive removal due to human activity of natural vegetation cover, thus exposing the underlying soil to the effects of high intensity rainfall, excessive heat from the sun, and wind driven erosion.

Soils in Ethiopia are relatively resistant. In the highlands of Ethiopia it is only after 2000 years of continuous cultivation that erosion has reduced soil depths from 2 meters to 10 centimeters. But the effect is, whether in the highlands or plains, once the soil cover is broken, it can be mobilized and transported away. This is partly because the soil structure, once bared, is quickly degraded under exposure to the elements. The sun causes bare soil to crack and powder so that it is more easily carried down the catchment system by rain run-off or blown away by wind. Much of the rainfall in Ethiopia comes in high-intensity storms, often at the end of the dry season when the soil is most vulnerable. The erosive effect of rain is enhanced by the steepness and length of the slope on which it falls. The cultivated slopes of part of Wollo, Tigray and Northern Gonder are particularly vulnerable and after generation of intensive farming they have lost a high proportion of their productive capacity.



Schematic representation of a soil profile and a pedon.

FIG. 9

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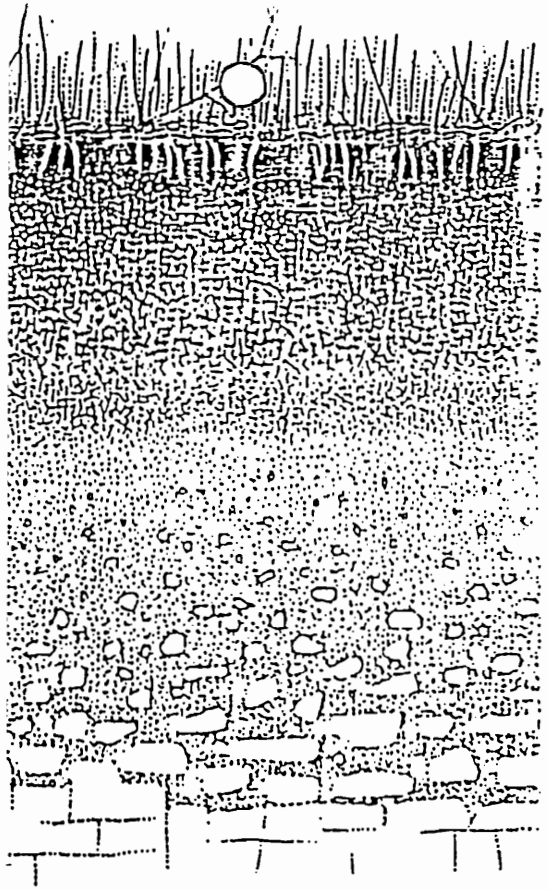

A HORIZONS	Includes litter, humus and top mineral soil. *A* horizons are those from which material is leached.
B HORIZONS	Mostly colored mineral soil, but includes humus layers and plant roots. *B* horizons are horizons of accumulation which receive materials washed out of *A* horizons.
C HORIZONS	Parent material. Underlying rock base, broken by frost or other deep weathering phenomena but essentially unaltered by leaching processes from above.

FIG. 10

Idealized soil profile.

e may be several subhorizons in each of the main horizons and roots may penetrate them ven deep into the parent material. There may be colored bands in each horizon, as some e later figures in this chapter show. Finally, the boundaries may be elusive. But the functional rations are clear enough: material is removed from "A" horizons, material is added to "B" ons, and "C" horizons are essentially unaltered by processes acting from above.

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As a natural environment, though still densely populated an intensively farmed, the Tigrayan plateau is a devastated area, having lost not only most of its topsoil, but also of its montane forests, much of its wildlife, and a great part of its perennial streamflow.

Added to the devegetation factor, the using of dung and crop residues for fuel rather than fertilizer further depletes the soil by reducing its humus content. Less humus affects the micro-organic structure and diminishes fertility. Combined with reduced soil depth, this leads to less moisture storage capacity and worsens the impact of drought. As a result, highland farmers are more vulnerable to drought and crop failure than ever before.

If the present pace of soil erosion continues, an FAO Highland Reclamation Report has estimated that by the year 2010 some 38,000 Km^2 of the Ethiopian highlands will be sown to bare rock and a further area of 60.000 Km^2 will have less than 10 centimeters of soil remaining on it.

Table 1. The distribution of land put to various areas (TGE, 1994)

	Area (ha)	%
Intensively cultivated land	12,596,900	10.3
Moderately cultivated land	15,287.500	12.5
Afro-alpine and sub-afroalpine vegetation, too cold for cultivation	244,600	0.2
High forest	5,381,200	4.4
Woodland	3,057,500	2.5
Riparian woodland and shrubland	733,800	0.6
Bushland and shrubland	26,172,200	21.4
Grassland	37,301,500	30.5
Water bodies	611,500	0.5
Others	20,913,300	17.1
Total	122,300,00	100.0

Deforestation

Another cause of land degradation is deforestation, producing macro-climatic, regional and more limited local effects. While deforestation is very pronounced in Ethiopia, whose highlands were once extensively covered by both dry and moist

montane forests of giant junipers, Natal pines and other conifers. Already in the early seventeenth century the Portuguese Jesuit Manoel de Almeida noted that the highlands were "not well stocked" with trees and explained that this was "not the soil's fault", but responsibility lay with the inhabitants who "every day cut down for their houses and for fuel the trees that [the soil] has grown and none of them has the energy or the will to replant a single one.

Deforestation - converting forests to agriculture and residential use is increasingly critical in Ethiopia. Population pressure contributes directly to deforestation. These pressures come both from outside the forests and from within. Outside the forests as population density rises on agricultural land, forests become the last available areas for new cultivation. To grow their crops, landless peasants migrating from urban areas or crowded rural areas have few options but to clear forests.

Within the forest, forest peoples traditionally have made their living by slash-and-burn, or shifting cultivation. They clear small plots, cultivate them for two to three years, and move on to repeat the process. Tropical forests have thin soils that lose nutrients after about three years of cultivation. If the forest is allowed to grow back over 10 to 20 years, and if the population is spread thinly (fewer than 40 people per Km) shifting cultivation is sustainable. When population densities increase, however, people must return to the same plot very often. They cannot allow the land to remain fallow long enough to regenerate.

While up to 40 percent of the landscape of Ethiopia may have once been covered by high forest, deforestation has occurred progressively over the millennia though historical trends have accelerated over the past four decades in response to rapidly growing human populations.

The eighteenth-century Scottish traveller James Bruce told a similar tale as Almeida. In the vicinity of Gonder, he wrote, the people had "everywhere extirpated the wood", and in consequence laboured 'under a great scarcity of fuel".

Shortage of wood was, in fact, a major factor leading to the institution of moving capitals which characterised several centuries of medieval Ethiopian history. Some of the more important towns of the past were relatively well wooded. Most of the houses of eighteenth-century Gonder were surrounded by *wanza* trees. According to Bruce, every house had 'two or three" planted around it, so that when first viewed from the nearby mountains the city appeared "exactly like a wood".

There is no record of any traditional policy of reforestation. The utilisation of wood by the Ethiopian peasant has always been wasteful. Trees were often felled by burning, thus not only destroying part of he timber but also preventing a regrowth from their roots. Much wood was also consumed in the production of charcoal and the conversion of forests to pastureland.

At the end of the nineteenth century, the French traveller Baron Emmanuel Rey observed: "The natives have a terrible lack of foresight and with the object of enlarging the grazing land for their herds or simply to improve the pasture, they

periodically burn the dry grass. Each time the fire gains new ground and the forests are invaded, and in this way the country is gradually deforested. Under the influence of torrential rains the land is washed away and rocks and barren land replace the soil-laden slopes."

Burning of the tree cover also took place for other reasons, notably with a view to killing or driving off wild animals, and to cleaning up decaying matter considered to be the cause of illnesses.

Tigray was already deforested when General Napier passed through at the head of the British expedition against Emperor Tewodros in 1867-68. Shewa was completely denuded by the turn of the century, when deforestation began in the area of Harar.

The destruction of trees around Addis Ababa which took place after its establishment around 1886 is well documented. A French scientific mission in the 1840s described the area as "covered with junipers and wild olive trees," but a little over half a century later only a few trunks remained. "All the trees have been destroyed...only one splendid group was spared," observed one European traveller.

The wood shortage around Addis Ababa was so acute that it was generally believed the capital would have to be abandoned. Only during the latter part of Menelik II's reign was attention given to deforestation. Towards the end of the century he forbade the felling of trees without permission, but this proved impossible to enforce. Hence he turned his attention to introducing new and fast-growing trees, primarily the Australian eucalyptus. The eucalyptus can be harvested every ten years and it changed the economic situation around Addis Ababa. Within little more than a decade the wood shortage was largely overcome. Other old wooded towns of Ethiopia's past, such as Gonder and Adua, were also, in a sense, resurrected. But the eucalyptus proves so thirsty that it dried up streams and wells in its vicinity and prevented other plants from growing beneath it. In 1913, the Minister of Agriculture issued a decree ordering a two-thirds' reduction in the number of eucalyptus. While the eucalyptus in Ethiopia was initially an urban tree, in spite of the 1913 decree it has spread widely into rural areas throughout the country, with the exception of he Ogaden and the lands of the Afar.

In 1990 approximately 40 percent (too high a figure not accepted by many) of the Ethiopian highlands was said to have been forested. Thirty years ago, the forest cover was down to 10 percent; according to the latest figures, only less than 3 percent of he high country remains forested. As noted above, decreased ground cover means increased soil erosion. Topsoil erosion increased markedly in the highlands and presently up to one billion tons a year are being carried down river, according to some experts. As a result of increased siltation, the useful lifespan of the Blue Nile's Roseires Dam, 1,000 kilometers downstream over the border in Sudan, has probably been halved.

Alternative fuel and building supplies could reduce the pressure on the shrinking forests. But unless those alternatives are available, people in Ethiopia will not stop cutting wood until the region is totally deforested.

Alternative energy and building material sources imply expensive foreign inputs and/or a transfer of technology from abroad. But conservation could also come with better education and more awareness. These are hard commodities to sell when a community is fighting for survival. Nevertheless, with the right political conditions, administrative incentives and greater security, people could be accustomed to replant what they extract from nature's storehouse. Legislation, such as it was, did not help in Menelik's day. But the situation was much different then. Improved communications and educational standards mean that greater public awareness is within every government's reach. Greater awareness would be a first step toward greater conservation.

The destruction of the vegetation means the loss of genetic resources of both plants and animals. This means the loss of useful plants e.g. medicinal plants, and the habitats where the wild animals live, resulting in the immediate reduction in their number and the extinction of some or most of them. It also means the loss of the plant cover that maintains the soil and hence the dry season water supply to most of the rivers.

Fuelwood Consumption:

Households are the largest energy consumers in Ethiopia of derived biomass fuels. Notwithstanding abundant technical research demonstrating how resources are being used beyond sustainable levels, there have been few projects for reversing these trends.

Traditional energy, mainly wood energy, is the major contributor to the Ethiopian energy economy; 95.8% of the country's energy is supplied by traditional energy. Only 4.2% comes from modern sources of energy (electricity and oil)and from fuelwood: 72%; dung and crop residue: 14%; charcoal: 1%; animal energy: 9.1%, respectively.

The Sectoral Energy Consumption is dominated by the household sector which accounts for 83% the total energy: 87% of the fuelwood, 97% of the charcoal produced, 96% of the agri-residue, 37% of the electricity and 9.7% of the petroleum fuels is consumed by this sector.

Use of biomass fuels, mainly fuelwood or derived charcoal and, to a lesser extent, crop residues and dung account for from 40% to over 90% of the total amount of energy consumed in the various sub-Saharan African countries; in Ethiopia it is 93% (Armitage and Schramm, 1992). Rapid population growth, which accelerates land clearing for agricultural purposes and increases the consumption of woodfuels, is causing drastic reductions of vegetation cover, with subsequent deleterious effects on the environment through increased runoff, erosion, siltation, and flood damage.

In many regions the increasing scarcity of wood supplies especially in the north and areas of concentrated consumptions (e.g. cities, plantations, etc.) has led to sharply increasing real prices, as well as actual shortages. In Ethiopia, substitutes such as petroleum fuels, coal, natural gas, or electricity are not readily available because of

a pervasive lack of foreign exchange to pay for additional imports, the lack of infrastructure to supply substitutes, the absence of suitable appliances for the use of other fuels, or the prohibitive costs of other fuels.

Population growth is the driving force behind increased demands for fuel in urban areas. The Ethiopian Government, like most developing country governments, has no reliable data on its forest resources, has no control over them, and does not collect significant revenue from them. This is in spite of the fact that sales of fuelwood and charcoal for urban use represent a multimillion birr business that employs tens of thousands of people. One reason for the uncontrolled exploitation of the vegetation cover is the economic value of the standing stock of wood cannot be easily recovered from those who cut it down.

In Ethiopia very often neither the land of which the wood is standing nor the wood itself belongs to those who cut it. Therefore, there is no incentive for long-term management that would lead to sustainable production of wood, nor is there an incentive to maximize yields. Even though wood cutting and charcoal making are often illegal, such activities are practically never policed.

There are several reasons why market prices do not reflect the growing scarcity. The first is related to stock-flow problem. Although in the past, in regions with little or no net population growth, wood extraction was probably roughly balanced by regrowth within economic hauling distance to centres of demand. This is no longer true. When cutting starts to exceed regrowth, stocks necessarily must decline.

Second, competition in the commercial firewood and charcoal business, combined with the fact that the resource base is common property, keeps prices low, reflecting only cutting, production, and distribution costs until the local resource base essentially has disappeared.

Third the wood for charcoal making comes mainly from the common forest resources and from agricultural land clearing operations. The wood from agricultural clearing has no alternative value and would otherwise be burned as waste; it represents a non-renewable resource. When the land clearing comes to an end, as ultimately they must when land suitable for agriculture runs out, supplies start to dry up. Shortages occur and prices rise dramatically. Such price increase induce more poaching of remaining wood resources in protected, environmental fragile areas (such as forest belts protecting important watersheds). They also cause overcutting of any kind of tree stocks, which leads to increased wind and water erosion, as has happened in Ethiopia (Armitage and Schramm, 1992).

Diminishing wood resource provides less fuel wood which the rural livelihood depends for household cooking, pottery, blacksmithing, and all other cottage industries.

Firewood scarcity is intimately linked to the food problem facing many countries in two ways. Deforestation and the diversion of manures to use as fuel are sabotaging the lands' ability to produce food.

In Ethiopia the most pernicious result of fuelwood scarcity is probably not the destruction of tree cover itself, but the alternative to which a good share of the people have been forced. Hand-molded dung patties drying in the sun is a common site all over the highlands of Ethiopia. In many areas these dung cakes have been the only source of fuel for decades.

Thus the fertility of the soil is indirectly affected by shortage of fuelwood. Dung supplies approximately 30% of the energy requirements for cooking. It is estimated that the dung diverted from farmland could add 1 - 1.5 million tons of grain to the country's harvests thus averting the destruction of the ecosystem by bringing marginal lands under the plough.

As stated earlier, from the total energy supply in the primary resources, fuelwood contributes the largest amount, with a share of more than 82 percent. It is thus a paradox that in a country which has suffered so much from environmental degradation and its attendant ills, a society depends almost entirely on a large consumption of the prime product of its environmental resources for energy supply. Even though the per capita energy consumption is low (0.73 tons of wood per capita) nearly all of it is obtained from biomass (Table 2). Modern energy consumption by comparison is very low (Table 3).

The costs of firewood and charcoal are climbing throughout Ethiopia. Those who can, pay the price, and thus must forgo consumption of other essential goods. Wood is simply accepted as one of the major expenses of living.

With the farmland trees and scrubby woodlands of unfarmed areas being depleted by these pressures, both the needy and the entrepreneurs are forced to poach for fuel wood in the legally protected ecologically and economically essential national forest reserves.

Table 2 Traditional Energy Consumption by Energy Types (1989/90)

Energy Type	Quality* (TJ)	%
Woody Biomass	473,330	80.9
Crop Residue	47,292	8.1
Bagasse	4,647	0.8
Dung	53,012	9.1
Biogas	1	0.0
Briquettes	19	0.0
Charcoal	6,543	1.1
Total	584,844	100.00

* Terra Joules

Table 3 Modern Energy Consumption by Energy Type (1989/90)

Fuel Type	Quantity* (TJ)	%
Electricity	3,702	10.1
Petroleum Products		
LPg	257	0.7
Gasoline	5,254	14.4
Avagas	32	0.1
Jet Fuel	5,506	15.0
Kerosene	2,942	8.0
Diesel Oil	14,966	40.9
Fuel Oil	3,853	10.8
Total	36,612	100.0

* Tera Joules

Agricultural Practices and Their Impact on The Environment

As a result of the diverse ecological conditions that are prevalent in Ethiopia, various agricultural practices/land use patterns have evolved in the country. Some are apparently environmentally friendly while others are not. For example the land management practices of the Konso, parts of Kembata, and Hadiya are relatively good and by and large are sustainable. On the other hand in most of the highland regions where mixed farming is practiced, there is a tremendous loss of soil estimated at 100 tons per hectare per year from croplands.

Highland Farming

People live and cultivate in the highlands because of the agro-climatic and security advantages they offer. Living in the lowland plains would make them more vulnerable to drought, disease and marauding pastoralists. Highland farmers traditionally produced food for subsistence, barter, storage and taxation. Under a subsistence regime, they routinely leave some land under periods of fallow, while grazing systems return animal manure to the soil, and intercropping helps diversify the ecology and protect the landscape from erosion.

Traditional strategies in many highland areas find families cultivating a number of fields in different locations to spread the risk of poor soils, rainfall variations and blight. In former times, traditional areas for hunting and gathering were also protected on uncultivated hillsides and valleys, so that family groups could survive when crops failed.

As population and economic pressures multiply, fallow periods decline and removal of tree cover increases, with farmers extending cultivation to steeper slopes, which in turn increases soil erosion and the effects of downstream siltation. Under these conditions. coherent landscape management is no longer sustainable. The result is more exhaustion of soils, loss of vegetation cover an decreasing yields. This means that the margins for survival today are much narrower, as water retention in the depleted soils has decreased so that even a small drop in rainfall can have disastrous effects.

The Ethiopian Highlands Reclamation Study (EHRS) (FAO, 1986) estimated that about 1.9 billion tons of soil are removed annually. At this rate (1985 level) it is projected that land with a minimum level of soil depth to sustain cropping (about 10 cm deep) will increase five fold on some 18 percent of the highland regions by 2010. Most of the erosion (about 80 percent) takes place on croplands, the remaining contributed by over-grazed grasslands, waterlands and from shifting cultivation.

At current rates of population growth and existing levels of agricultural technology it is estimated that by the year 2010 three quarters of the old awrajas will be unable to meet their subsistence food needs. It is also estimated that all potential grazing lands will be fully utilized by 2004, while all the potential cropland will likewise be utilized by 2017.

The highly erosive nature of the systems of annual cropping in the highlands may be attributed to several factors among which the important ones are:

- The fallow period is increasingly shortened because of increasing need for cultivable land;

- More and more slopes are put under cultivation because of an ever-increasing population and the associated unavailability of prime arable lands.

The preparation of fine seed-beds is a pre-requisite for the cultural practices of sowing of the majority of annual crops, particularly those with small seeds such as teff, sorghum, wheat and barley. This practice necessitates criss-cross ploughing thus triggering erosive runoff, particularly if the last ploughing is down the slope.

The fine seeds-beds are prepared either immediately before or during the heavy rains. The croplands continues to be devoid of any vegetation cover for a month or more and as a result the soil is exposed to severe erosion by torrential rains.

Very often crop lands have pure stands, intercropping is rarely done, and as a result the soils are exposed to erosive runoff.

The increase in livestock number has led to over grazing, which not only reduces protective vegetation cover, but also exacerbates soil erosion though compaction; this is much more so along cattle tracks.

Studies such as the Ethiopian Forestry Action Programme (EFAP, 1993) reveal that the production of the land is excessively reduced as a result of soil erosion and biological soil degradation.

It is estimated that:

- About 50 percent of the highlands (some 270,000 Km^2), have been significantly eroded of which 140,00 Km^2 are seriously eroded.

- In the Awash Valley in the government owned cotton plantations alone some 4000 ha of land (out of a total of 35,000 ha) have already been abandoned due to salinity problems. In other seven cereal farms, 18,000 ha have been abandoned due to weathering stony characteristics.

- In places where shifting agriculture is practiced, it has been estimated that 150,000 to 200,000 ha per year are seriously degraded. This is a sequel of removal of vegetation cover from cultivated lands.

Given the current rates of general environmental mismanagement as a sequel of uncontrolled human and livestock population growth much of the land will be completely destroyed. It is estimated that farm lands of some 10 million highland farmers (15 percent of the total population) could be totally unproductive.

Table 4 **Extent of Ecological Degradation**

Extent of Ecological Degradation

Habitat Loss 1980s

Habitat Type (Area in Kilometers).

All Forests		
Current		**55700**
% Lost		**86.0 %**
Forests		
Dry Forests	**55700**	
% Lost		**86.0 %**
Savanna/Grassland		
Current		**274,685**
% Lost		**61.0 %**
Desert/Scrub		
Current		**5,250**
% Lost		**30.0 %**

Overgrazing

Overgrazing, because it reduces the vegetation cover, is another important land degradation agent. It occurs for a variety of reasons. During prolonged periods of drought, free movement of livestock is necessary to prevent herds from ranging in one area and becoming a plague on fragile land. Overgrazing on semi-arid lands leads to loss of ground cover which in turn brings on desertification. If the overgrazed areas become sufficiently extended, as throughout the Sahel, then water sources may be depleted and settlement patterns put under pressure.

In semi-arid ares, plants and animals both depend on rainfall. But boreholes alter nature's balance. They supply water to cattle but not to the surrounding vegetation, and grazing pressure increases dramatically. A denuded circle spreads from the borehole and in times of acute drought the radius can extend up to eight kilometers. For example in the Sudan an estimated 1,000 boreholes were sunk in the 1960s, which in subsequent droughts left up to 20,000 square kilometers stripped of most of its ground cover. Similar have been observed in the Ogaden in Ethiopia.

Boreholes aside, when the number of animals exceed the carrying capacity of the land, regeneration of vegetation is inhibited. Most specialists and probably all pastoralists agree that the best way to restore semi-arid vegetation is to let the land rest for an appropriate period of time. To protect natural seedlings, goats and cattle

must be kept out of an area until regeneration occurs. Goats are hardier than cattle. They survive longer, range farther and are more efficient browsers, even climbing trees to eat the last green branches of necessary. Even when livestock is kept out of an area, there is controversy over whether land degradation is permanent. Most researchers think not, as appears to have been confirmed by the Israeli experience of cordoning off security zones in the Sinai and parts of the Occupied Territories. Left to nature's sweep, these areas - which had been overgrazed for generations - showed a spectacular regeneration, in some cases after twenty five years.

Drought, of course, decimates herds. But they, too, quickly recover. The hardiest females survive and nomads lend breeding stock to stricken neighbours. When rains return, a herd can double in seven years. As herds grow they are pushed into more marginal rangelands.

Overgrazing can also be provoked by cultivators moving into rangelands. Cultivators tend to appropriate the best grazing land. As cultivated land becomes less productive or population pressures increase, farmers move into more marginal areas, clearing away tree cover or turning unbroken rangelands with their ploughs. Rain races down the cleared slopes carrying away topsoil and in semi-arid areas wind scoops up the rest. Add to this the folly of not involving local resource-users in planning and decision-making, which has meant pushing pastoral groups into ever dwindling areas. Many have been forced to take up cultivation, marginal employment or move to urban areas. This in turn places greater pressure on local resources as it coincides with two important factors: major concentrations of human and livestock populations, and a cycle of lower rainfall.

Effects in Riverine Areas

Whether on slopes susceptible to fast run-off, or in windswept ares, increased cultivation and reduction of fallow periods without commensurate erosion control increases the danger of land degradation. Greater run-off boosts the removal of sediment, leading to downstream silting, flooding, loss of man-made water storage facilities and damage to diversionary structures. This shortens the useful life of dam reservoirs and increases the maintenance costs for canals.

High silt sedimentation increases the potential for rivers to burst their banks and canals to overtop, particularly when the hydrological regimes change with increased deforestation of the upstream catchment. Flood damage can destroy homes, irrigation structures and crops. Paradoxically, it also has one advantage by depositing downstream new layers of soil that replace some of the lost fertility from years of intensive cultivation (Awash as an example).

Riverine resources of ~~e.g.~~ Awash, have been dramatically transformed in this century by land expropriation for modern cultivation schemes. A major loss of natural riverine vegetation and its inherent species diversity has occurred in the process.

Changing Settlement Patterns

During periods of drought in Ethiopia southward migrations have occurred at various stages in history as well as in contemporary times. Such shifts require a more intensive sharing of resources by the incoming groups with those already there. If the social basis for this sharing cannot be worked out amicably, the inevitable result is increased tension that, if not checked, can lead to bloodshed. When the traditional means for mediation are removed, conflict becomes more likely.

In addition to rural migration, the rate of urbanisation, bringing with it changing lifestyles, has created a significant drain on forest eco-systems because of tree felling for fuelwood and building materials. Growing urban settlement also imposes a high concentration of water and power demands. Refugee flows are another destabilising factor. The displacing of large numbers of refugees into an area with limited resources results in destruction of vegetation for kilometers around. This has been particularly noticeable at camps in Hararge and Gambela.

Climate Change

Soil erosion, deforestation and overgrazing are viscously present in Ethiopia and major contributors to insecurity and a continuing fight for survival. Land degradation is at its worst in the highlands from which its effects trickle, or rather cascade, downstream into the surrounding lowland plains. The three factors of soil erosion, deforestation and overgrazing affect climatic cycles. Changing climate is a major contributor to insecurity in Ethiopia as it can turn the fight for survival into a rout and cause mass migration.

Climate change - i.e. longer and more frequent drought cycles - has been a major cause of insecurity in Ethiopia during the latter half of this century. Damage to the land, brought on by natural events, or more usually by economic and political factors such as overgrazing, warfare, overly intensive farming or deforestation, can affect climate cycles. Scientists, for example, are recording more frequent dust storms in the Sahel, a region that, as far as such resource-use ratios can be calculated, has 50 percent more people than fuelwood to sustain them. Increased dust in the atmosphere is believed by some climatologists to interfere with the production of rain by convectional systems. Similarly, vanishing ground cover increases the earth's albedo - the proportion of sunlight that the earth's surface reflects back into space. Bare earth, lighter in colour, reflects more sunlight. The soil no longer retains as much heat and gradually cools down. Since rain is caused by warm, moist air rising, rainfall is diminished. Because of its impact on convection patterns, wind current and rainfall regimes, the albedo effect is a basic factor in controlling climate.

Although no conclusive evidence exists, many scientists believe that widespread desertification combined with the clearing of the world's tropical forests increases the albedo effect, with rainfall repercussions extending into the temperate zones (especially those of North America and Eurasia). In this case, so far as can be projected, rainfall will decrease in the equatorial zone itself, but increase between

5 and 25 degrees North and South, and decrease between 40 and 85 degrees in the North, which latitudes correspond to the northern US, Canada, most of Europe and the Soviet Union.

The whole phenomenon of climate change is still poorly understood, but the results are undeniable: periods of persistent drought, with or without military action, cause the vulnerability of local people to increase and ecological vitality to decline. Since the beginning of history, people have evolved systems to cope with changing environmental conditions which in most cases are provoked or aggravated by human activity. The reason for the current failure of these tried and tested coping systems lies almost exclusively in the hands of those who govern, the policy-makers in the capitals concerned.

Disturbing The Biological Balance

Mountains of evidence confirm that managed changes of the environment and associated loss of species, ecological diversity and tree cover have been economically important since man's earliest attempts at settled community living. Local climate has a tendency to change as vegetation cover decreases. Wind-blown soil entering the atmosphere interferes with the eco-systems. Nature's redistribution of these materials can produce long-term effects. Soil micro-biology is affected by temperature change, which in turn impacts vegetation and the food cycle of host species both large and small that were associated with the vegetation prior to the change. This can create imbalances in crop and animal pests, promote diseases and eradicate vital secondary food sources. The association of widespread local changes are likely to have accumulating regional implications.

The balance of micro-fauna and smaller species in the bacterial, fungal, viral, insect and animal populations is more important to the vitality of the environment and survival opportunities than the current emphasis on larger wildlife would suggest. The larger animals, which are the focus of conservation activity, come at the top of the food chain and are more visible to tourists and policy-makers. Little is known about this lower ecological world that manages much of the sustenance and recycling of nutrients and energy.

Agricultural Change

The relationships between tree, shrub and grass covers with the natural range of larger animals that graze and browse on them enables a cycling of nutrients and energy through the physical and biological media of water activity, insects, soil micro-organisms and animal movement.

The introduction of high-yield crops has sometimes been accompanied by unforeseen consequences, producing a contrary, not to say disastrous, effect on food security. The sowing in the early 1970s of high-yield maize varieties in southern Ethiopia is a case in point. Traditional drought-resistant varieties were discarded for the new varietal that required dosed fertilizer input. For a brief period yields increased dramatically. But two events converged to produce disaster. Hard on the

heels of soaring fertilizer prices as a result of the world oil crisis came drought. The result was famine and starvation.

High-yield crops are only high yielding under optimum conditions, with adequate water, fertilizers and pesticides. They are unresistant to less favourable conditions, whereas traditional crop varietals have been selected and bred for their hardiness and ability to maximize yields under unfavourable conditions. Development planners often have the wrong priorities. Traditional survival systems are based on crops that are high-yielding under poor conditions, though they are only modest yielders - but adequate for survival purposes - even during good years (IUCN, 1991).

In the highlands the impact of drought and diseases on ox-plough cultivation is an important feature of continuing change. Where mechanisation has been introduced to export crop schemes, this technological advance is dependant on uninterrupted supplies of oil and foreign exchange. (Fig 11.).

4. CONSEQUENCES OF ENVIRONMENTAL MISMANAGEMENT

Food Insecurity

The consequences of natural resource depletion could be simplified as sketched in the following scenario.

As a rural and village populations grow, markets appear for wood, used both for construction and household fuels. Cutting wood from remnant forest generates income for peasant families who now burn crop residues and animal dung in their households and less wood.

Removing crop residues and diverting dung from fields breaches the nutrient cycle and leads to degradation of the soil structure and leaves fields more vulnerable to erosion. The depletion of the remaining forests is accelerated and the loss of soil fertility becomes noticeable.

Once nearby stands of trees are gone, dung and crop residues are traded in markets where formerly only wood was sold. The steady export of nutrients and organic matter from croplands severely limits crop yields and the ability of pastures to support livestock. Families depend more and more on the sale of dung and less on local harvests, for unreliable crop yields prove barely sufficient even for subsistence needs.

Eventually, cow dung becomes the main fuel source in the villages and the main cash crop from nearby farms. The income that rural families receive from selling (gathered) wood or dung in towns is small but significant. In parts of Ethiopia, sales of dung to town markets may account for as much as 30% of the family cash income.

Rural families use crop residues for cooking and as forage for their livestock which grazing land can no longer support. Pervasive topsoil depletion leaves farmers

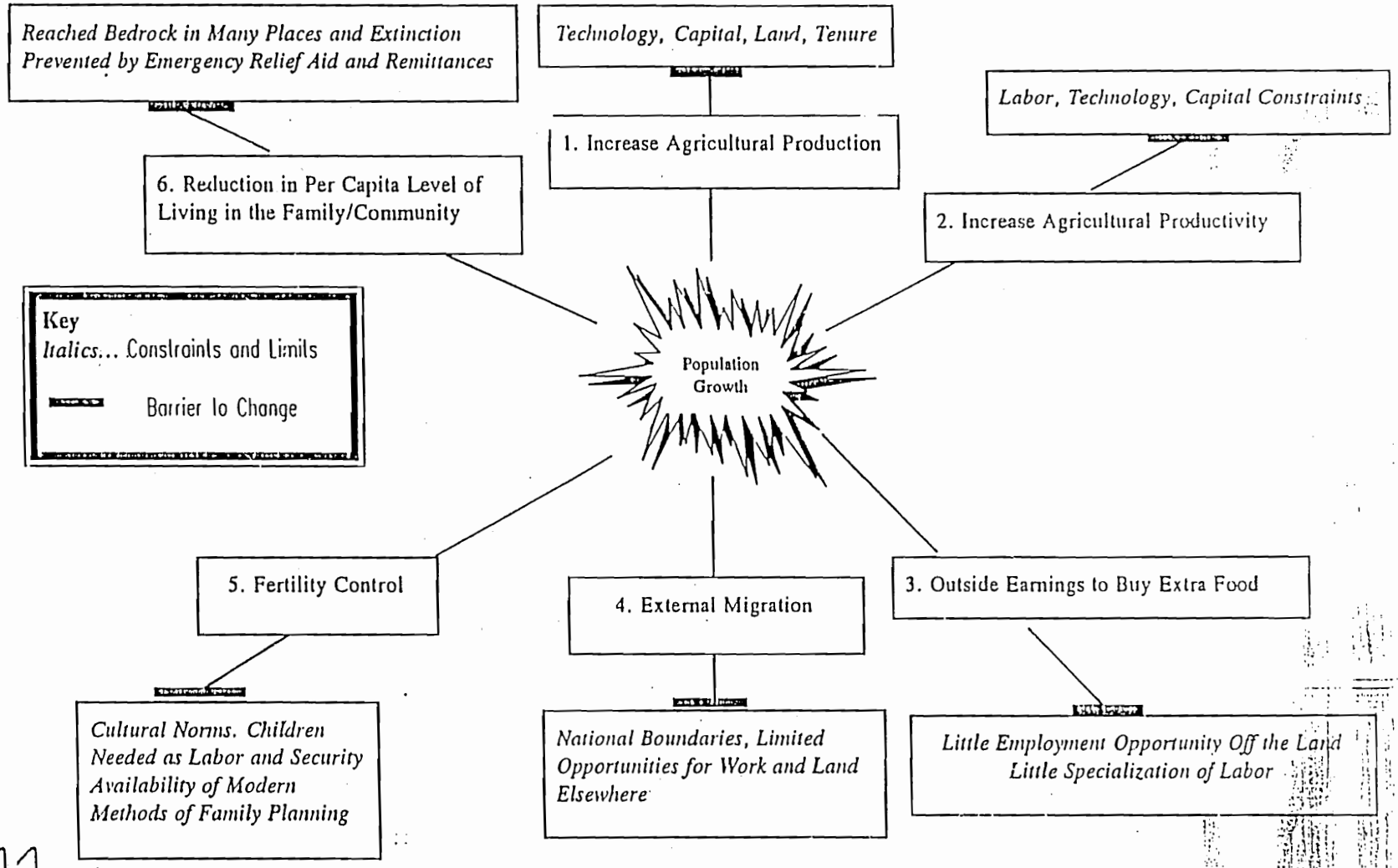

FIG.11

Opportunities and limitations relating to population expansion in a traditional agricultural community. [redacted]

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vulnerable to total crop failure during even routine dry seasons. In markets, both food and fuel prices rise rapidly.

At the final stage, biological productivity is destined to collapse. Families can no longer produce enough food for themselves or their livestock, let alone for markets. A massive exodus from rural areas begins, of the triggered by drought that could formerly have been tolerated. Famine is widespread; peasant's lack of income is compounded by absolute shortage of food at any price.

This scenario, this transition from first to final stage is in process right across Ethiopia and has reached the terminal phase in some parts of northern Ethiopian. In Ethiopia firewood demand is $3^1/4$ times the sustainable yield.

Loss of Biodiversity and Agricultural Productivity

The destruction of the vegetation means the loss of genetic resources of both plants and animals. This means the loss of useful plants e.g. medicinal plants, and the habitats where the wild animals live, resulting in the immediate reduction in their number and the extinction of some or most of them. It also means the loss of the plant cover that maintains the soil and hence the dry season water supply to most of the rivers.

Effects of soil erosion

- Loss of soil to support the growth of crops, grassland, and forests;
- silting-up of dams;
- deposition of sediment loads causing rivers to change course;
- variable seasonal flow of rivers, and flooding;
- water pollution: erosion of 1 t of soil containing 0.2% N and 0.05% P will transfer 2 Kg N and 0.5 Kg P to rivers and lakes;
- air pollution: fine soil particles in the air reduce solar radiation at the surface of the Earth and might affect chemical processes in the atmosphere.

5. RESOURCE/ENVIRONMENT INFORMATION SOURCE

Institutions

- Mapping Authority produces maps.
- National Meteorological Service provides climatic data; service provided to all at cost.
- Soil Conservation Research Project has produced general maps as well as localised and specialised maps.
- Ministry of Water Resources has or is in the process of having master plans for all the major river systems; Awash, Abay, Tekezie, Baro-Akobo, Gib, etc.
- National Conservation Strategy Secretariat has produced a National Conservation Strategy as well as Regional Conservation Strategies.
- Ministry of Agriculture:

- Woody Biomass Project, which is under MoA, has produced good maps with detailed information on woody biomass.
- Ethiopian Wildlife Conservation Organisation has produced various reports on wildlife resources in the country.
- Forestry Department has many reports on forests.
- Institute of Agriculture produces annual reports which are useful; it also reports its research findings.

Tertiary Education institutes such as Addis Ababa University, Alemaya University of Agriculture, among others, do generate a lot of useful information through research activities.

JOURNALS

There are various journals published in the country which contain useful information on natural resources:
e.g. Sinet: An Ethiopian Journal of Science
: Ethiopian Journal of Agriculture
: Journal of Ethiopian Studies
: NAPRECA Monograph Series
WALIA - Journal of the Ethiopian Wildlife and Natural History Society

Other Publications

There is a lot of grey literature (unpublished reports, etc.) in many of the government institutions, especially in the Ministry of Agriculture, Ministry of Water Resources. All one need do is to request for a specific information.

- The Investment Office should have development project proposals which ought to contain useful information on available resources.

- Ministry of Economic Development and Cooperation - MEDAC has a checklist of projects submitted by sectoral government institutions.

- Evironmental Protection Authority (EPA) is in the process of producing EIA documents. The production is sectoral - the ones for the industry sector and the transport sector have already been finalised. EPA gives guides on what is to be done in these sectoral development processes. The sectors will then know what to look for in the EIA process.

- Outside organisations such as Green Peace International, World Wide Fund for Nature (WWF), International Conservation Union (IUCN) and others will be more than willing to supply relevant information on resources/environment upon request. International organisations such as FAO will also do the same.

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7. Annex

7.1. ENERGY ISSUES

7.1.1 Table 1 National Energy Balance Summary

(1985/86 - 1990/91 Final Consumption)

Tons of oil equivalent (x 100)

Fuel Type	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	
Woody biomass	10,152	10421	10706	10983	11297	11717	77.8 %
Residues	1,116	1146	1175	1208	1240	1159	7.7%
Dung	1,141	1171	1201	1233	1265	1298	8.6 %
Charcoal	148	149	151	151	156	177	1.2
Biogas/ briquettes	0	0	0	0	0	0	
Petroleum fuels	715	746	799	836	799	621	4.1
Electricity	73	80	84	87	88	82	0.5
Total	13345	13713	14116	14499	14847	15055	

Source: Ethiopian Energy Authority

7.1.2 Table 2 Current and Projected Demand for Wood Products (millions m^{3s})

Year	Industrial wood	Construction wood	Fuelwood	Total
1992	.4	2.1	44.9	47.4
2000	.7	2.7	58.4	61.8
2005	.9	3.2	68.4	72.5
2010	1.3	3.8	79.5	84.6
2014	1.6	4.3	88.9	94.8

Source: EFAP Vol. II tables 1.1 and 1.2 in attachment 1993

7.1.3 Table 3 Household Energy Consumption by Source

	Urban		Rural	
	1992	2014	1992	2014
	% of total energy consumption			
Wood charcoal	62	42	66	68
Dung	16	8	20	13
Crop residue	11	5	14	7
Electricity	3	15	-	5
Kerosine.gas	8	20	-	2
Coal	-	10	-	5
Total	100	100	-	100

Source: EFAP Vol. II Annex 6.2 Table 2. 1993

7.1.4 Table 4 Woody Biomass Stocks (Availability) and Yield (use) by Administrative Region (000 Tcal)

Region	Total stock	Energy annual yield
Arsi	346.8	24.7
Bale	1836.7	119.1
Gamogofa	764.4	60.1
Gojam	482.1	22.7
Gonder	534.9	18.7
Harrarge	768.3	43.0
Illubabor	1707.3	142.4
Kefa	2549.3	218.2
Shewa	604.6	38.5
Sidamo	1621.1	97.5
Tigray	430.8	25.2
Wellega	925.1	55.9
Wello	393.3	30.4
Total	12965.3	896.4

Source: CEPEN-ANPALDO/FINMECCANICA group (1986b)

7.1.5 Table 5 Projected Demand for Fuelwood (000 m^3)

Year	Urban	Rural	Total
1992	3389	41564	44953
1993	3502	42948	46450
1994	3727	44231	47958
1995	3903	45615	49518
1996	4091	47101	51192
1997	4288	48629	52927
1998	4492	50201	54693
1999	4705	51816	56521
2000	4926	53477	58403
2001	5154	55156	60310
2002	5390	56879	62269
2003	5636	58647	64283
2004	5890	60460	66350
2005	6153	62320	68473
2006	6420	64163	70583
2007	6696	66049	72745
2008	6980	67987	74967
2009	7273	69949	77222
2010	7575	71964	79539
2011	7877	73935	81812
2012	8187	75943	84130
2013	8505	77988	86493
2014	8830	80069	88899
Total	133589	1367091	150680

Source: EFAP. Final Report
Vol. II. The Challenge for Development (1993)

7.1.6 Table 6 Projected Sustainable Fuelwood Supply by Source (000 m^{3s} p)

Year	Farm forestry	Indust. plant-action	High forest	Commu-nity plant	Wood land	Bush land	Peri urban plant action	Catchment protective forest	Total
1992	1365	583	200	112	6016	4000	252	34	12528
1993	2365	568	200	112	5920	3936	252	34	12354
1994	1365	561	200	112	5825	3873	252	34	12187
1995	1365	553	200	112	5729	3809	252	34	12020
1996	1365	549	200	112	5633	3745	252	34	11857
1997	1365	541	200	112	5537	3682	252	34	11689
1998	1365	578	200	112	5442	3618	252	34	11567
1999	1365	562	200	112	5346	3555	252	34	11392
2000	1365	555	200	112	5250	3491	252	34	11225
2001	1365	539	200	112	5155	3427	252	34	11050
2002	1365	533	200	112	5059	3364	252	34	10885
2003	1365	535	200	112	4963	3300	252	34	10727
2004	1365	575	185	112	4867	3236	252	34	10593
2005	1365	579	170	112	4772	3173	252	34	10423
2006	1365	581	155	112	4676	3109	252	34	10250
2007	1365	557	140	112	4580	3045	252	34	10052
2008	1365	575	125	112	4485	2982	252	34	9895
2009	1365	563	110	112	4389	2918	252	34	9709
2010	1365	621	95	112	4293	2955	252	34	9593
2011	1365	581	80	112	4198	2791	252	34	9378
2012	1365	564	80	112	4102	2727	252	34	9202
2013	1365	557	80	112	4006	2664	252	34	9036
2014	1365	525	80	112	3910	2600	252	34	8844
Total	31395	12935	3700	2576	114153	75900	5796	782	247237

Source: EFAP, Final Report Vo. II The Challenge for Development (1993).

7.1.7 Table 7 Fuelwood Demand and Supply Analysis

Year	Projected demand for fuelwood (000m^{3s})	Projected sustainable fuelwood supply (000m^{3s})	Deficit (000 m^{3s})
1992	44953	12528	32425
1993	46450	12354	34096
1994	47958	12187	35771
1995	49518	12020	37498
1996	51192	11857	39335
1997	52917	11689	41228
1998	54693	11567	43126
1999	56521	11392	45129
2000	58403	11225	47180
2001	60310	11050	49260
2002	62269	10885	51384
2003	64283	10727	53556
2004	66250	10593	55657
2005	68473	10423	58050
2006	70583	10250	60333
2007	72745	10052	62693
2008	74967	9895	65072
2009	77222	9709	67513
2010	79539	9593	69946
2011	81812	9378	72434
2012	84130	9202	74928
2013	86493	9036	77457
2014	88899	8844	80055

Source; EFAP. Final Report
Vol. II. The Challenge for Development (1993).

7.1.8 Table 8 Use of Wood Resources

Use	% of Total Volume	Volume Utilized m^3
Construction	4.21	1000
Charcoal	4.21	1000
Fuel	84.21	20,000
Others	0.63	150

(TGE, 1993)

7.2 POPULATION ISSUES

Annex 7.2.1

Table 1 Population Estimates (millions) and Corresponding

Growth Rates: 1900 - 2020.

Year	Pop.	r%	Yr.	Pop.	r%
1900	11.8	-	1945	17.5	1.8
1905	11.9	0.2	1950	19.2	2.0
1910	12.1	0.4	1955	21.1	2.1
1915	12.4	0.5	1960	23.6	2.2
1920	12.9	0.8	1965	26.3	2.3
1925	13.6	1.0	1970	29.5	2.3
1930	14.4	1.2	1975	22.1	2.6
1935	15.3	1.3	1980	37.7	2.8
1940	16.3	1.5	1984	42.6	2.9

Annex 7.2.2

Table 2 **Distribution of Human Population in Ethiopia**

Alt. m. (asl)	Area		Population		
	,000 Km^2	% of Total	Size	% of Total	Density
2600 +	63.1	5.8	5,364,164	10.4	85.0
2200-2600	128.4	11.8	20,218,772	39.2	157.5
1800-2200	211.2	19.4	14,390,402	27.9	68.14
1400-1800	306.0	28.11	5,931,528	11.5	19.4
1000-1400	145.9	13.4	4,229,437	8.2	29.0
Below 1000	234.0	21.5	1,444,198	2.8	6.2

Annex 7.2.3

Table 3 **Livestock Population (millions): 1976 - 88**

Types of Animals	Annual Av.	As % of Total	% change since 1975-78
Cattle	30.333	22.2	18.0
Sheep & Goats	40.467	29.8	1.0
Ewuine	7.015	5.2	3.0
Camels	1.037	0.8	8.0
Pigs	1.9	0	14.0
Chicken	5.7	42.0	9.0
Total	135.871		

Annex 7.2.4.

Table 4 Food Production and Population Size (1982-1989)

Period	Production in million quints	Population (millions)	Per Capita Production (quints)
1983 - 83	78.1	41.0	1.9
1983 - 84	63.4	42.2	1.5
1984 - 85	48.5	43.3	1.1
1985 - 86	54.0	44.7	1.2
1986 - 87	70.2	46.0	1.5
1987 - 88	58.7	47.3	1.2
1988 - 89	73.3	48.7	1.5

Annex 7.3 Socio-economic and Health Status Indicators

7.3.1 Table 1 **Maladies in the environment are expressed by some socio-economic and health status indicators in Ethiopia such as shown below.**

Population Size **Total 54.1 million**
Rural 89 percent
Urban 11 percent

Population Density
44 per Km^2

Annual Population Growth Rate
3.1 %

Child Population below 5 years of age
10 million

Women aged 15-45 years
10 million

Crude Birth Rate
45.5/1000

Total Fertility Rate
7.65/woman

Crude Death Rate
13.8/1000

Infant Mortality Rate
107.7/1000

Under 5 Mortality Rate
161/1000

Maternal Mortality Rate
7000/1000,000

Life Expectancy at Birth
47

Literacy Rate (over 10 years)
76 percent

Primary School Enrolment Ratio
22 percent

Access to Safe Water **Total 16 percent**
Rural 12 percent
Urban 83 percent

Health Service Coverage
46 percent

Rate of Family Planning Acceptance
2 percent

Per Capita Calorie Supply
1515 calories

7.4 Status of National Parks

PARK	STATUS	PROBLEM
Abijata - Shalla	- Charcoal industry - Cereal cultivation - Livestock grazing - Soda-Ash mining	- Soil erosion - (wind) - Loss of wildlife habitat - Reduction in wildlife
Awash	- Increased human and livestock population - Tree felling (construction and fuel)	- Soil erosion - Loss of wildlife habitat - Reduction in wildlife
Bale Mountains	- Human settlement - Livestock grazing - Hunting	- Loss of wildlife habitat - Reduced wildlife
Gambella	- Human settlement - Hunting	- Deforestation - Soil erosion - Reduced wildlife and wildlife habitat
Mago	- Human settlement - Poaching	- Loss of wildlife habitat - Loss of wildlife
Nechisar	- Human settlement - Wood (fuel and construction)	- Deforestation - Loss of wildlife - Loss of wildlife habitat
Omo	- Livestock grazing - Poaching	- Loss of wildlife habitat - Loss of wildlife
Senkelle Sway..	- Grazing	- Loss of habitat and wildlife
Simen	- Human settlement - Cereal cultivation - Livestock production - Wood cutting (fuel and construction_	- Deforested - Wildlife habitat reduced - Wildlife reduced
Yabello	- Tree cutting (fuel) - Illegal hunting - Settlement	- Deforestation - Reduced wildlife habitat - Reduced wildlife
Yangudi Rassa	- Tree felling (fuel)	- Deforestation - Reduced wildlife habitat

7.5 Endangered Animals and Plant Species in Ethiopia

7.5,1 Animals

Mammals	-	Northern Simen Fox
	-	African wild dog
	-	Leopard
	-	Cheetah
	-	Dugong
	-	African wild ass
	-	Grevy's zebra
	-	Black rhinoceros
	-	Tora hartbeest
	-	Beira antelope
	-	Dibatag
	-	Walia ibex
	-	Mountain nyala
Birds	-	African lammergeyer
	-	Teita falcon
	-	White-winged dove
	-	Turaco
	-	Scarce swift
	-	Bush Crow
Reptiles	-	Nile crocodile

(Bruce et al 1977, TGE, 1994).

7.5.2 Some threatened endemic plant species of Ethiopia as found in the main vegetation types. (Ensermu et al 1992).

Geographical areas: AR = Arsi; BA = Bale; EW = Eritrea West; GD = Gonder; GG = Gamo Gofa; GJ = Gojam; HA = Harerge; IL = Ilubabor; KF = Kefa; SD = Sidamo; SU = Shewa Uplans; TU = Tigray Uplans; WG = Welega; WU = Wello Upland. These abbreviations are used for the Flora of Ethiopia and ae followed here. The areas are shown in Figure 2 of Mesfin Tadesse's paper [17] on page 5 of this Monograph.

Status: E = endangered; Ex = extinct; R = rare; V = vulnerable.

Habitat: Herb = either an annual or pernnial awhich produces herbaceous stems; suffrutescent = a bushy/woody plant up to 1 m tall. shrub = bushy/woody plant over 1 m tall; small tree - a woody plant up to 8 m tall; tree = woody plant over 8 m tall; succulent = a plant with fleshy stems and/or leaves; semi-parasite = a plant which takes nutrients from its host but which also has green leaves an/or stems; geophyte = a plant with most of the stem below ground; pyrophyte = a plant which can tolerate a quich fire.

Species	Family	Distribution	Status	Habit
Desert and semi-desert scrubland				
Acacia prasinata Hunde	Fabaceae	WU; 500-1300 m	E	small tree
Boswella ogadenensis Vollesen	Burseraceae	HA; 300-450 m	E	shrub/small tree
Euphorbia doloensis M. Gilbert	Euphorbiaceae	SD; ca. 400 m	E	shrub/small tree
E. ogadenensis Bally & Carter	Euphorbiaceae	BA HA; ca 300 m	R	succulent
Indiofera kelleri Bak. f.	Fabaceae	HA; not recorded	E	small shrub
Monadenium shebeliensis M. Gilbert	Euphorbiaceae	HA; ca. 300 m	E	shrub
Picosepalus ogadensis M. Gilbert	Loranthaceae	HA; ca. 500 m	E	semi-parasite
Acacia- Commiphora woodland				
Acacia pseudonigriscens Brenan & Ross	Fabaceae	BA; ca. 300 m	E	small tree
Aeschynomeme ruspoliana Taub & Harms	Fabaceae	SD; not recorded	E	shrub or heb
Andrachne ephemera M. Gilbert	Euphorbiaceae	HA BA SD; 1000-1600 m	V	herb
Cammiphora monoica Vollesen	Bruseraceae	BA; 1250- 1400 m	E	small tree
Crotolaria awasensis Thulin	Fabaceae	SU SD; ca. 1700 m	E	herb
C. boudettii Polhill	Fabaceae	HA; 550 m	E	herb
C. heterotricha Polhill	Fabaceae	HA; ca. 500 m	E	herb
C. hypargyria Chiov.	Fabaceae	BA; not recorded	E	herb
C. jijigensis Thulin	Fabaceae	HA; 1750-1850 m	E	suffrutescent
C. ruspoliana Chiov.	Fabaceae	SD; not recored	E	herb
C. trifoliata Bak. f.	Fabaceae	BA; ca. 1400m	E	herb

Some threatened Endemic Plants of Ethiopia

Species	Family	Distribution	Status	Habit
Cyphostemma burgeri Vollesen	Vitaceae	HA; 1500-18000 m	E	herb
Erythrococca uniflora M. Gilbert	Euphorbiaceae	SD; 950-1325 m	E	shrub
Erythrophysa septentrionalis Verdc.	Sapindaceae	HA; 600-800 m	E	shrub/small tree
Euphorbia awashensis M.Gilbert	Euphorbiaceae	SU; ca. 1000 m	E	pyrophyte
E. baleensis M. Gilbert	Euphorbiaceae	BA; 1150-1450 m	E	shrub
E. betulicortex M. Gilbert	Euphorbiaceae	SD; ca. 950 m	E	small tree
E. burgeri M. Gilbert	Euphorbiaceae	HA; 1200-1550 m	E	succulent shrub

E. burgeri M. Gilbert	Euphorbiaceae	HA; 1200-1550 m	E	succulent shrub
E. cryptocaulis M. Gilbert	Euphorbiaceae	SD; 1350-1600 m	E	geophyte
E. dale M. Gilbertttiensis	Euphorbiaceae	HA; ca. 1200 m	E	succulent shrub
E. ellenbeckii Pax	Euphorbiaceae	SD; 1000-1100 m	E	succulent shrub
E. fissispina Bally & Carter	Euphorbiaceae	SD; ca. 750	E	shrub
E. gymnocalycioides M.Gilbert & Carter	Euphorbiaceae	SD; ca. 1350 m	E	succulent
E. monancantha Pax	Euphorbiaceae	SD BA; 1200-1800 m	V	succulent
E. nigrispinioides M. Gilbert	Euphorbiaceae	SU; 1000-1700 m	V	shrub/small tree
E. omariana M. Gilbert	Euphorbiaceae	BA; 1350-1400 m	E	herb
E. piscidermis M.Gilbert	Euphorbiaceae	HA; 1000-1050 m	E	succulent
E. sebsebei M. Gilbert	Eupnorbiaceae	SD; 1300-1450 m	E	succulent
E. somalensis Pax	Eupborbiacea	HA; ca. 1100 m	E	shrub/small tree
E. tetracantha Rendle	Euphorbiacea	BA; ca. 600 m	E	suffrutescent
E. uniglans M. Gilbert	Euphorbiaceae	SD; ca. 1400 m	E	small tree
Galega somalensis (Taub. ex Harms) Gillett	Fabaceae	SD; ca. 1600 m	E	suffrutescent
Indigofera cana Thulin	Fabaceae	WU; 1200-1800 m	E	suffrutescent
I. curvirostrata Thulin	Fabaceae	SD; ca. 900 m	E	shrub
I. ellenbeckii Bak. f.	Fabaceae	HA; not recorded	E	suffrutescent
Jatropha horizontalis M.Gilbert	Euphorbiaceae	SD; 1250-1500 m	E	suffrutescent
Lotus lalambensis Schweinf.	Fabaceae	EW HA; 1200-200 m	V	herb
Phragmanthera erythraeae (Sprague) M. gilbert	Loranthaceae	EW TU SU; 1150-2200 m	R	semi-parisite
Phyllanthus borenensis M. Gilbert	Euphorbiaceae	EW TU SU; 1500-2200 m	E	shrub
Plicosepalus robustus Wiens & Polhill	Loranthaceaee	SD; ca. 1100 m	E	semi-parsite
Rhynchosia erythraeae Schweinf.	Fabaceae	EW SU; 1000-2000 m	E	shrub
R. malacoticha Harms	Fabaceae	SU HA BA; 1350-2000 m	V	shrub
R. ramosa Verdc.	Fabaceae	HA; ca. 900 m	E	herb

Taverniera schimperi Jaub. & Spach.	Fabaceae	EW TU SU; 1000-1300 m	V	shrub
Wet Evergreen Forest				
Dorstenia soerensenil Friis	Moraceae	IL KF; 1950-2200 m	V	herb
Maytenus harenensis Sebsebe	Celastraceae	BA; 1600-3050 m	V	tree
Combretum-Terminalia Woodland				
Boswelia pirottae Chiov.	Burseraceae	GD GJ WU SU KF; 1200-1800 m	R	tree
Crotalaria fallax Chiov.	Fabaceae	SD; ca. 1500 m	E	herb
Cussonia ostinii Chiov.	Araliaceae	GD GJ WG KF; 1500-2100 m	R	small tree
Cyphostemma pannosum Vollesen	Viraceae	WG IL GG; 1500-2000 m	R	pyrophyte
Eriosema tuberosum A. Rich	Fabaceae	TU GD; ca. 1500 m	E	pyrophyte
Erythrina burana Chiov	Fabaceae	HA; 1350-2100 m	V	tree
Euphorbia bittataensis M. Gilbert	Euphorbiaceae	SD; ca. 1600 m	E	succulent shrub
E. furcatifolia M. Gilbert	Euphorbiaceae	SD; ca. 1600 m	E	suffrutescent
E. sareciana M.Gilbert	Euphorbiaceae	BA; ca. 1500 m	E	herb
Ficus ruspolii Warb	Moraceae	KF SD; ca. 1800 m	E	shrub/small tree
Indigofera moonevi Thulin	Fabaceae	WG SU KF SD; 1000-2000 m	R	herb
Pentas tenuis Verdc.	Rubiaceae	WG SU KF SD; 1300-2000 m	R	shrub
Phyllanthus dewildiorum M. Gilbert	Euphorbiaceae	WG KF; 1400-1800 m	V	suffrutescent
Rhynchosia splendens Schweinf.	Fabaceae	GD; ca. 1000m	E or Ex	sub-shrub
R. stipulosa A. Rich.	Fabaceae	TU WG GG; 1000-1800 m	R	climber
Tephrosia fulvinervis Hochst. ex A. Rich	Fabaceae	EW TU GD SU; 1100-1700 m	R	herb
Tragia abortiva M. Gilbert	Euphorbiaceae	GG; 1550-1800 m	V	climbing shrub
T. crenata M. Gilbert	Euphorbiaceae	BA; ca. 1300 m	E	twining shrub
T. triumfettoides M. Gilbert	Euphorbiaceae	SD; 1900-1950 m	E	twining herb
T. uncinat M. Gilbert	Euphorbiaceae	WG; not recorded	E	woody climber

Dry Evergreen Montane Forest and Grassland

Acacia negrii Pichi-Serm.	Fabaceae	WU GD GJ SU HA; 2000-3100 m	V	tree
A. venosa Hochst. ex Benth	Fabaceae	EW TU GD 1890-2400 m	E	small tree
Acalypha marissima M. Gilbert	Euphorbiaceae	WG; 1900-2050 m	E	sub-shrub
Argyrolobium schimperianum Hochst. ex A. Rich	Fabaceae	TU GD GJ SU; 2100-3500 m	R	shrub
Crotalaria intosa Polhill	Fabaceae	GD SU KF SD; 1850-2600 m	R	herb
C. sacculata Chiov.	Fabaceae	SD; ca. 2100 m	E	herb
Euphorbia makallensis Carter	Euphorbiaceae	TU; 2260-2385 m	E	succulent shrub
E. repetita A. Rich.	Euphorbiaceae	TU GD WU SU; 2160-2700 m	R	shrub
E. rubella Pax	Euphorbiaceae	HA; 1850-1950 m	E	geophitic herb
Galium boreo-aethiopicum Puff	Rubiaceae	GD WU; 2200-2800 m	R	herb
Hypagophytum abyssinicum (Chiov.) Gillett	Fabaceae	TU GD SU; 1500-2000 m	E	herb
I. rottii Bak.	Fabaceae	SU HA; 2150-2800 m	V	shrub/small tree
I. sparsa Bak.	Fabaceae	TU; not recorded	E	herb
Kalanchoe angustifolia A. Rich.	Crassulaceae	TU; not recorded	E/?Ex	herb
K. schimperiana A.Rich.	Crassulaceae	EW TU GG SU BA; 2400-2700 m	R	herb
K. stenopsiphon Britten	Crassulaceae	EW TU; 1600-2300 m	R	herb
Maytenus addat (Loes.) Sebsebe	Celastraceae	SU AR SD BA GG; 2200-3000 m	E	tree
Onobrychis richardii Bak.	Fabaceae	TU; not recorded	E/?Ex	herb
Pentas concinna K.Schum.	Rubiaceae	HA; ca. 1800 m	E	shrub
Phragmanthera sarertaensisi (Hutch. & E.A Bruce) M. Gilbert	Loranthaceae	HA AR SD; 2300-26500 m	R	semi-parasite
Polyscias farinose (Del.) harms	Araliaceae	TU GD SU KF; 1700-2000 m	R	small tree

Rhynchosia erlangeri Harms	Fabaceae	HA; 1840-2600 m	E	Shrub
Rubus aethiopicus A. Grah	Rodaceae	SU SD; 2600-3000 m	E	Shrubby climber
Sedum epidendron A. Rich.	Crassulaceae	GD GJ SU AR; 2500-3000 m	V	epiphytic herb
Taveniera abyssinica A.Rich.	Fabaceae	TU SU; 1700-2150 m	E	shrub
Tephrosia dichroocarpa Steud. ex A. Rich.	Fabaceae	TU GD GJ; 2000-2400 m	V	shrub
T. hochstetteri Chiov.	Fabaceae	EW TU; 1600-1800 m	V	herb
Thesium matteii Chiov.	Santalaceae	GJ SU AR; 2000-3050 m	R	herb
Tragia ashiae M. Gilbert	Euphorbiaceae	SU BA; 2200-2400 m	V	twining herb
Trifilium chilaloense Thulin	Fabaceae	AR; ca. 2900 m	E	herb
T. pichisermollii Gillett	Fabaceae	GJ SU; 2100-	V	herb
T. somalense Taub	Fabaceae	SD; ca. 2000 m	E	herb
T. spanathum Thulin	Fabaceae	WU AR BA KF; 2300-3000 m	R	herb
Vigna debenensis Martelli	Fabaceae	EW TU; 1600-2200 m	V	climbing herb
Afroalpine and Sub-afroalpine				
Alchemilla haumannii Rothm.	Rosaceae	GG AR BA; 3000-4250 m	V	Suffrutescent
Aphanes bachiti (Haum & Balle) Rothm.	Rosaceae	GD; ca. 37000 m	E	herb
Crotalaria exaltata Polhill	Fabaceae	SU BA SD KF; 3000-3400 m	E	shrub/small tree
Maytenus cortii (Pichi-Serm.) Cuf.	Celastraceae	GD; ca. 3500 m	E	shrub
Rosularia sermiensis (A. Rich.) Ohba	Crassulaceae	GD; 3600-4200 m	E	herb
Rubus erlangeri Engl.	Rosaceae	SD BA; ca. 3600 m	E	woody climber
Saxifraqa hederifolia A. Rich.	Saxifragaceae	TU GD GJ AR; 3000-4000 m	V	herb
Sedum baleensis M.Gilbert	Crassulaceae	BA; 2700-3400 m	E	succulent herb
S. glomerifolium M. Gilbert	Crassulaceae	BA; 3000-3800 m	V	succulent herb
S. mooneyi M. Gilbert	Crassulaceae	AR BA; 3400-4100 m	E	succulent herb

Riparian and Swamp Vegetation

Crotalaria polhillii Thulin	Fabaceae	SU KF; 1500-1800 m	E	herb
Polysphaeria aethiopica Verdc.	Rubiaceae	BA SD; 800-1350 m	V	shrub

Water and watershed management
One of the major environmental problem areas in Ethiopia

Preface

This lecture is presented for all those who are planning, implementing, or responsible for water projects intended to benefit small segments of rural communities and for community development workers who are not technicians in the area of water resources. It will serve as a general guide when planning environmentally sound small-scale water projects[1] and it is meant to provide a beginning for ecological analysis and a reference to the necessary technical materials. It is an initial guide for planning[2] and discussion with community leaders.

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[1] Projects which protect and conserve natural resources in a manner which allows sustainable development to take place.

[2] Planning refers to the process of thinking a water development project in terms of all its components and how they interrelate. It includes determining objectives, selecting strategies to fulfill them on a sustained basis, evaluating costs and benefits.

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1. Introduction

The primary goal of water resource development is to provide potable and reliable water supplies for human use. It may result from the development of a new safe source for domestic and livestock water supply, the expansion of an existing water source, improvements in collection and delivery or methods of water conservation.

In addition communities want more water for agriculture or as energy source to improve the living standard and increase job opportunities.

Water development projects often have unforeseen environmental factors with negative effects on the expected benefits of the project.

Some of the adverse effects of poorly planned water projects are:

- Watershed degradation, which includes increasing water-related erosion, changes in hydrologic balance, the loss of soil fertility, the decline of biological diversity, serious problems with the potable water supplies;
- Inferior and poor water quality leads to dramatic increases in water-related diseases and human health problems, which requires a plan for purification or improved sanitation;
- Unreliable and inadequate water quantity limits industrial and urban development, water being the source of energy for water-powered machinery like hydroelectric turbines for generating electricity, water ram for pumping water, turning water wheels for manufacturing;

Determining the possible positive and negative effects on environment are one of the major tasks faced by designers of small-scale water projects. Through appropriate watershed and water management interventions, and by selecting alternate techniques or minor modifications of the proposed project, some of the unwanted negative consequences can be substantially mitigated.

Understanding basic ecological concepts and having awareness of environmental relationships will help planners:

- to judge the direction and the magnitude of environmental changes of various alternatives;
- to assess the positive and negative effects of the options.

2. The hydrologic cycle

The hydrologic cycle forms the basis for all water development project, either small-scale or large-scale. A good understanding of the basic process and of its vagaries are important to water resource planning.

The movement of water from the earth surface to the atmosphere and back to earth is called the hydrologic cycle. It involves evaporation, transpiration, condensation, cloud formation, precipitation, surface runoff and percolation.

Through sun radiance a water surface, (ocean, river or water saturated land), warms up. The water molecules start moving. As the water surface gets warmer, the molecules move faster until some molecules forms water vapor and break away from the water surface and move into the atmosphere. This process is known as evaporation and is responsible for most of the water vapor in the atmosphere. After gradually cooling or condensation, the vapor form clouds. When water evaporates from land or water surfaces, the larger and slower molecules, such as salts and metals, are left behind.

Transpiration contributes also to atmospheric water vapor and is also generated by sunlight energy. Water is absorbed by plant roots and is passed into the internal plant system to the upper plant portion where partially it is used for photosynthesis but mostly passes through small pores at the leaf surface. Sunlight will change water into vapor.

Evapotranspiration is a term commonly used in agriculture project and indicates the crop water needs. Crop water needs are directly affected by the major climatic factors, including sunshine, temperature, humidity and windspeed. Therefore meteorological data are used to estimate the evapotranspiration losses of the agricultural area.

Moisture laden clouds cool when passing over mountain ranges or by meeting cold air masses. Further cooling compacts the water molecules into droplets which fall to the earth's surface as rain. Topography, cloud altitude and prevailing wind direction contributes to uneven distribution of precipitation.

Surface water will either flow to the oceans, seep into the ground or evaporate. Because surface water is so precious in most countries, it is used for many human activities before it reaches the ocean. Surface water could pass through a hydroelectric turbine or flow to an irrigated field, or be used for sewage removal of a riverside city. Each use will have some effects on the water quality and on parts of the hydrologic cycle by increasing or decreasing the rate of evaporation or percolation.

Most soils, in particular if covered with vegetation, absorb water. The excess water becomes part of the surface runoff. Soils which are impervious due to rock cover or compaction have a heavy runoff. Rapid or uncontrolled surface runoff can produce flooding, land slides or serious erosion. On smaller scale, runoff can have deleterious environmental effects. As water moves across land, it picks up soil particles and organic material important to soil fertility. Their removal decreases the productivity of agricultural land. If topsoil particles are deposited on downstream farmland, those lands are improved. Usually soil particles are transported to a water course and deposited as sediments in slow-moving bodies of water like reservoirs, lakes or oceans. Although this may enrich aquatic systems, it silts up water reservoirs.

Water falling on vegetation is more likely to remain in place than water which strikes bare soil. The plant not only dissipates the force of the rainwater but also impedes surface flow. Vegetation allows more time for the soil to absorb the rainwater and also improves the soil structure so that it can absorb more water at a faster rate. Once absorbed into soil, the water can percolate down to aquifers or reach an impervious layer and move as a subsurface or ground water flow. Some of the subsurface water will be absorbed by plants or by trees. The remaining ground water can be tapped through water wells, or becoming a part of the surface water system through springs. Subsurface flows being more leisurely than surface flows, there water remains available for human use for a longer time.

This simplified explanation of the hydrologic cycle indicates major areas for analysis before implementing a water development project. It suggests where water is likely to be found. It is the basis for determining the best methods to develop and to protect the source.

Most water development projects make minor local changes in the hydrologic cycle, since they provide additional human benefits in the form of additional water supplies or water movement. Alteration of hydrologic cycle does not involve changes in the basic processes, but rather in their rates or volumes.

Data from the National Meteorological Service for the span of 20 years indicates that the region's average annual rainfall is 578 mm which is by 37% less than the national average (921 mm). The rate of rainfall ranges from 35 - 75 mm/hr in the rainy season. The average annual evapotranspiration is 1,131.5 mm, the national average is 1109.9 mm.

3. Ecological concepts important for water resource development

- Development implies change for the better, that is to say, a change from existing conditions or resource use to a system that is safer or more productive, producing more benefits for a larger number of people.
- Development involves the alteration of resources or imposes a different strategy for using the available resources.

By better understanding of the ecological principles, developers can increase the success probability by increasing the positive and mitigating the adverse effects.

3.1. Ecosystem

The term "ecosystem' applies to an area of homogeneity of a particular part of the natural system, such as : - type of vegetation, - amount of rainfall, - topography, - physical feature.
Ecosystems can be classified as natural or artificial. In natural ecosystems, man is not the dominant factor and changes tend to be minor unless some catastrophic event occurs. Dynamic balances are achieved through constant natural minor adjustments within the system. Those balances ensure relative stability in plant and animal populations, minor fluctuations in water movement, and nutrient inputs nearly equal to nutrient losses. Artificial ecosystems are created by man.

The biological basis of any ecosystem consists of three major groups: - producers, - consumers, and - decomposers.

- The ecosystem producers are the green plants, whether algae, grasses, trees or weeds. Through the photosynthesis process, plants combine carbon dioxide and water in the presence of sunlight (energy source), to produce carbohydrates (sugars and starches) and release oxygen as a by-product. Using the carbohydrates for energy, the plants can take other nutrients from their environment to produce fatty acids, protein and vitamins, forming the energy and nutritional base for the other biological parts of the ecosystem. The goal of many water development projects is to supply water essential to those producers.

- The ecosystem consumers are animals and human beings, which eat plants or other animals. In order to produce energy, consumers must combine food with oxygen, releasing small amounts of carbon dioxide and water in the process. Animals and humans use their energy for heat, growth, movement, and the production of more complex chemical compounds, such as fats and proteins, which are important in storing energy, building new tissue or transmitting genetic materials to offspring. Consumers require additional supplies of water to construct new tissue to transport various chemical compounds within the body, and to regulate internal temperature.

- The ecosystem decomposers are microscopic organisms. These organisms play a vital role in the ecosystem. Decomposers, mainly bacteria and fungi, break down the large molecules in dead plant and animal tissues or waste, into simpler forms that can be used by plants. Without their presence, producers would not be able to construct new tissues. Indeed, plants cannot absorb nutrients unless they are in very simple chemical forms. The roots of a tree cannot use the nutrients in a dead animal's tissue unless the complex carbohydrates, fats and protein are broken down into simpler molecules which contain carbon, nitrogen, potassium, calcium and phosphate. Water development projects, whether for agriculture or sanitation, must rely on viable

populations of decomposers to continue the recycling of nutrients through the ecosystem.

The role of plants and animals in an ecosystem is not limited to production, consumption and decomposition. Their many other functions can be: soil protection, water retention, microclimate modification, pollination and seed dispersal. When altering a part of an ecosystem for making it more productive, or less hostile to mankind, other aspects than productivity should be examined.

3.2. What happens when natural ecosystems are altered?

The dominant natural feature of most land ecosystems is the plant cover or vegetation. The type and density of the vegetation influence the soil structure, water movement, nutrient balance, type and abundance of animal populations and microclimate. When the native plant cover is removed or changed for development, each of these areas can be affected.

- If vegetation is removed, wind can blow away soil particles and organic matter in the topsoil, and remove the most fertile elements of the soil.

- The combined action of wind and sun on exposed soil increases evaporation, causing the soil to become dry and brittle, and therefore less suitable for agriculture.

- In denuded areas, soil particles with attached nutrients, may be dislodged by hard rainfall. Runoff carries those soil particles and nutrients from land, where they are needed to maintain soil fertility, to waterways where they are not needed and cause silt and sediments. As a result, they may clog water courses, kill fish, increase flooding and fill reservoirs.

- Nutrients carried into the waterways may increase the growth of algae or waterweeds, rendering the water unfit for desirable animals, but more suitable for animals that transmit diseases (vectors). The nutrients may also make the surface water less desirable for human consumption.

- Protection from flooding is reduced when covering vegetation is removed. Plants maintain soil porosity which helps the soil absorb water. The roots and stems retard the flow of surface water. With removed vegetation, water does not percolate easily into the soil , but runs over the surface in sheets or gullies, increasing soil erosion and the danger of flooding downstream areas.

- Traditional natural resources like wood, fruit, medicinal plants, cooking herbs may be lost if the native vegetation is removed or replaced by agricultural crops.

- If the natural vegetation is removed by man, the wild life diversity will decrease, since animals depends upon natural plants for food or shelter. These animals are replaced by others who depend on domestic crops or livestock. Some of them are classified as

agricultural pests.

There are many other effects on the environment when natural ecosystem are altered. It is not possible to make a complete list. Some changes of the ecosystem have complex and difficult to predict effects, others are rather straight forward.

4. Water management

4.1. Water and agriculture

The role of water in agriculture is well-known. Good crop growth depends upon the availability of plant nutrients in the soil, sunlight and adequate water for seed germination, growth, flowering and maturation.
In arid or semi-arid regions, water is the limiting factor for crop productivity and farmers should select crops with low water requirements, develop techniques to store water and devise methods to provide water other than rainfall to the crops.
In wetter tropic areas, rain-fed cultivation is a common practice. In those areas the limiting factor in crop productivity is soil fertility. The farmers must control the water movements to minimize the loss of soil nutrients and changes in soil nutrients.

4.1.1. Water as transport

A quick review of the water-agriculture relationships will provide a common base for discussing environmentally sound projects. Water chemically and physically moves matter to and from agricultural lands and within plants.

Chemical Transport

Many minerals, nutrients, pesticides and other chemicals are dissolved and carried in water through surface runoff, subsurface flow or percolation.

Depending upon the amount of runoff, the kinds of materials carried and the amount of materials dissolved in the water, a number of negative effects can result from chemical transport. Increased nutrients can promote uncontrolled growth of algae and waterweeds in water bodies. Those plants cuts off sunlight to the bottom plants, reducing their capacity for photosynthesis. As the algae and waterweeds die, decay depletes the oxygen in the water which, coupled with the lower rate of photosynthesis, kills fish and other aquatic animals. At low concentrations pesticides are lethal to aquatic organisms. Nitrates and phosphates from agricultural fertilizers become health hazards when they contaminate domestic water supplies.

Percolation has some negative effects when moving nutrients down below the root zone of plants where they become useless to agriculture. Percolation has some beneficial effects as well when recharging the ground water table or when moving dissolved salts

deeper into the soil where they are not injurious to plants. The amount and frequency of deep percolation depend upon the soil structure, the amount of organic material in the soil, the amount and type of the vegetation cover, the amount of rainfall and the underlying geologic structure.

Physical Transport

Raindrops falling on unprotected soil strike and dislodge soil particles and move them by gravity towards streams.

Within limits, erosion is an important part of natural ecosystem. A flow of nutrients to aquatic environments is needed to maintain natural biological systems. Rich valley and plain soils were derived from erosion during earlier geological eras. The fertility of flood plains is enhanced by the annual increments from upstream highlands.

Erosion can have negative effects when it is allowed, or encouraged by man to become excessive. When the topography becomes less steep, water velocity slows down, and the suspended heavier soil particles settle as sediments. Stream or lake sediments can choke or divert streams, increase flood potential, clog turbines and kill aquatic life. The suspended lighter soil particles decreases sunlight infiltration and are a filtering problem for domestic or commercial water supplies.

4.1.2. Water sources

The project designer who intends to develop agricultural water sources should be aware that not all water sources can safely be used for cultivation. On the other hand, agricultural water supplies do not have to meet as high standards as those for drinking water. The presence of pesticides, nutrients and high bacterial or algal blooms or contamination does not necessarily compromise use of water for agriculture. The additives, eventually, may be beneficial to crop production. Water containing boron, is harmless to humans, but is toxic to plants.
In arid areas, water may contain salts, which affect taste but are not necessarily harmful to humans, however, the salts accumulate in the soil and kill plants.

Water resources for agricultural needs can be intermittent. Most crop plants do not require a constant flow or constant volume of water. The crop water needs vary with time in the life cycle (germination , growth, flowering, maturation). During some stages plants can survive with little or no rainfall. Other plants can endure long periods between rainfalls or irrigation by using the soil as a water reservoir. Crops can be selected to take full advantage of a wet season and supplemental sources may be needed only for short periods at the beginning or end of the growing season.

4.1.3. Irrigated agriculture

Irrigated agriculture involves very complex soil-water interrelationships and therefore is a very important aspect of the Environmental Assessment. Agricultural benefits may be high but environmental repercussions may reduce the benefits, often to the point where costs exceed benefits and with negative effects which endure long after the project has ceased yielding any positive returns.

Irrigation has been practiced over many centuries. Nowadays, irrigation is rapidly expanding through experimentation. New technologies permit small-scale irrigation and irrigation of sub-marginal lands.

New planned and managed irrigation systems are designed on compromise, depending on following factors:

- supply and quality of water;
- distance between water source and irrigated surface;
- site topography;
- soil characteristics:
    - infiltration and percolation rate;
    - water-holding capacity;
    - chemical characteristics;
- moisture requirements of the crop;
- climate;
- available funds;
- amount of skilled and unskilled labor;
- prevalence of water-related disease;
- experience with irrigated agriculture;
- cost of energy.

This list is not exhaustive, nor is it arranged in order of priority, but it helps to illustrate the complexity of irrigation decisions.

Irrigation projects can have far-reaching effects on the environment over an area larger than the project side. Irrigation has triggered dramatic increases in water-related diseases, especially bilharziasis and malaria. Insect pest populations, normally reduced to low level during dry seasons, prosper from the year-round water, thereby increasing the reliance on expensive pesticide control. Irrigation can have an impact on water table depth, water quality and soil productivity. Irrigation can also have consequences for society in terms of family structure, human mobility patterns, economic status of farmers and land ownership patterns. Hostilities between neighbors, adjoining communities and even countries have resulted from disputes over irrigation water and practices.

Just as irrigation projects affect the environment, some environmental factors can have a devastating impact on irrigation.

- Deforestation or mismanagement of the watershed can cripple an otherwise well-

designed irrigation system.
- Industrial waste from upstream sources may kill crops and render soils unsuitable for agriculture.
- Increased soil salinity or water-logging may put croplands out of production and be extremely costly to correct.

Project planners must take precautions to ensure that environmental changes outside the project area will not have uncontrollable negative effects.

Tigray suffers from repeated droughts, because rainfall is erratic. Crop production depends almost entirely on rain. However a recent assessment has shown that there is a huge potential of rainwater being estimated at 13 billion cubic meters every year of which about 40% can be used for irrigation expansion up to 300,000 hectares. Irrigation development has become a top priority to ensure food security. Currently, a 10-year irrigation development pan has been prepared and approved under the SAERT[3] program. About 500 micro-dams which are adequate for irrigating 50,000 ha will be constructed. The program has already been launched. Apart from the micro-dam based irrigation, irrigation schemes under river diversions will also be developed. Currently, there is about 45,000 ha under irrigation.[4]

4.1.3.1. Major problems in irrigation

The most frequent and major negative effects of irrigation are water-logging, soil salinization, soil alkalinization and increased disease.

Water-logging is caused by seepage from irrigation canals or over-application of water, accompanied by insufficient drainage. To correct this may require artificial drainage systems: either open interceptor ditches placed at intervals on the fields, or subsurface drains consisting of a series of perforated tile, concrete or plastic pipes in the soil. Subsurface drains, although more expensive, are the preferred option because they do not take up crop space, require less maintenance and do not provide habitat for disease vectors.

Farmers often operate on the philosophy that if a little water is good, more is better. Therefore, they over-irrigate crops. One way to increase irrigation efficiency might be to levy water use fees. Even if charges are minimal, farmers will be less likely to waste water. The fees can be used to pay for the routine maintenance of the irrigation system.

Salinization is the accumulation of mineral salts (sodium, calcium, magnesium or potassium) in the upper soil layers, including the plant root zone. A white crust or powder on the surface is characteristic of severe salinization, although crop yields decline before crusting appears. So-called secondary salinization occurs when ground water rises, carrying the salts upward to the root zone, and evaporation at the surface leaves the

[3] SAERT: Sustainable Agricultural Development and Environmental Rehabilitation in Tigray
[4] Source: Overview of agricultural development of Tigray: existing efforts and future prospects - Berhane Hailu - Tigray Bureau of Agriculture and Natural Resources Development

salts behind. If fields are well-drained and sufficient water is applied, the salts will generally leach down out of the plant root zone and will not affect plant growth. It is unfortunate that irrigation drainage does not receive the same degree of attention as the development of the water supply.

Alkalinization is a less common but more serious problem than salinization. Alkaline ground waters or sodium-rich irrigation waters can increase sodium ions in the upper layers of the soil by the same processes which cause salinization. The sodium ions change the soil structure, making it difficult to till and nearly impermeable to water. Alkalinization can be ameliorated by deep horizontal drains, application of large doses of organic manures, and permanent use of acids, but a cure requires expert analysis and treatment.

Increased disease associated with irrigation and other water projects may have some possible effects on human health.

- Water carries microscopic organisms that can cause disease in humans and livestock. The microscopic organisms include bacteria, viruses, fungi and single-celled protozoans.
- Water provides an environment necessary for the development of many animals (snails and insects) that transmit diseases. These animals, called vectors, rarely cause sickness directly but instead carry the microscopic organisms that cause serious illness. Flies and mosquitoes, especially, help to pass germs from sick people to healthy people, thereby spreading the disease. In many cases, the insect spends only a part of its life or life cycle in water, but can transmit disease to human without their direct contact with infected water supplies. (malaria, yellow fever).
- Water sources can provide suitable environments for animals that are extremely common parasites of humans. These parasites, which can be single-celled organisms, flat worms or round worms, are responsible for the world's most common diseases, causing massive expenditures for medical care and treatment as well as terrible suffering. Bilharziasis[5], Filariasis[6] and amoebic dysentery[7] are common examples of parasitic diseases.
- Water from polluting industries or agriculture can carry toxic chemicals that cause grave illnesses or death if the water is used for human consumption.
- Health is affected by the amount of water available for personal hygiene: washing clothes, bathing and washing of utensils and household items. If water supplies are limited, personal hygiene is often neglected. A safe supply of water for personal use is essential to good health.
- Water is directly and indirectly related to proper nutrition. Each adult must have a water intake of at least 6 liters per day to maintain adequate body fluids. In addition,

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[5] Bilharziasis: Disease caused by helminth worms and their eggs. Helminth are worms living as parasites in the human circulatory system and cause hematurie (blood in urine).

[6] Filariasis: Disease caused by mosquito in hot areas. The parasite worm, long and slim as a string, lives under the skin of various vertebrates.

[7] Amoebic dysentery: Chronic affection, due to amoebas, characterized by intestinal ulceration and hepatic complications (liverwort).

agricultural production requires water for survival and growth. If water supplies are not sufficient, agricultural production will decline and adversely affect nutrition.

4.1.3.2. Effects of using surface water for irrigation

Irrigation water from surface sources, usually diverted via canals, ditches or closed conduits, is commonly used for small-scale projects. The diversion of the water can affect aquatic and terrestrial environments.

Aquatic environments

- Removal of water from rivers and streams reduces downstream flows, decreasing habitat for aquatic plants and animals.
- After irrigation, water returned to surface sources is of poorer quality than original water, often containing substances lethal to aquatic organisms.
- Lowered streams or rivers entering the sea will suffer increased encroachment of saltwater.
- Reduced water flows may cause increased siltation and sedimentation of rivers downstream.

Terrestrial environment

- Irrigation may increase the amount of subsurface water until the water table rises into the plant root zone. The raised water table inhibits the growth of most agricultural crops by water-logging the soil, so that the exchange of oxygen between roots and soil pores cannot take place.
- The elevated water table may leave standing water at the surface providing ideal breeding sites for crop pests as well as snails and mosquitoes, vectors of disease.
- As evaporation from high water tables increases, salt residues form unless the water is exceptionally free of salts. The salts may remain at toxic levels for a long period unless remedial steps are taken. Salinization caused by improper irrigation is the most common cause of abandoned cropland in arid or semi-arid regions.

4.1.3.3. Effects of using ground water for irrigation

The effects of using ground water for irrigation are similar in many respects to the effects of using surface water, especially in the terrestrial environment. If the ground water is applied in excess and runs off to the surface waters, then the effects will be similar to those caused by return flows from surface sources, although the volume of the stream may be increased.

One significant difference does exist. Drawing irrigation water from ground water supplies does lower the water table, although not necessarily at the irrigated fields. The lowered water table causes secondary effects which must be considered by the planner:
- Marshes, springs and seeps may dry up. These areas provide habitat for wildlife.

- Stream and river flows may be reduced.
- Dug wells, used for domestic supplies, may run dry.
- Local vegetation, no longer able to reach the water table, may die. Animals dependent on native plants will disappear or become crop pests. Plants which are rare or unique to the area may disappear.

4.1.3.4. Irrigation methods

The type of irrigation selected for a small-scale project depends upon many variables. Each method has its advantages, some have specific site, water or material requirements. A brief summary of the different methods will highlight some of the benefits or limitations

Watering can

This is the simplest form of irrigation. If the water source is adjacent to the plot a person can manage a garden of approximately 500 m^2. If the water source is 500 m distant, he/she can manage only 250 m^2.

This method is labor intensive but requires little capital investment. It uses water economically and is best used with fruit or vegetable crops.

Basin irrigation

This method is widely used and easy to operate. The basins, ranging in size from 1 m^2 to several hectares, are surrounded by low banks (30 - 50 cm) called bunds. The size of the basin depends on land ownership, topography and soil characteristics. Basins are arranged adjacent to supply channels and water is passed through gates or siphons to each basin. Water inputs must be carefully regulated so as not to saturate the plants' root zones for extended periods.

Basin irrigation is not capital intensive and requires very little equipment. Land leveling can be done by hand or by draft animals pulling simple scrapers. Bunds can also be constructed and maintained by hand tools.

Basin irrigation does pose health hazards, providing breeding sites for snails or mosquitoes. Water-logging and salinization are also threats unless drainage is provided. The bunds can be destroyed by animals (domestic or wild). Erosion is not a serious problem.

Furrow irrigation

This method involves moving water in small channels (furrows) between rows of crops, down a gentle slope to a drainage ditch. In small systems, supply canals can be dug by hand and water diverted by shoveled openings for each furrow. Precise land grading is

necessary and the furrows require continued attention. The length of the furrow can be determined by experience, since it will depend on water flow and soil porosity. This method is best used for high value crops which cannot tolerate variable rainfall conditions.

4.2. Water development projects

"Country wide program for Rural and Urban water supply and sanitation, 1993", described the water supply situation in Tigray as being poor. In 1992, about 98% of the total population had no access to safe water. Only 2 towns with a population of 72,490 people had no adequate water supply, 26 towns with a population of 466,408 people had no adequate water supply, and 4 towns with a population of 28,445 people had no water supply at all. Most of the towns are supplied from boreholes, hand dug wells and springs. Rural water supply for drinking water are generally low yielding, far from villages and unsafe. The most commonly used water sources are streams, springs and shallow wells. They are mostly located in rugged terrains and are mostly accessible after an average of 4 to 6 hours travel.[8]

The goal of water development projects is most often to increase the amount of water available to a community. The supply can be increased in several ways:

1. Make more efficient use of existing water supplies. In most existing systems, a large amount of water is wasted through unwise use or poor methods of collection;
2. Improve water delivery systems to reduce water losses through evaporation or seepage;
3. Enlarge existing sources;
4. Develop new sources of water.

The above indicated alternatives should receive high priority because:

1. Community benefits are immediate and apparent;
2. Investment is relatively low;
3. Environmental impacts are not significant; and
4. Cultural adjustments are minimized.

When there are deficiencies in community water supplies, either by insufficiency or high rates of waterborne disease, the first reaction is generally to locate and exploit a new source of water without first considering improvement of the existing system. For economic, social and environmental reasons, community workers should reject proposals for new sources until the above alternatives, either single or in combination, are judged to be insufficient or unsound. All alternatives should be examined before selecting the best method for increasing the water supply to meet the desired objectives.

[8] Source: Tigray National Administrative Region Natural Resource Conservation Strategy - Bureau of Planning and Economic Development of Tigray Region - 1994

4.2.1. Collecting data

The first step in the process of water development projects is to calculate the water requirements of the community and measure the capacity of the existing systems.

In rural areas, with a limited number of water sources, such as community wells, the actual water consumption can be measured by recording the amount of water taken from each source over a period of two or three days. From these data, the annual water use can be estimated.

Another method is to employ minimum standards for domestic and livestock water use proposed by various international organizations. The average rural consumption in Ethiopia was estimated as 15 liter per capita per day (l/c/d) (Ministry of Interior, 1973). A daily per capita minimum of 38 liters for drinking, cooking and bathing is recommended by UNICEF. Livestock require 20 - 30 liters per tropical livestock unit (TLU[9]) per day. The calculation of future domestic and livestock water requirements per household, should take into account population and livestock growth and the increased per capita use which will result from improve supplies.

Evaluating the capacity of the existing system requires some field work and investigation. Each community water source should be mapped and notes taken on capacity, quality and type of use for each source (drinking, washing, agriculture). The yield of a spring can be determined by measuring the time required to fill a container of a given volume. Yields from wells can be measured by bailing or pumping a given volume after marking the initial water level. The time required for the well to return to the original level is used to calculate the yield per unit of time. The volume of water in a stream or channel can be estimated by measuring the cross-section area of the water flow and calculating the water velocity by timing a float along a measured distance.

Account must be taken of seasonal variation in the water sources. Village elders can provide the necessary information for this adjustment to the estimate. They know which wells run dry and for how long and they can describe the low water flows of streams and channels during the dry seasons.

If community water supplies are greater than water requirements, then the question may be how to protect the water from pollution or how to use it wisely. If wet season capacity exceeds community requirements and there is a shortage in dry season, then the best water development project may be some type of storage system for using the yearly water supply more efficiently. If minimum consumption requires more than 100 % increase in water supplies, it is likely that new sources will be needed.

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[9] One TLU is equivalent to 250 kg liveweight. Mature cattle, donkeys, horses and mules can be considered as 1 TLU each, while small ruminants (sheep and goats) and calves can be taken as 0.2 TLU.

4.2.2. Community water conservation program

The most obvious waste of water is from a source that runs constantly whether in use or not. Water is also wasted when the flow cannot be constrained to conform to the rate at which containers or conduits can be filled. Water sources should be equipped with devices, such as valves or reduction pipes, that can vary the flow and force of water being delivered.

Excessive use of water is common in agriculture, where farmers tend to put out more water than livestock require or to irrigate with larger quantities than are needed by the plants for optimal production.

Evaporation and seepage losses can be reduced to provide more available water. Exposed water surfaces, whether in reservoirs or ditches, lose huge quantities of water. Covers for water storage units or ditches can reduce evaporation up to 50%. By digging reservoirs and ditches deeper, more water can be moved or stored with less surface area exposed to evaporation. Seepage can also account for immense losses. Dug wells, springs or unlined irrigation canals allow water to seep into the soil. Lining with impervious materials like concrete or rocks can reduce the loss substantially. If pipes rather than open unlined canals are used, the water that can be delivered is effectively doubled simply by reducing losses.

4.2.3. Improved delivery or storage systems

Often, the water supply for a community would be adequate if it were evenly distributed over the year. Where it is not, improved storage systems can capture more water when it is available, for times when it is scarce.

The construction of enclosed water storage containers or cisterns is quite effective. Cisterns require a collection area or catchment to gather water during the wet season. A common method, is to collect rain from the roof, allowing it to drain into a covered tank. Later the water can be purified.

Catchments for agricultural cisterns is also a common practice (mostly in arid Middle East). Channels or furrows are placed along barren hills leading to large cisterns or open reservoirs at the base of the hill. Surface runoff water is diverted by water channels into the reservoir or cistern.
Often, safe water is available to a community only at considerable distances. Improving the delivery system is always an expensive task unless local labor and materials can be used. Recent improvement and transfer of PVC technology provides new possibilities. The pipe must be buried, since sunlight makes the material very brittle. Concrete is more commonly used for linings or conduits. Concrete lining permits construction of narrow and deep canals with higher water velocity to reduce mosquito and snail breeding and less surface area to minimize evaporation. Water flow is more easily regulated in pipes or

lined canals so less water is wasted through uncontrolled flows. Seepage losses in both situations are virtually eliminated.

4.2.4. Enlarging existing sources

Any water source unattended for some years will have reduced efficiency and capacity due to the addition of debris and sediments. Dug wells and tube wells slowly fill in as walls erode. As these wells are cleaned, they can also be enlarged either in depth or diameter.
With lined wells, or tube wells with casings, increasing the diameter is not recommended, since the lining would have to be removed. However, the well can be enlarged below the lining or casing and, unless there is impervious rock layer, can be dug deeper.

Open reservoirs and surface-water cisterns accumulate sediments and require periodic cleaning. The reservoirs can be enlarged during cleaning by removing more material both in and around the reservoir. Care should be taken not to disrupt any impervious layer or to exceed the water volume that can safely be held back by the dam or barrier.

4.2.5. Developing new water sources

If all alternatives for improving existing sources have been explored and a community is still short of water, the search of new source will be undertaken. New sources may be harder to find or more expensive to develop.

Dug wells

In rural areas, dug wells are a very common method of providing new water. Linings are recommended for dug wells to prolong well life and to reduce contamination. The casing or lining should rise at least one meter above ground level. This reduces the amount of contaminated water spilling back from the ground surface. The well should be covered and the water removed by hand pump, rather than by expensive and hard-to-repair motorized pump. In case of a simple bucket mechanism, the bucket should be part of the well so that people do not use their own containers, which may be contaminated, to dip water.

A problem common to all types of wells is seepage of contaminated water back into the source. Even the best casings cannot prevent all seepage, so methods to reduce spillage or seepage must be devised. Wells should be surrounded by sloping concrete aprons with drainage furrows. Water spilled at the well will then be directed away rather than back toward the casing. Trenches of loose gravel around the edge of the apron will eliminate puddles which encourage snail or insect breeding. Layers of clay mixed with water puddled around the casing will also reduce seepage into the well.

To keep livestock away from wells, water should be carried by conduits to troughs or holding tanks some distant away. Gravel beneath and around the trough and tanks

eliminates standing water. People should do their laundry or should bathe away from the well by the addition of a cement laundry or bathing area at some 25 m from the well. Gravel drains should also be included.

Open reservoirs

Open reservoirs can serve as livestock watering areas. They are useful in recharging aquifers in order to raise the water table and to refill dug wells. On the other hand evaporation is excessive and health risks are serious.

Sand reservoirs

In arid regions sand reservoirs can be constructed to provide new sources of water. A low barrier can be built across seasonal streams. If the sediment load of the stream is sand, it will settle behind the barrier. The dam can be increased in the next years. Water will remain in the spaces between the sand grains and can be tapped with drilled wells. Sand reservoirs can hold a great deal of water without expensive loss from evaporation and they do not provide habitats for disease vectors.

4.2.6. Operation and maintenance

Improving or creating water supplies is gratifying. Without ensuring effective maintenance however, the water supply may quickly return to pre-project levels. Plans and organization for operation and maintenance should be established before the project begins. Community support and acceptance of responsibility for the project are as crucial to maintenance as to development. Water development projects in which villagers have been assigned or elected as titled caretakers or watchmen trained in operation and maintenance have had great success. A community organization to "care for the water" can benefit water development projects. Effective water development projects will involve development of new skills and experience in working with metals, masonry, eventually water pumps and in preventative maintenance where appropriate. This will contribute to sustaining the project after the departure of the development team.

Local technology should be the basis of the project. If the project depends on outside skills or foreign parts, it will be only as good as the availability of those goods or services. Before accepting a pump or other mechanical device, connections should be made to be sure that the replacement parts are available and repairs can be made by members of the community.

5. Soil erosion

Erosion is the displacement of soil materials on the ground surface by the action of moving water on the ground surface or wind, which causes respectively water erosion or wind erosion.

5.1. Water erosion

Moving water has a certain amount of kinetic energy allowing it to disturb the soil components and to transport those soil particles over varying distances. The study of erosion necessarily involves looking at all the places where moving water is in contact with the ground. Soil erosion represents a reduction in land assets. The soil materials carried away are lost for ever.

Three ways in which water moves are essential for erosion analyze:

1. Splash or the beating action of raindrops on the ground;
2. Infiltration or water moving in the ground;
3. Runoff or water moving on the ground surface.

5.1.1. Splash and crushing over

When a drop of water falls from the sky, it acquires kinetic energy in proportion to the height of its fall and transmits this energy to the ground at the moment of impact. The impact of raindrops on small clods of soil may be compared to that of a sledge hammer striking a stone.

Splash is the first step in land erosion because it disturbs and sorts the soil:

- the heavy soil parts such as gravel and coarse sand are subjected to the beating of the raindrops without being moved;
- the fine parts composed of clay and silt are picked up by the water which rebounces and they are deposited again on the ground surface;
- when clay-humus aggregates from the soil structure, splash break them up into their component particles.

The moving, sorting and breaking-up effect is in proportion to the energy given off by the raindrops. Consequently, rain disturbs the soil all the more when the drops are heavy and frequent and fall from a great height.

The drops falling on the bare ground split up into droplets which rebound after they have picked up silt, clay and mineral salts. The greater the energy of the splash, the greater the wash load. The splashing droplets fall on the ground again and form a sheet of water. The lie of the land and soil structure at the place of the fall determine the water movements which follow: runoff, infiltration or stagnation and their possible consequences: erosion, soil clogging or leaching.

When the soil parts are sorted by splash, the finest grains work their way into soil pores, forming a sort of clay cement which hardens as it dries. In some cases, the top three or four millimeters of soil, sometimes more, form a crusted layer or hard crust. That is, a compacted layer, clogged up by beating rain.

The presence of clay and silt on the ground surface makes the crusted soil more compact and impermeable. When the soil is composed of sand and gravel, the beating raindrops merely shake the sand grains. The water infiltrates because there is not enough clay to fill the pores. This is a free-draining soil. When the soil is clayey-sandy, the beating rain makes the pores clog and leads to the formation of a clay crust which forces the water to runoff rather than to infiltrate.

5.1.2. Infiltration and soil clogging

A clogged soil is a soil with its pores full of fine materials, mainly clay, which impede water flow.

The soil or the subsoil may be clogged for many reasons and at many levels:

- The soil pores may be clogged in the first few millimeters or centimeters, on the ground surface. This happens when the soil is crusted over. This type of clogging causes runoff or flooding. From the farmer's point of view, soil crusted on the surface needs to be tilled by hoeing or plowing in order to break up the crust and re-open the soil pores.
- The soil pores may also be clogged several tens of centimeters below the surface. This may be as a result of the displacement of clay grains carried down by water percolating through the soil, or by chemical transformations. On level ground in wet regions, this type of clogging gives rise to the formation of swamps: water stagnating in the top soil layers can only escape by evapotranspiration or by lateral flow. This type of clogging is sometimes corrected by subsoiling.
- The soil may also be clogged at a depth of many meters, even down to the subsoil. Well diggers sometimes come across this type of soil formation as they dig in search of water tables. Near the ground surface, they find porous material through which water percolates. Then they meet impermeable clay on top of which , and in which groundwater accumulates.

5.1.3. Runoff and erosion

If the sheet of water deposited by the rain is not absorbed at once into the ground, it starts to flow along the slope and runoff follows. The flow of runoff water builds up kinetic energy in proportion to its velocity and this energy is able to move soil grains. The greater the flow and the higher its velocity, the greater the volume of materials transported.

Runoff must be analyzed and understood before control is attempted. There are many kinds of runoff and erosion.

5.1.3.1. Sheet runoff

Sheet runoff is the result of water beating the ground surface, making it almost impermeable and then running off slowly in large sheets. This type of runoff occurs on land sloping very gently.

The force of water is slight in the case of sheet erosion on gently sloping ground. It transports only the finest clay elements which it picks up at the time of splash and the lightest materials such as small organic waste and humus. Nevertheless, these elements are essential for soil fertility.

Sheet erosion is not spectacular but it is insidious and very destructive. Some areas, between 1 and 3 millimeters of soil are scraped off each year. Scraped soil is a soil from which sheet runoff has removed the uppermost layer. After a few rain seasons, gravel begins to accumulate. This particles may combine to form a completely impermeable hardpan. Vast stretches of land are lost in this way.

5.1.3.2. Gully erosion

The sheets of runoff water gradually collect in gullies on sloping ground.

As the slope gets steeper, the water moves faster, and cracks and breaches may form. The water falling in a little stream into the crack acquires more force and begins to undermine the slope. This is the beginning of regressive erosion.

The spot where a slope is breached marks the start of ravine erosion.

Water from the gullies continues to flow down the steepest slopes and combines to form larger and larger channels.

5.1.3.3. Runoff in ravines

A ravine is a deep narrow water passage with torrential flow. The bed of a ravine is usually steep-sided and its banks are roughly hewn by the passage of runoff water.

The origin of a ravine can always be traced to one or several obvious breaches in the slope. The breaches on the terrain are constantly moving back up the slope. This type of erosion is called regressive erosion because it tends to move backwards.

5.2. Principles of erosion control

The principles of erosion control are:

- protect the soil from rain damage;
- retain water where it falls;

- create infiltration routes;
- fight erosion at its source;
- channel and control runoff water;
- force runoff water to deposit its load.

5.2.1. Protect the soil from rain damage

Erosion first appears in the form of splash which leads to the formation of a hard, impermeable soil layer. If the ground is protected by any kind of cover, this absorbs the impact of the raindrops and the water reaching the ground surface no longer has the force to sort the soil parts.

There are many ways of applying the principle of soil cover:
- not denuding the soil needlessly;
- maintaining permanent cover, for example, by interplanting trees with seasonal crops;
- planning the sowing season in such a way that soil cover by young plants is speeded up;
- using a variety of natural or artificial mulches.

5.2.2. Retain water where it falls

This principle should be put into practice on land where there is no risk of waterlogging, for example, on dry land, or on free-draining or well-drained soils.

Two practices must be distinguished:
- farming practices which have to be repeated every year;
- land works planned to last for several years or permanently.

5.2.3. Create infiltration routes

Runoff control goes hand in hand with the improvement of soil porosity.

There are 3 ways to create infiltration routes:
- working the soil to give it a cloddy structure;
- adding organic matter to the soil to encourage the formation of a crumb structure. The organic matter is transformed into humus which, combined with clay, forms the clay-humus complex of the clods and crumbs and stabilizes them;
- creating cracks and tunnels in the rooted layers to encourage soil life and especially root and fauna life.

5.2.4. Control runoff at its source.

As the volume of runoff flow and its velocity increase, the water generates more kinetic energy and its erosive capacity rises. Hence is the need to control runoff before it acquires force. Several small successive improvements are often more effective and cheaper than one large work.

5.2.5. Channel runoff water

Runoff need not always to be prevented. On the contrary, in some cases, the water must be drained off in such a way that the kinetic energy of water flow is curbed and cannot lead to erosion or to regressive erosion, in particular.

For example, runoff water can be channeled towards pools, birkas, using meandering drains. A drainage layout with loops and turns lessens the incline and therefore the water velocity. In other cases, falls or stone reinforcements should be needed.

Every aspect of water inlet and outlet to and from the plots to be protected must be studied. How should the water be controlled as it approaches the land to be protected? How and where should the water leaving the same land be directed without causing problems of erosion in the plots lower down?

5.2.6. Force runoff water to deposit its load

As water gathers speed, it picks up larger and larger material. On the other hand, as water slows down, it gradually deposits its load, beginning with the heaviest elements. In consequence, erosion control necessarily implies the slowing down of runoff water.

There are many ways of slowing down charged water:
- lessening the slope and preventing the runoff water from gathering speed;
- barring the way so that the water is forced to stagnate in a place where it can infiltrate;
- letting the water trickle through and slowing down flow at the same time.

6. Watershed management

"Watershed management is the process of guiding and organizing land and other resources used on a watershed to provide desired goods and services without affecting adversely soil and water resources. Embedded in this concept is the recognition of the interrelationships among land use, soil, and water, and the linkages between upland and downstream areas."[10]

Strictly speaking, a watershed is a topographically delineated area that is drained by a single water course system. The watershed is a functional unit established by physical relationships where upstream land use can incite a chain of environmental impacts affecting downstream areas. Watersheds hold multiple, interconnected natural resources: soil, water and vegetation. Impact on one resource invariably affects the status of others.

[10] Cfr. Brooks - 1990 - Landholder Cooperation for Sustainable Upland Watershed - University of Minnesota.

"Watershed management differs from forestry, agriculture and water development activities because it explicitly acknowledges and embraces the physical linkages between these resources. These physical relationships only become an issue when individuals have vested interests in a watershed or a portion of watershed (when it is populated or valued by external agents). These vested interests are separated by political boundaries or institutional arrangements which normally do not correspond to the topographic limits of watersheds. The trans-boundary water flow is essentially an asymmetrical externality, and can be either positive (adding to the value of downstream areas) or negative (decreasing to the value of downstream areas)."[11]

Examples of positives trans-boundary externalities which derive from upstream watershed treatments include regulated water flow which reduces crop damage, sufficient supplies of irrigation water, improved water quality, and decreased sediment loads.
Examples of negative trans-boundary externalities include: sediment, unimpeded surface water flow which causes sheet and gully erosion, unregulated storm flows, reduction of downstream flow due to diversion of water upstream, floods, mass wasting, and polluted water of inadequate or dangerous quality.

Landholder exposure to externalities is predominantly a function of their location in the watershed. Most of the upstream landholders are not impacted by the land use of others. Midstream landholders are impacted by upstream actions, and the holders of the most downstream position are the most vulnerable of all.

When assessing the potential for watershed management, two key elements should be considered:

1) the vested interests are asymmetrically interdependent (upstream activity affects downstream value); and
2) a degree of uncertainty (behavior and physical) exists as to the impact of this interdependence (downstream owners are uncertain of upstream owner behavior and of the physical impacts of that behavior). Different actors are also exposed to different uncertainty and risks dependent upon relative position in the watershed and nature of the resources held.

Watershed protection or improvement projects are long term projects. Their benefits are indistinct or accrue to future generations. Therefore, these projects are less likely to receive enthusiastic support unless an education program can persuade the community of their present importance and future value.

The protection of the watershed is often neglected because the value is not readily apparent. Watershed protection is a long-term investment that only gradually improves

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[11] Cfr. Brooks - 1990 - Landholder Cooperation for Sustainable Upland Watershed - University of Minnesota.

the water supply. Many current water problems are the result of poor watershed management in the not-so-distant past.

The supply of water available to a community can be increased by protecting watersheds in order to maximize water output and avoid wide fluctuations.

Water development projects should include strategies for protection of watersheds by some form of erosion control which will and encourage runoff infiltration.
Erosion control methods fall into two main types:

1) Mechanical methods based on physical works affecting the land, ravines, valley bottoms and hillsides which includes slope treatment and landslide prevention measures and gully control. The works consists of aligning stones, stone bunds, earth bunds, terracing, check dams, building flexible gabion structures, concrete construction, ditches, dikes, and microcatcments.
2) Biological methods, so called because they are based on vegetative and soil treatment practices. The natural ecosystem prevents excessive runoff and erosion by providing a vegetation buffer between the rain and soil. In order to maintain this natural protection, plant cover must be retained in water collection areas or areas adjacent to water supplies. The vegetation can consist of a mixture of grasses, shrubs and trees. The first step in developing this protection is through reforestation projects. Agricultural technologies can improve water retention and infiltration by plowing following the contour lines, improving the soil structure by adding manure and using of the appropriate fertilizers.

In order to protect watersheds it is not necessary to create inviolate preserves, but rather a management area. Plants or wood products can be harvested as long as the natural rate of replacement is equal to or greater than the amount harvested. However, the management area should be well-defined and should receive higher levels of protection than areas that do not contribute to the water supply.

The rewards of a well-executed watershed management program are not dramatic. Unless records are kept, the improvements are so subtle that villagers will not see the results nor remember the conditions before the project began. Like most environmental change, increments are small and spread over long periods but they can produce significant results. Efforts to protect watersheds are one of the best investments for the future.

The following table indicates runoff and soil losses in Tigray under different land use types, on a 9% land slope.[12]

[12] Source : Getachew - 1985 - Mekelle.

Treatments	Runoff (m^3/ha/year)	Soil loss (ton/ha/year)
Grass cover	257	2.5
Teff cover	880	8.8
Barley cover	1,255	15.9
Bare fallow	1,094	17.9

Tigray's regional government is determined to prevent further degradation of the natural resources, particularly the soil and vegetation cover. The entire rural community is mobilized for about a month every year for as well as forestry development activities. Tigray's soil and water conservation activities, during the last 4 years are as follows:[13]

Type of work	Measure	Area
Terrace on arable land	ha	384,000
Check dam	km	2,000
Land re-afforest	ha	98,000
Natural forest	ha	130,000
Area closure	ha	77,000

7. Conclusion

Increasing or improving water supplies is a difficult and expensive task. The United Nations' goal of providing safe water for everyone by 1990 was never achieved. But to improve the daily lives of those people to whom 38 liters per day would be a luxury is an achievement not to be measured in numbers alone. Small steps with environmentally sound water development projects on village level undertaken in thousands of villages are far more effective than environmentally unsound gigantic projects at a few sites.

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[13] Source: Overview of Agricultural Development of Tigray: Existing efforts and future prospects - Berhane Hailu - Tigray Bureau of Agriculture and Natural Resources Development

Data source

1. *Ethiopian Mapping Authority produces aerial pictures, topographical maps on scale 1/250,000 and 1/50,000.*
2. *National Meteorological Service provides climatological data.*
3. *IAR (Institute of Agricultural Research) has done some research on irrigation*
4. *FAO library has a large documentation on soil water conservation, irrigation, environmental related works*

Bibliography

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2. *Using Environmental Indicators to Promote Environmentally, Ecologically and Socially-Sustainable Resource Use - Mike D. Young & Sarah A. Ryan - USAID - January 1995;*
3. *Landholder Cooperation for Sustainable Upland Watershed - Thomas A. White - University of Minnesota - July 1992;*
4. *Environmental Guidelines for Small-Scale Activities in Africa - Bureau of Africa - USAID - June 1996;*
5. *Watershed Management Field Manual - FAO - 1989;*
6. *Environmentally Sound Small-Scale Water Projects - Gus Tillman - VITA - 1981;*
7. *Using Water Resources - VITA - 1978;*
8. *Ways of Water: Run-off, Irrigation and Drainage - H. Dupriez - P. De Leener - CTA - 1992;*
9. *Vanishing Land and Water: Soil and Water Conservation in dry lands Jean.Louis. Chleq - Hugues. Dupriez - CTA - 1988.*

4. Environmentally-Sound Design: Principles and Practice

Description/Objectives

This module will introduce resources you can use to ensure projects are designed, from the start, to avoid negative environmental consequences. It also covers how these principles can be incorporated into USAID activity, project, or program design process, and reviews briefly the principal issues by sector, such as:

- domestic water supply and sanitation;
- water supply development;
- resettlement;
- development of new agricultural lands and agricultural mechanization;
- road building and improvement;
- natural resource management;
- ecotourism;
- health care facilities;
- solid and hazardous waste management and projects involving the procurement or use of pesticides.

Readings

Module Backgrounder

Sectoral Sections from *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities*, USAID, AFR/SD/PSGE, 1996.

Annex 1 - "Excerpts from the electronic copy of *The World Bank Environmental Assessment Sourcebook: Volume I* on Environmental Sustainability (1996)", based on Annexes 1-5, pp. 51-53.

Useful Reference Materials

<u>The Coordination in Development (CODEL)/Volunteers in Technical Assistance (VITA) Series</u>

Altieri, Miguel. 1988. *Environmentally Sound Small Scale Agricultural Projects*. Revised edition. Guidelines for planning, project design, and implementation of agriculture projects with a community development emphasis. Includes technical and ecological information. Aimed toward the general user.

Bassan, Elizabeth and Wood, Timothy. 1985. *Environmentally Sound Small Scale Energy Projects.* Guidelines for planning. project design and implementation of energy projects. Addresses how to

use natural resources for energy in a way that maintains ecological well-being. Aimed toward the general user.

Frolliott, Peter and Thames, John. 1983. *Environmentally Sound Small Scale Forestry Projects.* Guidelines for planning, project design, and implementation of forestry and agroforestry projects. Meant for the general practitioner, with an emphasis on community development.

Jacobs, Linda. 1986. *Environmentally Sound Small-Scale Livestock Projects.* Guidelines for planning, project design, and implementation of livestock and range management projects. Included is material on waste management, health, and husbandry.

Tillman, Gus. 1981. *Environmentally Sound Small Scale Water Projects.* Guidelines for planning, project design, and implementation of water resource development projects. Suggests low-cost techniques to avoid adverse impacts of water development.

> **To order CODEL/VITA documents**: VITA Publications, PO Box 12028, Arlington, VA, 22209. (703) 435-3245. No fax orders. $12.95 including shipping (USA), 15.95 (overseas surface), and 19.75 (airmail).

World Bank Environmental Assessment Sourcebook (with Updates). 1993. Washington, D.C. Available as a software package from the Bank, this document is filled with a wealth of information on environmental screening, assessment, monitoring and mitigation.

Relevant chapters for this session include:

> *Chapter 1: Update: Public Involvement in Environmental Assessment*
>
> *Chapter 3: Social and Cultural Issues in Environmental Review*
>
> *Chapter 5: Strengthening Local Capabilities and Institutions*

MODULE BACKGROUNDER
Environmentally-Sound Design

1. Introduction

USAID's Bureau for Africa has developed a set of *Environmental Guidelines for Small-Scale Activities in Africa* which are used as the primary reference in this session to discuss the process of environmentally sound design, before we deal with the specifics of meeting USAID environmental procedures and requirements.

1.1. Some Definitions[1]

- **Impacts**: Consequences which occur because of a problem, either direct immediate impacts or more indirect secondary impacts and/or cumulative impacts.[2] These include impacts on public health, environmental quality, and natural resources, as well as on other human activity.

- **Causes**: Factors which produce or contribute to the problem. Some causes are immediate direct causes and others are root causes, somewhat removed in time and space from the problem itself.

- **Mitigative Measures**: Actions which can be taken to mitigate (avoid, redress, ameliorate or compensate for) the problem.[3] Examples: Siting decisions, environmentally responsible design of physical facilities, training programs, monitoring and other actions.

Design: Project or program formulation from initial concept development through development of detailed strategies and plans for implementation.

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1. Wyatt, A., Hogrewe, W., and E. Brantly, *Environmental Guidelines for PVOs and NGOs: Potable Water and Sanitation Projects, Water and Sanitation for Health Project*, Prepared for the USAID Mission to the Dominican Republic Under WASH Task No. 383, Washington, D.C., November 1992, pp. 10-11

2. Cumulative impacts are particularly important under small-scale PVO/NGO activities.

3. The U.S. Council on Environmental Quality defines mitigation as: avoiding impact altogether by not taking a certain action or parts of an action; minimizing impact by limiting the degree of magnitude of the action; rectifying the impact by repair, rehabilitation, or restoration of the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; or compensating for the impact by replacing or providing substitute resources or environments.

1.2. Background

Through its activities, USAID aims both to protect the environment and foster sustainable development. Host governments, contractors, PVOs/NGOs and USAID staff can play an important role in pursuit of this goal as they implement USAID-funded projects and programs. They can do so by:

(i) integrating environmental considerations early in program and project designs;

(ii) ensuring local and community participation in identifying potential environmental problems both in design and throughout implementation;

(iii) taking into account the potential effects of income and population growth;

(iv) understanding fully the effects on the environment associated with varying scale and intensity of activities;

(v) understanding the effects of environment/resource constraints on long-term environmental and economic sustainability;

(vi) anticipating potential impacts of drought, famine or civil strife and related emergency assistance, including food aid;

(vii) providing for training in environmental and natural resource management, where appropriate;

(viii) providing for effective environmental monitoring and evaluation;

(ix) safeguarding the long-term viability of implemented activities with sound natural resource management and mitigation of identified environmental problems; and

(x) weighing long-term economic costs and benefits of environmental management among 'pristine' and a range of 'less than perfect' scenarios.

1.3. Learning from Experience - Two Examples

Box 1. From "River basin Projects in Africa" Environment 31 (2): 4-9; 27-32 March 1989) by Thayer Scudder

The narrow focus of most planning studies (and of most development) on river basins as hydrological systems has tended to restrict development, on the one hand, to water resource management, and , on the other hand, to national (rather than local) accounting of electricity generation and crop production on large dam projects. National accounting of project benefits allows the costs to riverine populations to be discounted and ignored. (page 9)

Recently, irrigation has been receiving more and more emphasis as a secondary objective. However, the priority given to medium- and large-scale irrigation projects is difficult to justify on grounds either of funding costs or of postconstruction economic repercussions...Even by double cropping high value crops, it is not possible to pay off such costs; frequently projects do not even cover operating costs. Although some families living on irrigated settlements may be better off than they were before the project, many do not move beyond subsistence. (Page 27)

On balance, the impacts of dam construction on downstream riverine habitats have been negative. The elimination of downstream flooding has devastated many local production systems. Riverine habitats for flood water farming and livestock management are adversely affected, and fisheries' productivity and hence fish landings for consumption and commercial purposes are greatly reduced.

The most detailed analysis of the adverse effects of dam construction on downriver users deals with the Kaniji, Bakolor and Tiga dams in northern Nigeria. In a study area extending 200 kilometers downstream from Kainji, catches of fish and dry season harvests from flood plains declined over 50 percent after construction of the dam. Similar decreases in fish landings were reported further downriver, and loses in yam production of approximately one hundred thousand tons were reported in the lower Anambra basis of eastern Nigeria. Following the completion of the Bakolori Dam, fish catches and dry season harvests also decreased. Farmers had to leave home to find work in the cities or on other farms as migrant laborers to support their families... Following completion of the Tiga Dam, decreases in fish landing and in flood plain harvests were reported to exceed those recorded during the drought from 1972 to 1974. (Page 27-28)

The impacts on the people living in the basins of future reservoirs are no less devastating than those on populations downstream. Throughout Africa, the resettlement of riverine communities to lands outside of future reservoirs has been the least satisfactory component associated with dam construction...Over the long term, resettlement is apt to lead to lower living standards and environmental degradation because of the difficulty of planning and implementing viable production systems in new, frequently problem-prone habitats. (Page 28)

Box 2. IUCN Review of Southern Okavango Integrated Water Development Project, IUCN Wetlands Programme (1992)

The Southern Okavango Integrated Water Development Project (SOIWDP) was developed for the Government of Botswana's Department of Water Affairs by the Snowy Mountains Engineering Corporation (SMEC)....Focusing on the lower portion of the Okavango Delta and the Boteti River, the SOIWDP was intended to achieve a set of broad goals. These included improved utilization of land and water resources, increased food production, and creation of employment opportunities and a raised living standard for the people of Ngamiland District and Boteti Sub District. (Exec. Sum. p.1)

The goals for the SOIWDP were to be achieved by an integrated scheme of surface water development requiring an enhancement of Boro distributary outflows in the lower portion of the Okavango Delta by channelization and construction of three reservoirs...The effect of channel excavation and bunding would have been to reduce the area flooded on a seasonal basis, thereby reducing evapotranspiration from those areas and increasing outflow. A programme of reseeding and transplanting of indigenous species was proposed with the intention of ensuring the revegetation of impacted areas and reducing the environmental impacts...increased flow from the Boro was to be stored in three reservoirs..these reservoirs were designed to provide storage for..water supply, commercial irrigation and flood plain agriculture. Other intended benefits included a more reliable flow to Lake Ngami and - in the form of the Sukwane Reservoir - a partial barrier between wildlife in the Makgadikgadi Pans Game Reserve and villages on the west bank.
When the contractor began mobilisation in November 1990, strong opposition to the Project arose. Following a major meeting to solicit the views of the local community in Maun in January 1991, the Government - showing its responsiveness to local concerns- suspended the project and agreed to seek further review. To the best of IUCN's knowledge this was a precedent setting decision, being the first time that a national government has asked for an independent review of a major water development project by an international conservation organization. (Executive Summary - page 2)

When released publicly on May 21st 1992, the IUCN Review Team's Draft Final Report recommended that the Southern Okavango Integrated Water Development Project be terminated. Emphasizing local opposition, the Government of Botswana announced later that day that the SOIWDP was being canceled. IUCN's recommendation for termination was based on a number of deficiencies and the availability of a more effective and less expensive alternative.

Implementation would have been at the expense of the village population. With a low rate of return, the SOIWDP was justified on humanitarian rather than economic grounds because of the benefits it was supposed to bring to the village population within the impact region. Analysis by the IUCN Review Team, however, leads to the conclusion that the low income rural major (including resident communities along the Boteti) would, on balance, have been worse off if the proposed scheme had gone ahead.... (page 4)

One of our major criticisms of the SOIWDP is that parts of the design were based limited data of questionable accuracy. (page 6)

One of the claimed benefits for the Sukwane Reservoir was the fact that it would act as a barrier between the Makgadikgadi Pans Game Reserve and the cattle on the other side of the Boteti. We calculated the open length on a month-by month basis which showed that in three years out of four the open length is around 20 km in June and July and in half of the years the open length is over 30 km in those two months and still 20 km in August. In one year in four the open length is over 30 km the whole year and reaches up to 60 km. The length of the river along the game reserve is around 70 km. As the reservoir tends to be drawn down at times of the year when animals are likely to be attracted to the river for grazing, the benefit of the reservoir barrier between cattle and game seems unlikely to be a major one. (page 10)

Box 2. IUCN Review of Southern Okavango Integrated Water Development (continued)

Another claimed benefit was that releases from the Maun Reservoir would lead to some regeneration of Lake Ngami with potential benefits for bird populations. It was estimated that in years when there was no natural inflow the release would create a lake of 16 km^2 whose life would be extended by rainfall. Initial analysis showed that this was unlikely; evaporation loss during the month when the release was made would not allow a lake of 16 km to form, even ignoring losses from seepage, and that there were very few months where rainfall was larger than evaporation (p.10). While there can be no question that villagers have over-emphasized the impact of historic interventions on their lives (and in the process have downplayed the importance of drought and an increasing human and livestock population), their analysis can be shown to have validity in some cases, examples being dredging and bunding the lower Boro in the 1970s and creation of the Mopipi Reservoir and diversion of Boteti waters into that reservoir.

The conclusions drawn from a review and assessment of the SOIWDP benefits are that, while project benefits have been examined, they are excessively optimistic and flawed by conceptual errors. The review of disbenefits finds a striking asymmetry in accounting for project costs and benefits. All of the benefits which could conceivably be quantified were quantified; many of the costs which could have been quantified were left unquantified (p.12). Historically, compensation and resettlement have been one of the least satisfactory aspects of water resource development projects, with a majority of those compensated and relocated apt to be made worse off as a result of the project. The IUCN SOIWDP Review has concluded that implementation of the SOIWDP will have similar results (p.12).

Realistically, artificial revegetation of the dredged length of the Boro River could be achieved only by rhizome planting in the river bed and banks, and by complete control over water level and flow for over a year. At 5,000 rhizomes/ha the total aquatic bed vegetation required for revegetation of 600 ha would be 3 million plants. Clearly, the logistics of acquiring, transporting and transplanting millions of plants would be substantial. Presumably the impact of obtaining such planting material from natural populations outside the Boro River area would also be substantial. Even if rhizomes were planted, transplanting-induced desiccation and shock require that the plants are supplied with water to the correct depth until the shoot and root systems are fully developed...IUCN believes that the SOIWDP has not shown that the proposed revegetation strategies would work. SMEC considered that most of the typical riparian woodland plants would survive adjacent to the full supply level in the reservoir, but that the more typically dryland species might be adversely affected. However, the impact of changes in soil chemistry has been entirely overlooked in the study. Based upon analysis of the structure of riparian soils along the proposed reservoirs and of the woodland community structure, IUCN concludes that the probable impact of raising the water table will be to largely destroy the riparian woodland.

In addition to analyzing the project deficiencies in detail, {IUCN analyzed] why a project which has been so carefully planned over a ten year period has been found to be so deficient... Implicit with the Terms of Reference for the SOIWDP is an untenable assumption; namely that the provision of more potable water in a semi-arid habitat is by definition a good thing. While the SOIWDP would have provided more surface water for the village sector in the SOIWDP impact region...analysis has shown that associated reductions in the availability of floodplain fields and in grazing would have lowered the living standards of a majority of the rural population contrary to projection intentions....The Terms of the Reference for the SOIWDP were too restrictive and therefore incompatible with the broad goals that the SOIWDP was expected to meet. For example, **insufficient attention was paid to alternatives** [emphasis supplied] in project design.... The SOIWDP was planned as an integrated rural and urban development project. Such a project requires the continuity of an interdisciplinary team. While IUCN found the engineering components...to be of a high professional standard...during a ten year period less social science expertise was utilized than fielded by IUCN during its one year assessment...Institutional weaknesses (including inadequate continuity of consultation) restricted cooperation with other government institutions and ...district residents.

2. Understanding the Policy Context and Enabling Conditions

The following enabling conditions facilitate sustainable environmental management:

(1) a legal and policy framework enabling sustainable private-sector initiatives;
(2) institutions and human resources to apply laws, policies, and information;
(3) clearly defined national objectives;
(4) information regarding national environmental resources (e.g., assessments or management plans); and
(5) appropriate environmental practices.

In developing countries and those in transition, agricultural growth is important for overall economic growth and the alleviation of poverty and food insecurity. Macroeconomic, trade and sector policies are important for agricultural growth and sustainability.

Resource tenure and property rights often influence patterns of natural resource management or mismanagement. Such rights vary among cultures and are frequently gender-specific. Understanding the distribution of these rights among states, communities, families, and individuals is essential to making informed decisions that promote and encourage sustainable use of the resources base.

To address medium- and longer-term impacts of development activities, experience has shown that the most effective and least management-intensive approach is to build in capacity through policy reform, institutional support and strengthening of the NGO/PVO community, along with the participation and empowerment of the public through the political process. The object is to let Africans take charge of the environmental movement, directly at the grass roots level. This will help evoke political support for environmental and natural resources management as governmental priority.

3. Ensure Community Participation

Promoting genuine and effective participation of the populations involved or influenced by development activities is the shared responsibility of all parties.

Successful activities, especially agricultural & natural resource programs and projects, should involve local stakeholders from the beginning of the design process because:

- they must live with the environmental impacts of activities;
- by participating in project design, implementation, and monitoring, local stakeholders have a sense of ownership and responsibility, and a clear understanding of objectives and anticipated outcomes;
- their full participation serves as an incentive to identify and mitigate any adverse environmental impacts;

- it is important that they have the understanding and capacity to adapt activities to future change after donor support ceases;

- their detailed knowledge of local natural resources and environmental conditions is often critical in anticipating and identifying potential impacts;

- they may have prior experience with particular types of activities (either traditionally or through past development projects), and can therefore foresee possible negative impacts with which they have had previous experience; and

- they are in the best position to monitor long-term environmental effects of project activities. Local communities are the long-term residents of the area, and will be best able to identify and address adverse impacts after donor assistance ends.

Unfortunately, ensuring local participation remains a poorly understood process. How to go about gathering information and promoting local, community or village involvement is rarely clear or easy. With each program or project, experienced individuals need to work with various techniques until the right ingredients are found which allow fruitful participation to happen. The recipe inevitably varies from activity to activity depending on local interests and conditions. For rural stakeholders, Participatory Rural Appraisal and Rapid Rural Appraisal are two techniques often employed in design. However, methods for continuous monitoring, evaluation and adjustment based on feedback, also become very important to effective implementation of long-term development activities.

Participatory techniques and methods need to be more widely available to NGOs through training, and the use of these tools should be further developed and consistently applied. An example is the application of Participatory Rural Appraisal techniques to the development of the priority issues to be addressed in the Andasibe-Mantadia integrated conservation and development project in Madagascar.

4. Consider Gender and Equity Perspectives

Women, as important players in food production, natural resource management, and economic systems, constitute a major stakeholder group. In many rural communities women and children constitute over 3/4ths of the total population. They must be integrated into development projects as both participants and beneficiaries to meet the dual objectives of better resource management and improved community welfare.

As users and managers of the natural resource base, women have extensive knowledge of the environment and play a critical role in their communities, though their contribution may not always be obvious to outsiders. They often have indigenous knowledge unknown to men in the community, especially regarding such subjects as subsistence agriculture, woodfuel utilization, water availability and quality, gathered foods and certain medicines. This knowledge should be tapped during program and project planning sessions, as well as for input into design and implementation of activities, such as developing the scope for environmental assessment work.

Box 3. Namibia: Gender Factors in Natural Resource Management

Gender factors play a central role in natural resource management. The responsibility for monitoring and managing a given resource may fall along gender lines. For example, in Namibia some pastoralist women have begun to sell woven palm frond baskets, traditionally used to store milk, to tourists to generate income. In order to prevent harmful increases in consumption of palm leaves, tree counting and monitoring was transferred by conservationists to the male lineage heads of the community. Women traditionally controlled the rights over milk and its distribution, symbolized by the keeping of the milk in the palm frond baskets. With men now monitoring the trees from which the baskets were made, women began to feel their rights over milk distribution were under threat. They began to overharvest fronds from certain trees, killing some of them, to intentionally ignore the old way of managing palm trees. The lineage heads blamed the women as lazy, but the women explained their rationale for doing so. Once responsibility for the trees was returned to women, they continued to harvest fronds for baskets in the old way of cutting only a few from each tree, and the palms thrived. The women observed that it was in their interest to protect the resource from which they earned income.

Source: Adapted from Brown and Wyckoff-Baird, 1992.

5. Consider a Training Element for All Sector Activities

Environmental education and training should be important parts of projects in all sectors. Project planners and community participants alike need to be adequately trained to recognize how project activities can affect the environment in order to foresee their adverse impacts. They should be able to examine ways in which sound environmental management and sustainable development can occur simultaneously.

Education and training activities might include environmental education in schools, teacher awareness training, extension worker training, and even workshops for journalists (to promote public dialogue of environmental issues). Government agencies, even if not directly involved with a project, need to be informed in order to deal with any indirect effects of project activities. There are many potential ways to achieve this goal, and locally appropriate methods of doing so should be explored.

6. Identify Regional Lessons: Learning from Each Other

NGOs recognize the importance of increasing regional sharing and learning. Similar biological and socio-economic conditions often characterize each of Africa's geographical regions. For this reason, there may be opportunities to apply lessons learned in one country to others within a particular region. However, one NGO may sometimes be unaware that another NGO is conducting a similar implementation activity within a particular area or region. Regional coordination and the use of consistent field methodologies can facilitate the sharing of lessons learned regarding potential positive and negative environmental impacts associated with rural development implementation activities.

NGOs and PVOs with their collaborators need to create more mechanisms for inter-country exchanges. Building on existing models like the USAID NGO/PVO NRMS Project, ways can be found to cost-effectively access the work of colleagues tackling similar problems, and share experiences at the ground-level. Prime examples would be in the area of community-based natural resources management projects and integrated conservation and development projects.

7. Seek to Standardize Methods Among NGOs

The use of standardized field methodologies can ensure that lessons learned by one NGO can be used by others. Some examples of implementation activities that incorporate an array of field methodologies are socio-economic and biological surveys and management plan development.

8. Monitor and Evaluate: Towards Adaptive Program Implementation and Mitigation

Project budgets should identify funding sources and responsibility for monitoring and evaluation from the onset of project design. Monitoring should be seen as an opportunity to test assumptions, identify linkages, modify implementation activities, and share lessons learned locally and regionally. Monitoring must support basic management functions of the NGO. And special efforts are needed to reduce the typically passive role of the resource user community in this context. For example, monitoring and evaluation can be used as collaborative tools in a training and learning context.

An on-going monitoring process should be established as part of a project. This includes the gathering of environmental impact information during the project design, the initial environmental examination (see Section 4), environmental assessment activities, and project implementation.

Some flexibility and a learning curve need to be built into environmental programs, to accommodate the tremendous flux to be experienced in the development arena. While it makes sense initially to focus attention on implementing the existing program concept, the NGO should maintain some ability to change, since a directed activity focused only on the initial goal may encounter operational problems (of showing impact, managing activities, etc.) in future years. In particular, managers, need to be able to make adjustments and take mitigative steps to deal with unanticipated negative impacts.

9. Implications of Income Generation

Often, development activities increase income-earning opportunities for some members of a community and provide tangible short-term benefits. However, on some occasions greater income generation requires may have adverse social and environmental impacts. Examples:

- Increased community wealth may lead to a rise in market prices. Many individuals may be able to pay higher prices by using their new income, but the poorest of the poor may be even further marginalized;
- Increased income may result in purchase of land and cattle without regard to environmental carrying capacity;
- Increased income may result in greater solid waste production, and an increased accumulation of unrecycled materials;
- Groups benefiting from an income-generating scheme may be ones other than those targeted, e.g. district councils rather than farmer associations.

10. Sound Design of Integrated Conservation and Development Projects (ICDPs)[4]

For agriculture/natural resource management projects sound design can be fostered by applying biological and socio-economic criteria in site selection. Priority should be given to areas where:

1. A large proportion of target natural resources remains and the host government has an effective conservation policy;
2. High species richness and endemism[5] exists;
3. Conserving habitat in a project area assures conservation of a large number of species;
4. Government has been genuinely supporting efforts to preserve biodiversity in protected areas that are facing high population pressures; and
5. Use and threat to resources is weighed with the opportunity and costs of affecting change.

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4. Adapted from Brown and Wycoff-Baird, 1992.

5. Endemic: found only in a certain region.

Application of these criteria helps in identifying interventions where the chances of success are favorable. By setting a good example, one can establish the credibility of ICDPs and encourage their use elsewhere.

11. Food Aid and Natural Resource Management[6]

Food aid appears in many forms, from emergency relief to program food aid, including food for work (FFW). These forms of food aid are targeted at various beneficiary groups, and each form may have a different impact on the environment. Direct impacts may achieve the goals of assistance---to relieve starvation in a disaster setting or encourage soil restoration through FFW payments, for example. As relief and development are not mutually exclusive, food aid activities can involve components of both. Indirect impacts allow or cause people to change the way they use their environment, as a result of changes in household attitudes, motivations, and economies.

All links between food aid and sustainable natural resource management should be examined prior to and during implementation. The flow of food resources into a region and the mechanisms put in place to support that flow are also intended to improve the food security and economic strength of the beneficiaries. The arrival of food aid into a community can potentially alter the relationship between people and how they use the natural resource base. Potential effects include:

- shifts in crop and livestock production strategies;
- changes in local institutions that govern how the community interacts with its physical environment: land tenure arrangements, grazing regulations, etc.
- changes in seasonal and long-term migration patterns;
- altered wood gathering patterns; and
- reduced local seed production and utilization, resulting in a loss of genetic resources and biodiversity.

With program food aid and other forms of food assistance supporting development objectives, the following questions should be considered:

- Is program food aid necessary for the development of natural resource management in the host country, or indeed, for the development of the country?
- What are the costs and benefits of this food aid?
- Are there more cost-effective ways to achieve development?
- To what extent does food aid create local dependency on external resources and a loss of self-reliance?

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6. Adapted from Catterson, et al., 1993.

Food aid should be used to mitigate famine and protect the environment, but assistance should not be at the expense of undermining food security, self-reliance and resource management capacity of the beneficiaries. While sometimes a useful tool for relief and development, Food aid is not an ideal mode of project activity. Planners need to carefully consider if long-term sustainability of local communities is best served by food aid or by other development activities.

12. Summary

The process of environmentally sound design is summarized in Figure 4-1.

Sound natural resource management includes both environmental conservation and sustainable development; they are inseparable. USAID recognizes that sustained and broad-based economic growth is linked to responsible stewardship of the resource base. Effective development programs focus on this linkage, using locally-based, specific approaches. Coordination among donors, host governments, PVOs/NGOs, and other institutions is important to ensure policies are consistent regarding the environment, health, economics, and other issues.

Project and program success is enhanced by considering biological, social, and political criteria together early in design and throughout the implementation process. Activities are most likely to succeed in situations where:

- there is significant local participation and collaboration among stakeholders, especially at the grassroots level [Experience has demonstrated that effective development projects require negotiating a set of commonly shared perceptions and understanding between all key stakeholders. Establishing working relationships and processes for communication and decision-making with the involvement of all parties is critical. During the design phase, if it appears that conflict cannot be brokered or negotiated to the satisfaction of the different groups, the feasibility of the whole project should be questioned];

- the potential economic return to stakeholders is high;

- indigenous knowledge has been incorporated in the design and implementation of the activities [Experience has shown that incorporation of traditional or indigenous knowledge into project design leads to projects that are socially more sound. To do so, one must understand the rationale of indigenous resource management systems and indigenous peoples' perceptions of the mechanics of ecosystems and the role of intervening actors];

- local control exists over access to resources and there are effective institutions to set and enforce rules over use. The ability of local people to limit access by outsiders in the short and long-term is critical to effective resource management. If resource users do not have control over access, the most rational management strategy is to use the resource to the benefit of insiders before "outsiders" expropriate the resource. Maximizing local control must be encouraged and implemented within the context of all stakeholders' interests. This can be done through some form of co-management where project planners balance long-term collective interests. Institutional strengthening should be another component, applying techniques in areas such as participatory rural appraisal and ecological monitoring;

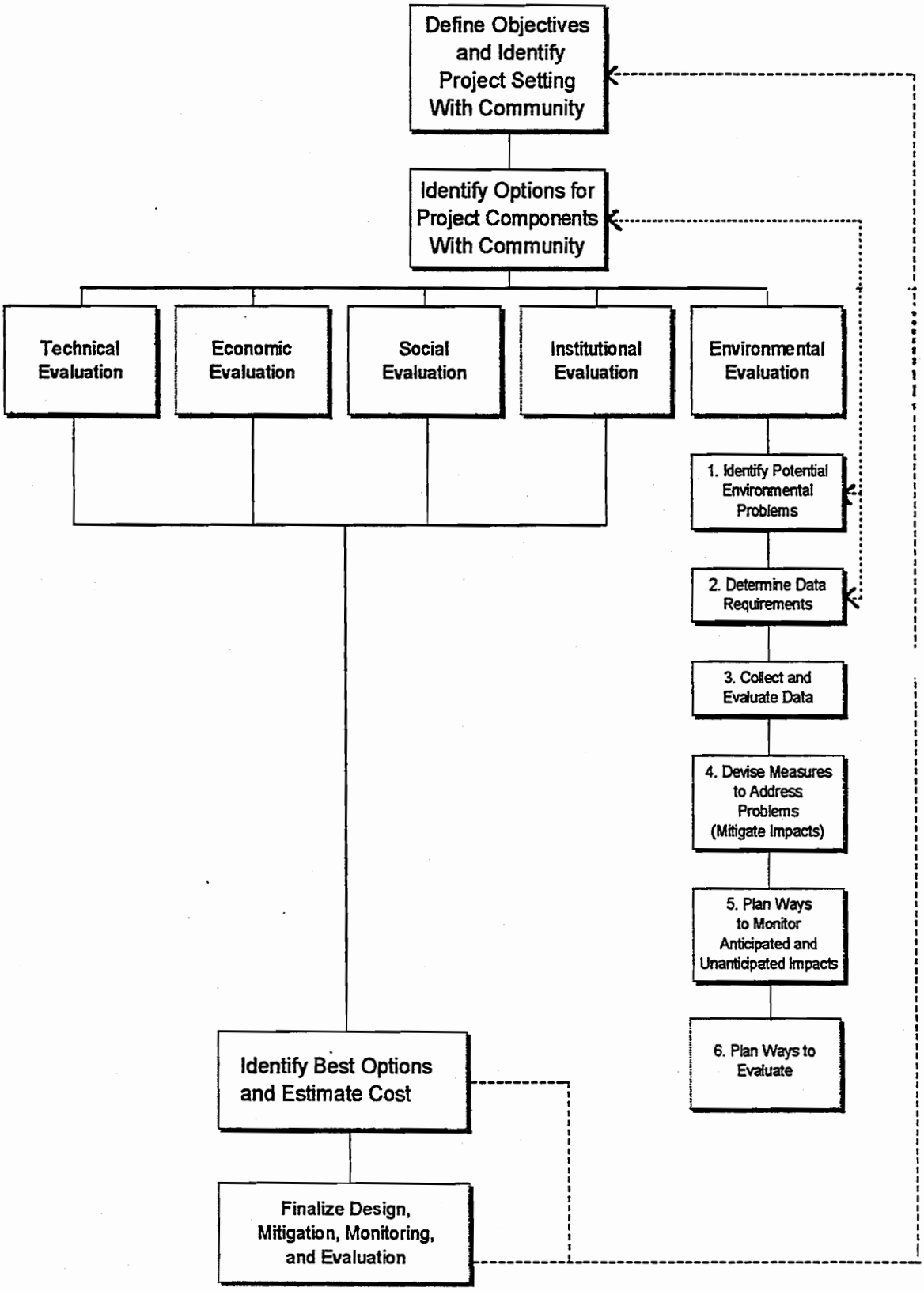
- the relationship between action and benefit to local populations is as direct as possible. All material benefits should be clearly tied to the conservation action, as perceived by the people themselves. Sometimes, linkages between development and conservation activities can be strengthened by directing the activities toward groups or individuals whose current actions threaten the protected area. Viable alternative economic opportunities must exist for individuals to adopt conservation behavior, particularly when the conservation activity requires the alteration of existing exploitative activities.

- the activity includes a conservation education component. Development and conservation activities frequently must be complemented with a conservation extension or education program that informs all parties of their responsibilities under the project, and the interrelationships of conservation and development;

- national policies and their potential impact on program and project implementation have been taken into account. Any design must consider the manner in which international, national, and local laws and policies affect both local resource-use patterns and management options available to resource users. From the outset, program and project planners need to consider the full range of issues both geographically and thematically that will affect project implementation, particularly those policies related to land development; and

long-term financial and economic viability have been assured. It is imperative that financial and economic analysis be done as part of any activity which requires any change in land use management. To become sustainable, resource users must be aware of the opportunity costs and potential benefits accruing to shifts in resource management strategies.

Process of Environmental Sound Design



Annex 1

Excerpts From The Electronic Copy of The World Bank Environmental Assessment SourceBook: Volume I On Environmental Sustainability[1]

In what follows the use of the terms "assimilative or regenerative capacity" should not be taken necessarily to imply that there is a discontinuous threshold of use intensity below which there is no effect on the ecosystem being used. Capacity may be thought of as a current level of a particular ecosystem service beyond which further use will cause unacceptable (e.g., cumulative, irreversible, excessive) degradation of the ecosystem and loss of its future services. Also capacity refers to the capacity of the relevant ecosystem, not to individual species in isolation. There are many difficulties in defining sustainable yield and sustainable use, just as there are many analogous difficulties in defining income.

But to answer the unavoidable question -- How much can we consume this year without reducing our capacity to produce next year? -- requires that we at least give a prudent rule of thumb.

Output Guide

Rule: Waste emissions from a project should be within the assimilative capacity of the local environment to absorb without unacceptable degradation of its future waste absorptive capacity or other important services.

Discussion: If each project obeyed this rule, then the sum of all projects, or the average project, would also conform to the rule. But the average or sum may obey the rule even though each project fails to, as long as there is compensation among project pairs or other combinations. Of course it is easier for earlier projects to meet this condition than for later ones added after assimilative capacities have been largely used up or even decreased. Once capacity has been reached a new project might be paired with an old one that is removed to make room for it, if the new one is more valuable than the old one. Alternatively the new project may be paired with another new project that makes room by absorbing the waste outputs of other projects up to the amount emitted by the new one. The pairing idea has been discussed by David Pearce, and is a variant of the "bubble concept". Under the "bubble concept" the total emissions for an area must be set collectively, but the market can allocate that total among competing uses by exchange of emission permits.

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1. These excerpts are based on Annexes 1-5 of the *World Bank Environmental Assessment Sourcebook, Volume I: Policies, Procedures and Cross-Sectoral Issues*, Annexes 1-5 "On Project-Level Guides for Environmental Sustainability", 1991. pp. 51-53, but were extracted from the electronic version by using the keyword: 'sustainability'.

Input Guide

Rule: Harvest rates of renewable resource inputs should be within regenerative capacity of the natural system that generates them; depletion rates of nonrenewable resource inputs should be equal to the rate at which renewable substitutes are developed by human invention and investment.

Discussion: The inputs of interest are the primary inputs from nature, not the interindustry or intermediate inputs from other firms. This rule then only applies to the extractive sector, whereas the previous rule applies to all sectors. Inputs from nature are of two kinds, renewable and nonrenewable.

(a) Renewable inputs: The rule is that harvest rates should not exceed regeneration rates. In other words sustainable yield exploitation should be the rule. The sustainable yield concept presents two problems: measurement difficulties, and the existence of many different sustainable yields, one for each possible population of the exploited resource. The measurement problem is similar to that faced by the income accountant -- measuring income in a way that keeps capital (productive capacity) intact and prevents inadvertent impoverishment by over-consumption. The point in both cases is to find a prudent rule of thumb to avoid over-consumption, not to find the "theoretically unique scientifically precise number." But the rule to exploit at sustainable yield does not tell us what size population of the exploited resource should be maintained in this way. Choosing the population size that gives maximum sustainable yield does not give a sufficient answer, although it is relevant consideration. The economically optimum yield generally does not coincide with the biological maximum yield (they coincide only when harvest costs are constant with respect to the amount harvested). There is no warrant for assuming that the existing population size of an exploited species is optimal. It can be quite reasonable up to a point to cut down forest for farmland. But when we do this we must be clear that the trees from the virgin forest cut in excess of replacement represent capital consumption, not income. If total capita is to be maintained intact the net receipts from the cut virgin timber should be treated as a depreciation fund to be reinvested in some alternative renewable resource that is more valuable at the margin.

(b) Nonrenewable inputs. The rule is to deplete at a rate equal to the rate of development of renewable substitutes. Thus extractive projects based on nonrenewable resources must be paired with a project that develops the renewable substitute. Net receipts of nonrenewable exploitation are divided into two components (income and a capital set-aside) such that the capital set-aside, when invested in a renewable substitute each year will, by the time the nonrenewable is depleted, have grown to a stock size whose sustainable yield is equal to the income component that was being consumed all along. The capital set-side will be greater the lower the growth rate of the renewable substitute (real or biological discount rate) and the shorter the lifetime of the non-renewable reserves (i.e., the reserve stock divided by annual depletion). The logic and calculations have been worked out by El Serafy in the context of national income accounting, but apply with equal relevancy to accounting at the project level.

5. Environmentally Sound or Unsound? Participant Experiences in Design and Implementation

Description/Objectives

This module is designed to stimulate your open discussion of successes and failures and to identify key problems that need to be tackled in the activity, project or program development and implementation process. You were asked in your invitation to bring with you to the workshop examples from your own experience. These will be used in this module to discuss actual design and implementation issues.
Participants present experiences (formal or informal) with specific activities in the country that were notably successful or unsuccessful in managing potential environmental problems.

You will also be asked to prepare a summary list (and seek consensus) on principal obstacles to environmentally sound design and implementation. Please post your list (e.g. on a large piece of butcher block paper) in the classroom for the duration of the course to refer back to when delving into the details of the course and feel free to add items to it.

Questions to Think About

- Environmentally-sound design principles are not new. Have they been followed? If not, why not?

- What more can be done nationally and locally to improve environmentally sound program, project and activity design?

- Do you have specific examples of sound or unsound designs that the other participants would benefit from knowing about or should be alerted to? Are there particularly sensitive situations to watch out for? What low-cost techniques have you seen applied to identify potential problems? Are there certain kinds of regionally-based technical resources/expertise (e.g. GIS, remote sensing, water resource planning, etc.) that could improve environmentally sound design?

6. Individual Experiences with Environmental Design and Assessment

Description/Objectives

This session is designed to allow you to share your experiences and thoughts and get to know the other participants a little better. You will be asked to describe the activities or projects you work on, your thoughts on the first day, and your goals for the week.

In addition, you may have taken part in the design of development activities or projects. These activities may have had an impact on the environment, positive or negative, reversible or irreversible, direct or indirect. This session provides an opportunity to share your thoughts and observations on activity or project design, successes and failures.

Questions to Think About

1. How are environmental considerations incorporated into the design of activities that you work on? Is there a major difference between what is supposed to happen and what does in practice?

2. Have you witnessed any major successes or failures in terms of environmentally-sound design? If so, please describe them.

3. What do you perceive as the most important changes that need to occur to improve activity or project design and reduce negative environmental impacts? Are they legal, social, cultural, or other?

7. Assessing Environmental Impacts: Basic Concepts

Description/Objectives

In most cases, the assessment of environmental impacts is a straight-forward process. It requires good information, reasoning, judgment, and communication. It is not just a job for scientists and other experts with complex techniques; anyone with the basic concepts and skills can contribute to the process.

This module is designed to introduce you to that process and its basic elements. What is the environment? What is an impact? When is it significant? How does one go about determining the magnitude and importance of a potential environmental impact? Why bother? Subsequent sessions will elaborate on the environmental assessment process in its many forms, while this session lays out the basic questions that all tools and techniques, simple or complex, seek to answer:

- What will happen to the environment as the result of an activity, project or project?
- What will be the extent and magnitude of these changes?
- Do these changes matter?
- What can be done about them?
- How can decision-makers be informed of what needs to be done?

Readings

Module Backgrounder: "Assessing Environmental Impacts: Basic Concepts"

In Appendix B: UNEP, 1988. Environmental Impact Assessment: Basic Procedures for Developing Countries.

(Not included, but quite useful: World Bank, Environmental Assessment Sourcebook, 1991. The three volume set provides an excellent resource for those preparing IEEs, EAs, EMEMPs or other documents, and is available free of charge from the Bank. Volume 2 focuses specifically on environmental assessment of Agriculture and Rural Development projects.)

Questions to Think About

1. How would you define a "significant impact on the environment"?

2. Are most environmental impacts you have seen reversible or irreversible?

3. How objective can environmental impact assessment ever be?

MODULE BACKGROUNDER
Assessing Environmental Impacts: Basic Concepts

In this module, we will introduce you to the general terminology and concepts of how to assess projects from an environmental perspective.

1. What is Environmental Impact Assessment?

The first formal efforts to assess environmental impacts were conducted in the US in the early 1970s, in response to rising public concern over environmental deterioration. They were prepared in order to "provide full and fair discussion of significant environmental impacts" of a planned action and to "inform decision-makers and the public of the reasonable alternatives, which would avoid or minimize adverse impacts, or enhance the quality of the human environment." Since then, thousands of environmental impact assessments have been conducted around the world. Today, they are a legal requirement for major development projects with significant environmental impacts in most industrialized countries and in many developing countries.

In addition to legal requirements that may exist within the countries themselves, projects funded by most bilateral and multilateral funding agencies, such as USAID and the World Bank, must adhere to their own legal requirements, which generally specify the need for initial environmental examinations or more thorough environmental impact assessments.

To date, these and other donor requirements motivated the application of environmental impact assessment methods in many developing countries. While the process of assessing environmental impacts in developing countries has often been conducted by foreign consultants, with limited local participation, this situation is changing. More governments are developing their own environmental assessment programs with growing participation of local experts, officials, and the public.

The environmental assessment process should provoke question-asking. Both the questions and the answers can lead to a different focus for an activity, clarify its purpose and need, help refine alternatives, or suggest ways of improving an activity or project design. The impact assessor serves an important role by asking questions and,in doing so, soliciting the advice and information of both experts and the population affected by a proposed action.

The material presented in this module, and a subsequent one on tools and techniques, is designed to *familiarize* course participants with the key terminology and concepts involved in the process of assessing environmental impacts. Much of the material is general, and can be enriched by the experiences of local experts and project developers with environmental impact assessments in their own country.[1]

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1. It is principally drawn from four sources: UNEP, 1988; EPA, 1993; World Bank, 1991; and, Samba, 1994. Numerous textbooks are available for participants who are interested in learning more about EIA methods and practices. (See list of supplementary background readings, e.g., Wathern, 1988.)

Some Key Definitions and Principles

Assessing environmental impacts focuses on:

- ***The environment***, including three major and interconnected components: *physical components*, including the geology, topography, soils, water resources, and air quality; *biological components*, including fauna, flora, biodiversity, and ecosystems; and *social components*, including culture, religion, and local values.

- ***Impacts***, which are deviations from a baseline situation, or the likely future conditions in the absence of the project. It is important to recognize that the baseline situation is not static, and that conditions may be improving or deteriorating regardless of whether a proposed action is undertaken. Defining this baseline situation, and more specifically the availability of sufficient and accurate data to do so, is one of the most important constraints in assessing impacts, particularly in developing countries.

- ***Assessment***, an activity that is part art and part science. Environmental information should be gathered and analyzed using rigorous scientific methods. However, environmental data are often lacking, analysis can never be complete, predictions are always uncertain, and outcomes are not guaranteed. The interpretation and evaluation of the results requires judgment. And choices inevitably involve the subjective weighing of costs and benefits and of the varied interests of different stakeholders. Assessing impacts involves far more than science alone.

The purpose is to:

- ***identify*** and ***concentrate*** on problems, conflicts, or natural resource constraints that could affect the viability of a project (UNEP, 1988);
- ***predict*** the likely environmental impacts of projects (or programs);
- ***identify*** measures to minimize the problems and ***outline*** ways to improve the project's suitability for its proposed environment (UNEP, 1988); and,
- ***present*** predictions and options to decision-makers and the public before irrevocable decisions are made.

The process should be:

- ***systematic*** to assure that all feasible alternatives are considered and compared and that all measures that could protect important environmental resources are given full consideration in the planning process;
- ***reproducible*** to permit independent verification of the findings and conclusions; and,
- ***interdisciplinary*** to ensure that experts in the relevant physical, biological, cultural and socioeconomic disciplines contribute their expertise to the overall assessment so that important perspectives and analyses are not missing.

2. Why Assess Environmental Impacts?

Apart from fulfilling legal requirements, **tangible benefits** can result from soundly assessing environmental impacts. The process should lead to more environmentally-sound and sustainable activities; and as a consequence, preserved or enhanced quality of life.

The process of assessing environmental impacts aims to ensure, to the greatest degree possible, that the undesirable environmental effects of an action are kept to a **practicable minimum**. Although virtually any new development, redevelopment, or remedial action will alter some attributes of the existing environment, the process of assessing environmental impacts can influence decision-making on key aspects of project design. Some of the potential benefits of assessing environmental impacts at the initial stages of a project include (Sadar et al., 1994):

- ***lower project costs*** in the long term (fewer costly changes later in the project; lower probability of environmental disasters, court cases, or costly clean-ups);
- ***alternative designs***, which provide options for decision-makers and the public to choose from, and thus show that environmental impact assessment can be an important *development planning tool;*
- ***mitigation activities*** that can be incorporated into project activities in time to address and minimize adverse impacts.

Timely environmental assessments have led to more balanced decisions that have made development projects more sustainable, both environmentally and economically. The following examples from Chew (1988) are just two of many that could be offered:

- "The environmental assessment of the Cairo Wastewater Project indicated that it would be necessary to phase construction activities and recommended several alternatives for the USAID mission and the Government of Egypt to consider before the engineering design and construction schedule were finalized.";
- "The environmental assessment of the ecological conditions in the Palcazu Valley in Peru was instrumental in convincing the USAID Mission and host country government to change the project's development strategy. The original plan centered on road building and encouraging settlers to clear the tropical forest in the area for large-scale, agro-industrial activities. The environmental assessment recommended against the proposed activities and, instead, proposed activities that emphasize natural forest management with very limited small-scale agriculture in the project area."

An important component of assessing environmental impacts is **public participation**. Local involvement gives communities and individuals a voice in issues that may bear directly on their health, welfare, and quality of life. Public participation should begin in the earliest phases of project planning and continue through the decision-making process.[2] An open flow of environmental information helps bring out the range of issues and offers the opportunity for people to make reasoned choices about the

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2. Public involvement can be formalized by scheduling public meetings and public information sessions, creating public advisory and/or liaison groups, and periodically distributing information concerning the status of project planning.

benefits and risks of proposed actions. Some benefits to the public of timely environmental assessments include (Sadar et al., 1994):

- an opportunity for the public to learn about the potential environmental effects of the proposed project and to express concerns;
- an opportunity for the public to influence the decision-making process, possibly leading to alternative designs or mitigation activities; and,
- enhanced public confidence in public and private institutions.

3. How to Assess Environmental Impacts? Some Basic Concepts

Assessing environmental impacts begins with posing a few simple questions about the nature of the proposed project (after UNEP, 1988):

- Is the purpose and need well-defined?
- What are the components of the proposed action?
- What will happen as a result of the project?
- What will be the extent of the changes?
- Do the changes matter?
- What can be done about them?
- How can decision-makers be informed of what needs to be done?

To answer these questions, you will need information and a framework for organizing that information.

Understand the Purpose and Need. The purpose and need for a project or activity should be thoroughly examined. It is misleading to define the purpose or need for a project in terms of the characteristics of the activity proposed, e.g., a road, a well, or introduction of fertilizer; instead, purpose and need should be defined and described in terms of why one is doing the project , e.g. improved access (in the case of a road); improved water supply or quality (in the case of a well); or improved agricultural production or increased income (in the case of fertilizer introduction). Important characteristics of describing the purpose and need for a project are the intended beneficiaries, the results to be expected, and the rationale for how the activity is expected to achieve the results. Often, thinking in this broad way will lead one to realize that other alternatives may be possible to serve the purpose and need. For example, water transport or sometimes air access can sometimes be viable alternatives to a road.

Determine the Project Components: Without knowing what the proposed action is, you cannot know how the action could alter the environment, much less what the impacts of those alterations would be. To understand the impacts of the action, communicate with program developers, project designers, engineers, and whoever else is involved in formulating the action and, if possible, visit a similar activity or project. By knowing what the activity or project components are specifically, you can determine what is or is not likely to be a problem. For example, air or noise may not likely be a problem, but loss of habitat could be.

Also, you should consider all the ancillary parts of a project. For example, reservoirs may require haul roads, borrow areas at some distance from the site, or intake structures on a river and

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pipelines to carry water to feed the reservoir. Road construction, including rehabilitation, may require borrow areas, quarry sites or temporary detour roads. You should define not just the action, but all subsidiary components.

Evaluate the Baseline Situation: The baseline situation refers to the important characteristics of the area in which the proposed action would occur. The baseline study is necessary to enable prediction of environmental impacts of the proposed action and to provide a basis for comparing these impacts with what would likely happen in the absence of the proposed activity. Some points to remember are:

- Concentrate on relevant and important factors. There is often a tendency for scientists to waste considerable effort on research not directly relevant to assessing the nature and degree of environmental impacts. Early baseline studies compiled lists of "things" in the affected environment, and told little about ecosystem function and response. Today, baseline studies are more focused on the ecosystem properties most sensitive to disturbance.

- Establish the potential zones of impact, i.e., the appropriate geographic study areas. Consider the phases of the activity from planning through decommissioning and determine what aspect of the environment the action might alter at the site itself, in the immediate site vicinity or neighborhood, within the watershed, in the general area or region (transport routes or off-site construction related or disposal areas), within specific administrative jurisdictions or areas with economic and trade linkages (particularly with regard to socioeconomic or fiscal impacts), within the nation, across borders, globally, etc. Different alternatives can affect different geographic areas; and different types of alterations in the environment vary in geographic extent. Visual impacts, for example, are limited to what can be seen (with ordinary eyesight, with binoculars, from the air?) Avoid the common mistake of concentrating too much on the site of the activity itself and not on the surroundings.

- Provide a level of descriptive detail that is sufficient to indicate the nature of the natural and human resources that are potentially affected by the proposed action. The level of detail will vary with the nature of the proposed action and affected resources, as well as with the availability of data and the priority concerns identified in the scoping process. Table 7A-1 describes the major categories that should be addressed in a baseline study.

Don't need to write an environmental encyclopedia

Table 7A-1

Major Categories in a Baseline Study

- **Geology** - geological provinces, bedrock formations, history of geological stability or instability.
- **Topography** - general topography of region, specific topography of project area.
- **Soils** - soils mapping, soil series properties, constraints to development.

- **Groundwater Resources** - nature of water-bearing formations, recharge rates, sustainable safe yields, locations and depths of existing wells, quality.
- **Surface Water Resources** - drainage basins and sub-basins, named and unnamed water bodies and watercourses, regulatory classification of water bodies, flow regimes, water quality data and evaluation, identification of existing permitted discharges to surface waters.
- **Terrestrial Communities** - spatial arrangement of vegetative community types, vegetative species-abundance listings, wildlife species-abundance listings, records of threatened and endangered plant and animal species.
- **Aquatic Communities** - nature of aquatic habitats, species-abundance listings for aquatic macro-invertebrate and fish communities, ecological indexing of community data.
- **Environmentally Sensitive Areas** - identification of wetlands, floodplains, steep slopes, stands of mature vegetation, aquifer recharge areas, areas of high water table, areas of rock outcrop, prime agricultural lands, and mines.
- **Air Quality** - regional quality and trends, data from local monitoring stations, reported exceedances of standards.
- **Sound Levels** - existing sound levels, sources of sound.
- **Land Use** - existing patterns of land use in region, regional planning for future use, zoning.
- **Demography** - censused or estimated population, recent trends and projections for future population.
- **Socioeconomics** - economic and social structure of communities, tax rates, characteristic types of development.
- **Infrastructural Services** - nature and status of human services such as police and fire protection, hospitals, schools, utilities, sewage, water supply, solid waste disposal.
- **Transportation** - layout and function of existing roadways, railways, airports; existing and projected capacities and demands.
- **Cultural Resources** - location and characterization of identified cultural resources (archaeological, historical, cultural, landmark), potential for unidentified resources to be present in project area.
- **Project Economics** - comparative analysis of proposed alternatives with present worth cost-effective criteria, cost/benefit criteria, or other methods.

Consider a Range of Alternatives: You should consider the impacts of three options: a) the *proposed project* under consideration; b) the *no-action alternative*[3]; c) and *other alternatives* to the proposed project. In most cases, legal requirements indicate that all three must be considered. Alternatives are different means of meeting the general purpose and need of a proposed action, project, or program. Some points to remember are:

- Identifying and describing feasible alternatives should be carried out as soon as possible after the purpose and need are established; in this way, project planning does not bias the assessment toward one alternative or another.

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3. It is important to stress the role of the no-action alternative as it serves as a baseline against which the other alternatives can be measured. When the environmental consequences of the other action alternatives are weighed against their projected benefits, the no-action alternative can sometimes be the preferred alternative and the one selected.

- Alternatives should offer legitimate and substantive choices. The alternatives evaluated should ideally provide the decision-makers with different geographical locations for the action and with different technical or planning solutions for achieving equivalent goals.

Identify Potential Impacts: This is where both the science and art of the process are applied. Although scientific methods should be used whenever possible, there are often limitations due to inadequate data, complex relationships, and limited time and resources. Therefore, seeking the input of knowledgeable local experts and applying experienced judgment are essential - where these are lacking, simple intuition and logical reasoning are useful for initial purposes.

There are many tools and methods, from simple to sophisticated, that can be applied; the art lies in knowing when to apply each tool and how to make important assumptions in the absence of complete information.[4] The simplest and most commonly used tools are *checklists, matrices, map overlays, and network analyses*, which are primarily used for impact identification. Other more sophisticated techniques can be employed, such as geographic information systems. Impacts can fall within several different classes, which can have bearing on their overall significance, as described below:

- **Direct (Primary) vs. Indirect (Secondary) Impacts.** ***Direct impacts*** are those effects that are generally associated with the construction, operation, maintenance of a facility or activity, and are generally obvious and quantifiable. ***Indirect impacts*** are those induced changes in the environment, population, economic growth and land use, and other environmental effects resulting from these changes in land use, population, and economic growth. Indirect impacts can include additional construction and/or development, traffic increases, increased recreational demand, and other types of off-site impacts generated by on-site activities.

- **Short-Term (Temporary) vs. Long-Term (Permanent) Impacts.** Impacts can be short-term or long-term depending upon the persistence or duration of the impacts. The duration of impacts may have a lot to do with project ***phase*** in which they occur: ***pre-operational*** (e.g. construction), ***operational***, or ***post-operational*** (e.g. after project completion or plant decommissioning).

  Impacts can also occur in anticipation of a project. The threat of an activity or project considered undesirable can lead to loss of land value, making it difficult to transfer nearby properties, even before the project occurs. Likewise the promise of an action considered desirable may induce people to move to the location, in hopes that they will become project beneficiaries. Concerns about relocation can be more intense before a move than the actual relocation. It is a common pitfall to ignore those impacts occurring in the planning and assessment phase or those that occur after the project has served its useful life.

- **Positive (Beneficial) and Negative (Adverse) Impacts.** Although the term "environmental impact" has come to be interpreted in the negative sense, many actions have significant positive effects that should be clearly defined and discussed. This is

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4. Tools and methods are described in more detail in a later session ("*Methods and Tools*").

particularly appropriate for redevelopment or remedial actions whose specific purpose and need is to remedy any undesirable condition.

- **Cumulative Impacts.** Cumulative impacts are those environmental impacts that result from the incremental impact of the proposed action on a common resource when added to other past, present, and reasonably foreseeable future actions. Circumstances generating cumulative impacts could include: water quality impacts from an effluent discharge that is combined with other point source discharges or from non-point source runoff; or loss and/or fragmentation of environmentally sensitive habitats (forests, wetlands, farmlands) resulting from several separate development projects. The assessment of cumulative impacts is difficult, in part due to the speculative nature of the possible future actions, and in part due to the complex interactions that need to be evaluated when considering collective effects. Water and air quality modeling provide a means to study effects of cumulative impacts.

Predict Potential Impacts: Once impacts are identified, the next step is to predict the extent of the changes in environmental conditions that are *caused* by the proposed action. To do so requires an understanding of the important *cause-and-effect relationships*. Environmental impacts will have a number of distinct characteristics which should, if possible, be separately forecast to give a complete picture of the anticipated change due to the project. Typical impact descriptors are (adapted from Takawira, 1995):

- **Magnitude**: the absolute or relative change in the size or value of an environmental feature. Uncertainty is likely in forecasting the magnitude of change, and some upper and lower estimates may need to be given.

- **Direction**: the impact will represent a beneficial or negative change. It is therefore important to know the direction of the impact as the beneficial impacts are welcome. It is the negative impacts which are cause for most concern.

- **Extent**: the area affected by the impact -- e.g., in hectares of productive agricultural land or kilometers of river. A distinction here between on-site and off-site impacts is often useful.

- **Duration**: the time period over which the impact will be felt. Some impacts may be very short term (i.e., during construction), some may occur over a number of years, and some may be permanent. It is often desirable to specify duration in terms of short-term (i.e., 1 year or less), medium-term (i.e., 1 to 10 years), and long-term (i.e., more than 10 years).

- **Frequency**: refers to the return period for impacts which will recur over and over again -- e.g. seasonal air quality problems. Categories of return period can often be used to advantage in specifying frequency (e.g. annually or less, 1 to 10 years, 10 to 100 years).

- **Reversibility**: refers to the permanence of the impact. Several distinctions are possible here. Impacts may be reversible by natural means at natural rates, or be reversible by various forms of human intervention at reasonable costs, or be, for all practical

purposes, irreversible. Irreversible impacts are likely to be more severe as this assumes permanent damage to the environment.

- **Likelihood of Occurrence:** refers to the possibility of a particular impact occurring as forecast. Here, an estimate is made about how certain the impact prediction is, given the limitations of environmental science. Again, establishing categories of analysis such as "definite," "probable" and "possible" may come in useful if they are well-defined.

Risk & Probability

In general, there are two approaches that are commonly used to predict ultimate impacts:

- ***Quantitative analyses*** rely on simulation models, such as air quality or water quality models, that aim to represent the linkages between ecosystem or other environmental components in simplified, mathematical relationships. Simulation modeling tends to be complex, expensive, and data-intensive. Their use may be limited due to data and financial constraints of most developing countries. Not all quantitative analyses need to rely on models, however. The number of people affected, such as those relocated or subject to some describable change in the environment, can be counted; the acres of habitat disturbed can be measured; the per capita amount of sewage or solid waste generated can be estimated; the loss of an economic resource and its income value can be calculated.

- ***Qualitative analyses*** rely on professional judgment or intuitive reasoning to predict cause and affect relationships and ultimate impacts. Often, these types of predictions are most appropriate given resource constraints. One straightforward way to consider impacts qualitatively but systematically is to think about linkages among impacts. Road-related noise, for example, is a function of projected traffic volumes and speeds, which, in turn, depend upon the type and kind of road and the employment or population in an area; the level and significance of impact would depend upon how many people might hear the noise and whether or not this would affect daily activities (schools or places of worship might be more significantly affected than more ordinary work places).

Determine Significance of Impacts: Significance of a predicted impact depends upon its context and intensity. Significance varies with the setting or context, e.g. the loss of one hectare of park in an urban setting may be more significant than the same quantitative loss in a more rural setting, unless of course that hectare is habitat for an endangered species (or belongs to you!). A new or rehabilitated road in an urban area could be far less significant than the same road in a remote or wilderness setting. The intensity of an impact depends upon the degree to which an action:

- affects public health or safety;
- affects unique characteristics of an area (culturally or historically important resources, park lands, prime farmlands, wetlands, wild and scenic rivers, ecologically critical areas);
- is likely to be highly controversial;
- is highly uncertain or involves unique or unknown risks;
- establishes a precedent;

- adversely affects nationally defined historic places, adversely affects endangered or threatened species or habitat and the like (Council on Environmental Quality regulations, 40 CFR 1508.27).[5]

Thus, determining "significance" involves a judgment, tempered not only by applicable national or international laws protecting the environment but by societal perceptions about what is important.

Compare and Evaluate Alternatives: Once the level of potential impacts has been predicted, you will need to weigh and compare the various types of impacts in order to decide on the preferred alternative. Of necessity, this process involves value judgments and trade-offs between environmental and economic gains and losses. Therefore, the methods you use to make the comparisons should be as explicit and transparent as possible. Although there are various systematic approaches that can help in this effort, such as *environmental indices*, *cost-benefit analysis*, *hypothetical choice approaches*, and *multi-criteria analysis*, they all involve subjective and value-laden premises, since comparisons must be made that are essentially like comparing "apples and oranges." Answering the question 'which is more valuable?' is problematic and subject to controversy because it is very difficult to compress information about attributes into a single monetary measure. For example, there is no objective criteria one can apply to compare the inherent value of an endangered species with the aesthetic value of a natural forest.

Identify Mitigation Options: Mitigation is the purposeful implementation of decisions or activities that are designed to reduce the undesirable impacts of a proposed action on the affected environment. Mitigation is a general concept that could include the following list of categories:

- Avoiding impacts altogether by not taking a particular action;
- Minimizing impacts by limiting the magnitude of the action;
- Rectifying impacts by repairing or restoring particular features of the affected environment;
- Reducing impacts over time by performing maintenance activities during the life of the action; and,
- Compensating for impacts by providing additions to or substitutes for the environment affected by the action.

You should note that the above categories of mitigation approaches are arranged hierarchically according to their desirability. In other words, it is more desirable to avoid impacts than to have to rectify impacts or provide compensation for them (from Environmental Law Institute, 1991).

4. When Should Environmental Impacts Be Assessed?

The environmental assessment process ideally begins early, as early as the planning stage. Environmental considerations should be integrated with other planning to ensure that decisions reflect environmental values and to identify potential conflicts. The situation to avoid is having decisions made

5. Please note that USAID regulations (22 CFR Part 216. 1(c)(11) define significant with respect to effects on the environment outside the US as doing significant harm to the environment, but this very particular definition is not common to environmental impact assessment in general.

and/or monies committed before the environmental assessment process occurs; in this case, the environmental assessment has little (or, certainly, less) influence on choices regarding project or activity design, siting, technology, scale, beneficiaries or the like. At worst, the environmental assessment can become simply an exercise to meet a requirement -- not an appropriate way to achieve environmentally sustainable development.

The assessment of environmental impacts is conceptually a continuous or ongoing process, linked to the project cycle; although assessment is typically thought of and done prior to project implementation, the principles and practice of environmental assessment should continue to be applied, once an action is approved and implemented. Following are some examples of when the principles and practice of environmental assessment can be applied:

- programmatic or generic review of recurring activities or projects, leading to criteria for implementation, generic modifications, or adoption of required procedures for screening or assessing project or activity sites and/or components;
- initial examination during a pre-feasibility phase;
- detailed assessment, if required based on an initial analysis;
- detailed mitigation plans as a follow-up to the initial examination or detailed assessment to accompany the design phase;
- monitoring (and adjustment as appropriate) of mitigative measures carried out, during construction and/or operation;
- re-assessment at decommissioning or abandonment of a project.

It is rarely too late to incorporate environmental concepts into a project or activity; the point is to consider long run environmental sustainability throughout a project or activity and, wherever possible, to consider environmental issues and concerns as part of the ongoing planning and development of an area.[6]

5. Who Should Be Considered When Assessing Environmental Impacts?

The sponsor of an action (the proponent or the group or institution that proposes the action) is typically biased in favor of the action. Despite this, it is common that the proponent will, at least initially, be responsible for assessing the environmental impacts. In some situations, a funding or lending agency (such as USAID, the World Bank, or sometimes even a mortgage lending bank) and/or a regulatory agency (such as a national or other level body) will have reviewing or even veto authority. Other agencies of government or even international bodies can be concerned, although not necessarily have statutory responsibility. For example, a Wildlife Department may be concerned about activities

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6. Assessing environmental impacts can go beyond the project or activity level. The concept of "strategic environmental assessment" recognizes the importance of considering entire sectors, regions or policy level actions.

or projects in the vicinity of a protected area; activities that affect habitat for migratory birds could attract the attention of other nations or of international groups concerned about birds. It is extremely useful to understand the concerns of a reviewing or funding/lending agency, to know the limits of jurisdiction and the authority of regulatory agencies, and to involve them at the earliest stages.

Clearly, the concerns of directly or indirectly affected populations need to be considered. In this regard, it is important to recognize that activities affect segments of the population in different ways, e.g., old or young; healthy or infirm; male or female; rich or poor; farmer, pastoralist, transporter, businessman, etc. Populations are also differentially affected depending upon where they live or their use of resources relative to the proposed action. For example, a dam affects downstream users of a river differently from upstream users; alterations in river water flows or in water quality affect dryland farmers differently from farmers using irrigation, differently from herders, and differently from industries or urban areas withdrawing water. In assessing environmental impacts, it is important to think about who (and how many different "whos") stand to lose or gain from the proposed activity.

6. Some Practical Guidelines

Assessing environmental impacts typically requires that you understand the project or activity in detail, think about how it alters the environment (including people) and determine when, where and to whom the alterations occur and whether they matter. The steps you typically need to take include:

- review the literature,
- perform a reconnaissance,
- refine a data gathering approach and method,
- execute data gathering,
- analyze data,
- predict impacts,
- recommend mitigation measures, and
- communicate all of the above (typically in a document and often in meetings).

8. National Policies and Experience in Environmental Impact Assessment

Description/Objectives

This presentation will describe how the process and practice of environmental impact assessment are undertaken in your country. The number of governments, globally and within developing countries, with active policies requiring some form of environmental impact assessment for development projects is increasing steadily. The status of such policies and regulations will be reviewed here.

Furthermore, experience with the application of national or international (e.g. World Bank, UN, USAID, or other funding and donor agencies) environmental impact assessment procedures most likely exists within local research, academic, and consulting organizations. This expertise could prove of value to you and your institution in assessing environmental impacts. This presentation will also provide an overview of these institutions and their experience, so that you may draw upon them as needed in the future.

Readings

Presenter's paper(s).
Consult the National Environmental Action Plan, National Conservation Strategy or Environmental Statutes for your country.

CHAPTER I

INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION TO THE CONSERVATION STRATEGY OF ETHIOPIA

1. The Conservation Strategy of Ethiopia (CSE) takes a holistic view of natural, human-made and cultural resources, and their use and abuse. It seeks to integrate into a coherent whole existing and future federal and regional government planning in all sectors that impinge on the environment, including agriculture, forestry, wildlife, fisheries, soils, water, minerals, energy, urban planning and cultural heritage conservation.

2. A sound partnership has been sought between planners, decision makers and the Ethiopian people to manage Ethiopia's natural resources for the Ethiopian people and their children. Most sections, groups and classes of people have been consulted and have participated in the formulation of this strategy.

3. The policy-making phase encompassed broad ranging discussions and a full debate at both federal and regional levels in order to arrive at a consensus. The process was launched by the Government in May 1990 at a conference held in Addis Ababa. The conference provided an opportunity for issues to be considered at all levels. Representatives from every Government department attended, together with delegates from the business community, United Nations, and donor and NGO agencies. Experts from many fields provided their powers of analysis.

4. The conference was followed by the creation of task forces and regional workshops and a deeper analysis of the issues raised. The regional and zonal task forces took the action into the countryside through a series of field visits and grassroots level consultations. In this way regional and community needs and priorities have been effectively addressed.

5. The Conservation Strategy of Ethiopia will be implemented by the Government of Ethiopia through a coordinated investment programme. A complete review of legislation that may affect conservation is in progress. Laws will be modified or enacted to support the process of conservation without hindering development.

6. This is an umbrella strategy which considers all sectors of human activity and enhances the capacity and effectiveness of existing and subsequent strategies. In this respect, the CSE will play an important role in coordinating sectoral strategies.

7. The CSE recognizes the very low standard of living of the majority of the people of Ethiopia and thus their minimal ability to invest in activities that do not yield quick returns. It is, therefore, realistic and works towards enhancing their ability and will to invest in conservation.

1.2 INTEGRATING ENVIRONMENT WITH DEVELOPMENT

8. Development is essential for every country if it is to improve the quality of life and to satisfy the needs of each person. However, a short-term view can destroy the very long-term development a country sets out to achieve. But given the chronic poverty which pervades in Ethiopia and the urgent need to achieve rapid economic growth, does pursuing a sustainable environmental policy involve sacrificing economic growth and the alleviation of poverty?

9. Any country can maximize economic growth over a very short term by depleting non-renewable resources, by harvesting more than the sustainable yield of its renewable resources (e.g. forests) and by disposing of wastes into ecosystems that cannot assimilate them and thus by degrading its soil, aquatic, and atmospheric resources. However, basing economic growth on such a policy would be like building a house on shifting sand. Already the country's chronic poor live in the worst urban environments, occupy and work the marginally productive land, have least access to clean water and fuelwood, and are most at risk of starvation. Pursuing a policy of environmentally unsustainable economic growth would thus only exacerbate the living conditions of today's poor and bequeath to future generations an impaired natural resource base and an environment in which it would be impossible to live.

10. Therefore, given the high degree of dependence that Ethiopia has to place on its natural resources and environment in order to achieve economic and social development and regarding the magnitude of the processes of environmental degradation, there is a clear and urgent need to integrate environmental protection and sustainable natural resource management with development policies, strategies and their implementation. Environmental concerns cut across all sectors and levels of development and thus a policy framework for sustainable environmental management must be comprehensive

in scope and scale. This is not to say it becomes the "national economic development policy" but rather that it should provide a solid and firm foundation for ensuring that the country's economic and social development will be sustainable.

11. A sustainable development incorporates three necessary and complementary elements: environmental sustainability, social sustainability and economic sustainability. Development planning has hitherto mostly concentrated on economic systems, to a much smaller extent on social systems and hardly at all on environmental systems. Similarly environmental planning has mostly concentrated on environmental systems, to a much lesser extent on social systems and hardly at all on economic systems. These have resulted in the unsustainability of attempts at economic development and the economic untenability of efforts at environmental management carried out hitherto as well as virtual disregard of social development. The policy presented here seeks to integrate the three systems on an equal footing into a framework for sustainable development.

12. Agriculture has been identified as the lead growth sector in the country's Agricultural Development-Led Industrialization (ADLI) Strategy. This strategy depends on sustainable agricultural development. Sustainability in agricultural development depends on the sustainable development, use and management of the country's natural resources and environment. The strategies presented in this Policy are thus of vital importance in achieving a successful implementation of the national economic development strategy.

1.3 THE IMPACTS OF POPULATION, POVERTY, GOVERNMENT POLICIES AND THE LACK OF PEOPLES' EMPOWERMENT FOR NATURAL RESOURCES AND ENVIRONMENTAL MANAGEMENT

1.3.1 Linkages and Relationships

13. The detailed linkages between population and poverty, the role of government, the empowerment of people and the sustainability of management of natural resources and the environment are extremely complex. However, a number of discernible strands can be recognized. Poverty is characterized by a lack of access to resources and goods such as land and clean water for the satisfaction of basic needs, and to health and educational services. These linkages have quantitative and qualitative characteristics. Thus although a person has access to land it may be insufficient in extent and quality. Herein often lies the connection between unsustainable use and

management of natural resources and poverty, although the relationships are not absolute.

14. Poverty and access to basic resources have close and complex relationships with the degree of individual and community empowerment to use and manage those resources and the environment. This complex area of relationships includes such issues as the role of government in environmental management and the effectiveness of policy framework and the degree to which it actively intervenes in and regulates environmental management. Included in this complex set of issues are security of resource access and tenure rights, local democracy, resource management institutions and participatory development.

15. Finally, population growth in the context of increasingly scarce natural resources provides the destabilizing factor in the dynamics of resource use and management systems, access to resources and the satisfaction of basic needs and thus maintains or worsens poverty. Also involved are the spatial relationships between population, natural resource endowment and changing resource use and management systems.

1.3.2 Population and the Sustainability of Environmental Management

16. The Ethiopian human and domestic animal population is growing fast and, given the low level of economic development of the country, the pressure exerted by this growing population is causing a serious depletion of the natural resources base. More information on the situation is given in section 3.1. It is worth recalling here, however, that this pressure is most intense in the highlands, which constitute only 43 per cent of the land area but accommodate about 90 per cent of the human and 80 per cent of the animal populations. This has resulted in the steady impoverishment of many farming families and, in some areas, in their more or less complete dependence on food aid.

17. Population growth rates in the pastoral lowlands are much lower than in the highlands. The long-term total livestock numbers probably oscillate above and below the ecological carrying capacity of the rangelands which, itself, oscillates above and below a mean. However, in these fragile environments frequent droughts, loss of vital grazing resources to rainfed and irrigated agriculture, war and civil conflict have combined with an increasing population to cause a reduction in livestock assets to well below subsistence requirements in many households. This has caused increasing numbers of marginalised pastoralists to take up precarious rainfed cropping to supplement

food supplies from dwindling livestock resources. In this ecologically fragile environment, rainfed cropping is causing soil erosion and increasingly sedentarized herds are causing both soil and pasture degradation.

1.3.3 Poverty and the Sustainability of Environmental Management

18. In 1992, it was estimated that 8.7 million people needed relief assistance in Ethiopia. The situation has been compounded by the demobilization of more than 400,000 former soldiers with an estimated 800,000 dependents, and nearly 1.5 million refugees, returnees and internally displaced persons.

19. Ethiopia ranks as one of the poorest countries in the world with a per capita GDP of about US$120 a year. A recent study on poverty in Ethiopia estimated that approximately 27 million people fall below the poverty line. Some 13 million rural people who are mainly subsistence farmers with very small farms or no farms at all constitute the major group of poor people. However, even in the urban areas the chronically poor are about 4 million (out of a total population of over 7 million). This all pervading poverty is exemplified by some of the worst social indicators in Africa. These are shown in Table 1.

1.3.4 Previous Government Involvement and Interventions in Natural Resources and Environmental Management

20. In 1975, an economically *laissez faire* centralist imperial government was replaced by an even more centralist "command economy" military government. Between 1976 and 1985 it has been estimated that some 600,000 kms of soil and stone bunds were constructed on cropland and some 500,000 kms of terraces on hillsides, some 500 million tree seedlings were planted and about 80,000 hectares of hillsides closed for regeneration. Reafforestation was implemented on nine catchments in nine regions and peri-urban plantations were established in Addis Ababa, Nazareth, Dessie and Debre Birhan. The cutting down of trees by peasants was banned. However, despite these and other massive intervention and regulation by the past government in the economy as a whole and in environmental management in particular, natural resource and environmental degradation continued unabated. Those forced government interventions and their negative environmental impacts can be usefully grouped into three sets of "policy or government failures":

a) Policy and regulatory interventions which had direct or indirect negative environmental impacts;

Table 1 *Ethiopia: Basic Socio-Economic Indicators*

No.	Indicator / unit / year(s)	Ethiopia	LDC	SSA	ADC	World
1	GNP/Capita /US$/ 1991	120	240	540	880	4160
2	GNP/Capita Growth Rate /1980–88/	–1.4	–0.8	–2.2	3.3	3.6
3	Food production /per capita/ 1991 /1979-1=100/	8.6	0.8	9.6	10.9	–
4	Daily calory supply as % of requirement 1988–90	71	92	92	118	113
5	Daily calory supply per capita 1988–90	1700	2070	2170	2480	–
6	Gross domestic savings /as % of GDP/ 1991	0	2	12	25	23
7	Gross domestic investment /as % of GDP/ 1991	10	15	17	26	23
8	Population below poverty line /% total/ 1980–88	64	75	–	32	–
	– Rural	65	70	–	36	–
9	Population growth rate /1990–2000/	3.0	2.8	3.4	1.9	1.6
10	Dependency ratio 1990	94	90	97	69	64
11	Infant mortality per 1000 live births 1992	123	112	101	60	–
12	Life expectancy /years/ 1992	46.4	50.1	51.1	63.0	65.6
13	Health coverage /%/ 1985–91	46.0	54.0	59.0	81.0	–
14	Access to safe water /%/ 1988-91	28.0	45.0	46.0	70.0	–
15	Adult literacy /%/ 1992	50	46	51	69	–
16	Primary enrolment ratio 1986–88					
	– Male	46	46	75	110	109
	– Female	28	69	61	92	93
17	Primary & secondary enrolment ratio 1986–88	27	50	43	70	78
18	Debt service /% of exports of goods & services/ 1991	18.6	25.2	29.3	21.3	–
19	Total debt /as % of GDP/1991	53	81	101	40	–
20	Exports /as % of GDP/1991	5.0	11.0	26.0	21.0	16.0
21	Imports /as % of GDP 1991	17.0	22.0	22.0	24.0	17.0
22	Food import dependency ratio /%/					
	– 1969/71	1.1	–	6.5	6.7	
	– 1988/90	9.4	11.3	10.2	10.5	
23	Cereal imports 1991 /thousands Mt. tons/	802.0				
24	Food aid 1992 /US$ millions/	217.8				

LDC = Least Developed Countries
SSA = Sub–Saharan Africa
ADC = All developing Countries

Source: UNDP, Human Development Report 1994, Oxford University Press.

b) The failure to implement policies and regulations which would otherwise have had direct or indirect positive impacts;

c) The lack of policies or regulations, the default producing negative environmental impacts.

21. Perhaps the most important policy and regulatory interventions in terms of their negative impacts on the environment were those impositions which increasingly and cumulatively eroded the rights of individuals and communities to use and manage their own resources.

22. For about a century prior to 1975, social, economic, and cultural constraints were put in place to ensure the subjugation of the peasantry and popular participation was not allowed beyond religious and ritual ceremonies. The impact of these on natural resources and the environment has been analyzed in Volume I.

23. The creation of Peasant Associations in 1976 with the power to allocate and control their own resources created for the first time an agrarian structure which established local units of administration and self-determination. However, from 1977 onwards the central organs of the state increasingly assumed control of resource use and management, coopting the individuals in the peasant organizations into becoming mere executing agents of the centralized repressive state.

24. The semblance of continuing to be peasant organizations was however continued in the power to allocate and reallocate land. But even thus, the frequent reallocations of plots only institutionalized the insecurity of tenure that had been created by the feudal system and led increasingly to a perception by individual farmers of a complete alienation from their crop and grazing lands and particularly their produce including any trees planted on them. The consequences were that soil conservation structures were not constructed and those that had existed or were constructed by coercion were not maintained. Trees found or planted on communal lands were, though communally owned, divorced from community authority. The prohibition on cutting down trees made both the community and the individual loose interest in protecting them, and led them into becoming "open access" resources owned by nobody and to be "illicitly" cut down by anybody. Thus, because farmers and communities did not have any control over trees which they might plant, either they did not plant any at all, or when coerced to plant did not

maintain or care for them. In this way many community woodlots planted with great physical effort resulted in little gain.

25. State demarcation and management planning of forest land which often encompassed farming communities was undertaken with little or no participation of those communities. This, coupled with the inability of the government forestry agencies to effectively "police" all the protected forest lands, led forests to being increasingly encroached upon, and cleared and turned to farmland. Because this farmland was "illicitly" obtained, farmers perceived that they had even less security of tenure on it and consequently had no desire to invest in soil conservation work. Thus, ill defined tenure rights on the part of both the state and the farmers over forest land and the inability of the coercive state to enforce its own regulations led to the massive and often haphazard destruction of natural forests.

26. The lack of or the implementation of incorrect policies and their negative impact on natural resources was exemplified by the lack of appropriate pricing policies with respect to water and/or appropriate regulatory supervision over its use. Irrigation water used on the state farms in the middle Awash valley was never costed and poorly regulated, and lead to excessive usage without proper drainage with eventual salinization of the land which was then either abandoned or rehabilitated with high additional investment.

27. In retrospect, a major common characteristic of the rural programmes and campaigns which were implemented between 1977 and 1991 is seen to have been their lack of sustainability. In particular, many of the programmes of villagization and the creation of producer cooperatives, physical soil conservation and community forestry have collapsed as a reaction to coercion. Between the fall of the Military Government and the consolidation of power by the Transitional Government the pent up feeling of resentment in the rural people was released resulting in much forest and wildlife destruction.

1.4 CURRENT TRENDS IN THE USE AND MANAGEMENT OF NATURAL RESOURCES AND THE ENVIRONMENT IN THE CONTEXT OF THE NATIONAL ECONOMY

1.4.1 The Natural Resource Base

28. Natural resources are the foundation of the economy. Smallholder peasant agriculture, in some areas including forestry, is the dominant sector accounting for about 45 per cent of the GDP, 85 per cent of exports and 80

per cent of total employment. Agriculture has also been the main source of the stagnation and variability in GDP growth caused in the main by policy failures and exacerbated by recurrent drought, civil war, natural resource degradation, and poor infrastructure.

29. Renewable natural resources, i.e. land, water, forests and trees as well as other forms of biodiversity, which meet the basic needs for food, water, clothing and shelter have now deteriorated to a low level of productivity. In many areas of highland Ethiopia, the present consumption of wood is in excess of unaided natural sustainable production. Estimates of deforestation, which is mainly for expansion of rainfed agriculture, vary from 80,000 to 200,000 hectares per annum.

30. The burning of dung as fuel instead of using it as a soil conditioner is considered to cause a reduction in grain production by some 550,000 tonnes annually. In 1990, accelerated soil erosion caused a progressive annual loss in grain production estimated at about 40,000 tonnes, which unless arrested, will reach about 170,000 tonnes by 2010. Livestock play a number of vital roles in the rural and national economy but according to one estimate some 2 million hectares of pasture land will have been destroyed by soil erosion between 1985 and 1995. Land degradation is estimated to have resulted in an annual loss of livestock production in 1990 equivalent to 1.1 million tropical livestock units (TLUs), and, unless arrested, will rise to 2.0 million TLUs or to 10 per cent of the current national cattle herd by 2010.

31. In economic terms, soil erosion in 1990 was estimated to have cost (in 1985 prices) nearly Birr 40 million in lost agricultural production (i.e. crop and livestock) while the cost of burning dung and crop residues as fuel was nearly Birr 650 million. Thus in 1990 approximately 17 per cent of the potential agricultural GDP was lost because of physical and biological soil degradation.

32. The permanent loss in value of the country's soil resources caused by soil erosion in 1990 was estimated to be Birr 59 million. This is the amount by which the country's soil "capital" should be depreciated in the National Accounts or which should be deducted (as capital depreciation) from the country's Net National Income (NNI).

33. The Ethiopian Forestry Action Program (EFAP) estimated the full value of forest depletion in 1990 to have been about Birr 138 million or some 25 per cent of the potential forestry GDP of Birr 544 million.

34. Despite the presence of mineral resources in quantities and qualities suitable for exploitation, they currently contribute only about 2 per cent of the GDP.

35. Only 1 per cent of the potential of Ethiopia's vast water resources for irrigated agriculture and hydropower generation have been developed. The energy sector is one of the least developed in the world with 90 per cent of needs being met from biomass fuels, particularly wood, charcoal and animal dung. The genetic diversity of Ethiopia's domesticated plants and its unique flora and fauna is increasingly being eroded in the face of an expanding population and the needs of agriculture.

1.4.2 The Urban Environment

36. The current urban proportion of the population is relatively low at only 15 per cent although the annual rate of growth is 5.4 per cent and this rate is likely to rise to 30 per cent by the year 2020. There is a high proportion of female households headed by women in urban areas.

37. About 31 per cent of households in Addis Ababa have no sanitation facilities, while in other urban areas the proportion is about 48 per cent. The serious deficiencies in sanitation services and the lack of proper sewerage and random defecation in urban areas have created dangerous health and environmental problems. Rivers and streams in the vicinity of Addis Ababa and other large urban centres have become open sewers and are one of the main sources of infections resulting in diarrhoea and other diseases. Privacy for women is almost impossible as many latrines are shared among many people and even simple doors are often absent. The current stock of urban housing is both insufficient and of very poor quality.

1.4.3 Natural and Cultural Heritage

38. Ethiopia's rich natural and cultural heritage permeates every facet of daily life and provides a powerful and socially cohesive force in the national consciousness. It can also provide a major attraction for tourists and is an important element in the development of a tourist industry. However, much of this heritage and culture is under threat through neglect, decay, removal or destruction as well as through the less visible and tangible impacts of changing socio-cultural values, foreign ideas and imported technologies.

1.5 THE NEW ROLE OF GOVERNMENT IN ACHIEVING THE SUSTAINABILITY OF ENVIRONMENTAL MANAGEMENT

39. Any potential role for government in achieving sustainable environmental management by individuals, communities, private organizations and state agencies will have three distinct but overlapping and complementary dimensions:

a) An enabling role

b) An interventionist role

c) A regulatory role

40. The role of the Transitional Government has been defined in the various macro policy and strategy documents which are described more fully below. Essentially the Government has as its major economic objective the transformation of the previous centrally planned economy to a market based one. In the context of the three dimensional conceptual framework outlined above this involves:

a) An increased enabling role for government to ensure that the fundamental conditions exist for markets to function by:

   i) Rectifying previous policy failures which have caused or exacerbated market failures which have in turn resulted in a lack of sustainable management of resources, and caused environmental damage and economic stagnation and even decline;

   ii) Exercising a prudent macro-economic management and ensuring that other macro-policies do not have negative environmental impacts;

   iii) Making available market information where this is lacking; and

   iv) Reforming and/or establishing, as the case may be, legal frameworks and democratic institutional structures which provide clearly defined and secure natural resource access and tenure rights as well as a framework for constructive partnership, dialogue and negotiation between government on the one hand and resource users and developers on the other;

b) A reduced interventionist role in direct economic and production activities except in investment in the development of key strategic resources (e.g. large-scale hydroelectricity generation, large-scale mining) and confining its other interventions to

i) Investment in the provision of "public goods" which the private sector would or could not otherwise provide such as infrastructure, education, training, credit, research, and technology development and extension; and

ii) Enhancement of the enabling environment through the use of specific policy instruments such as taxes and incentives as well as charging full user costs for previously "unpriced" resources (e.g. water, forests);

c) As an adjunct to its reduced interventionist role, government will adopt a relatively minimal and cost effective monitoring, regulatory and, where all else fails, coercive role which is always within its capacity to enforce in order to minimize the perpetration of environmental damage and thus act as the country's "environmental guard".

41. Thus while the new primary economic role of government is to provide an enabling environment for a market economy it is recognised that there may be many cases where markets will fail in the allocation and efficient and sustainable use of natural resources and in care for the environment. These "market failures" provide, therefore, a rationale for government intervention.

42. But a "market failure" is a necessary condition not a sufficient one. The benefits of any government intervention or regulation should exceed the costs of its planning and implementation. As indicated above the previous centrally planned economy saw many examples of intervention where the costs to government greatly exceeded the benefits.

43. The new government structure takes power away from the centre to regions and localities. The relative roles of government at the different levels (Federal, Regional and Local) in terms of powers and duties, including on fiscal matters, have been defined by Proclamations 33 of 1992 and 41 of 1993, in part and 4 of 1995.

44. The duties and responsibilities of the Federal Government are to:

a) Initiate policies, prepare plans and allocate budgets and implement the same;

b) Ensure the enforcement of laws, regulations and directives of the Federal Government;

c) Undertake studies and research, as well as collect and compile statistical data;

d) Give assistance and advice to Regional States, and follow up the proper implementation of laws, regulations and directives by their executive organs; and

e) Enter into contracts and international agreements in accordance with the law.

45. Duties and responsibilities of Regional States are to:

a) Prepare and implement plans and allocate budgets;

b) Ensure the implementation of laws, regulations and directives;

c) Undertake studies and research, as well as collect and compile statistical data, and transmit same to concerned central executive organs;

d) Enter into contracts in accordance with the law; and

e) Submit periodic activity reports to concerned regional and federal executive organs.

1.6 THE NEW MACRO POLICY AND STRATEGY FRAMEWORK

1.6.1 Ethiopia's Economic Policy during the Transitional Period

46. In November 1991, the Government issued **Ethiopia's Economic Policy During the Transitional Period.** Its stated objectives are to establish peace and security as well as to reduce poverty by encouraging growth. The broad strategies that the policy advocates are:

The replacement of the previous centrally planned economy with a market-orientated one;
A reduced role for the state sector;
Popular participation in the development process;
The promotion of private investment; and
The mobilization of external resources.

Within these strategies, there are a number of policy elements of importance to The Conservation Strategy of Ethiopia.

47. **Rural Land Tenure:** The Policy recognizes two opposing views on the ownership of rural land: continuation under state ownership or changing to private ownership with the right to sell and exchange. Given the political and economic problems associated with the issue the question was taken to the debate on the new constitution. In December 1994, this constitution was approved. It retains land under the control of the people and government of Ethiopia thus prohibiting its buying and selling. But it ensures its usufructuary tenure rights and allows for leasing its usufructuary rights to or from others.

48. During the transition period there were no changes (except for three minor amendments) in the current policy of public ownership. This policy was originally established by **Proclamation 31 of 1975**. The last policy amendments to land tenure were made at the 11th Plenum of the Workers Party of Ethiopia in March 1990 and it must be assumed that these together with the three amendments in the Transitional Economic Policy define the current policy. The 1990 announcements confirmed the policy changes announced the previous year that all further new land allocations and plot re-allocations of existing holders should cease. All existing land use rights for peasant farmers were confirmed. Existing holders were permitted to transfer holdings by inheritance to legal heirs. Cooperatives were to be democratically based and commercial (i.e. private commercial) agriculture permitted. State control of grain marketing was abolished and farmers were permitted to sell their produce where and how they pleased. In order to implement the new policy a set of regulations and directives were issued by the Council of Ministers.

49. The Transitional Economic Policy confirms that there should be no reallocations of land except to the landless and that there should be no further fragmentation of holdings. Whilst preventing the sale or mortgage of land the policy upholds the rights of peasants to lease land, to pass it on to kin, to freely sell their produce, to hire labour, and to be compensated fully if expropriated. There are three new elements in the transitional policy: (i) permitting new land allocations to the landless, (ii) the right, which was not

openly expressed in the pronouncements of the 11th Plenum, to lease land in or out, and (iii) the right for existing land holders to be compensated fully if land is expropriated by the state. In practice allocation to the landless has largely been confined to demobilized soldiers, and returning refugees and settlers, and not to the landless already within the community. In some areas state farms have been formally handed over to their relevant Regional State Governments.

50. There have been a number of legal instruments issued with respect to the leasing of land, to water and to mineral exploitation.

51. **Proclamation 15 of 1992** (A Proclamation to Provide for the Encouragement, Expansion and Coordination of Investment) provides for investors to have access to sufficient land and water commensurate with their investment. The conditions of the use of the land and water are to be governed by lease agreements. The Proclamation provides for government incentives in the form of tax and other exemptions for investment in agriculture, natural resource development as well as protection and preservation, the construction and building industry, and rural transportation.

52. **Council of Ministers' Regulation 120 of 1993** provides for the issuance of licences for investors wishing to engage in agricultural activities. Agricultural activities include the production of annual and perennial crops, animal and fish resources, forests, wildlife and wildlife products. An investor must first obtain land on a lease agreement entered into with the Regional State Government and no land will be given in a manner prejudicial to the rights and interests of peasants. The Investor will also have to provide a feasibility study which should include "conditions regarding environmental protection".

53. **The Mining Proclamation 52 of 1993** provides for state ownership of all mineral resources and sets out responsibilities for ensuring the conservation and development of mineral resources. The Proclamation sets out the conditions for licences for prospecting, exploration and development, and distinguishes between artisanal mining (of a non-mechanized nature), and small-scale and large-scale mining the difference between the latter two to be defined later under Mining Regulations. The Proclamation sets out the different ways in which prospecting, exploration and development licences and discovery certificates may or may not be transferred.

54. **Development of Agriculture**: The Policy confirms a reorientation of government support away from state farms to peasant agriculture, in particular for the construction of rural infrastructure (roads, etc.), the expanded

distribution of inputs and the provision of extension services. The policy also indicates a significant increase in Government support to the previously neglected "areas with special problems": Previous Government policy had been to focus support almost exclusively on "surplus producing weredas". Included in the areas with special problems are the lowland pastoral areas.

55. The role of the state farms will be reduced and that of private modern farms expanded on "open and fertile lands" made available on a concessionary basis provided that no existing peasant, pastoral or shifting cultivators will be evicted or their interests affected adversely (see Ministers' Regulation 120 of 1993).

56. **Conservation and Development of Natural Resources**: The Policy gives priority to the conservation and development of natural resources. Priority will be given to the conservation and development of forestry, soil, water, and livestock resources. Policies will also be issued with respect to public participation in forestry development and conservation land use, wildlife preservation, soil and water conservation, and the proper use and development of livestock. Participation of peasant farmers will be a key element of all these policies.

57. **Resettlement and Villagization:** Although recognizing the problems associated with previous resettlement programmes the Transitional Policy acknowledges that voluntary resettlement where it does not create conflict with local populations will be required to assist in relieving shortages of land and high population densities. However no programmes will be instituted during the transitional period. Where settlers on current schemes wish to return to their original areas they will be assisted. For those who wish to remain efforts will be made to promote goodwill between the settlers and the local peoples and to enhance their self-reliance.

58. No further villagization programmes will be instituted unless based on the free will of the people and only when the necessary infrastructure is in place.

1.6.2 Policy Framework Paper

59. In September 1992 the Government presented its **Policy Framework Paper 1992/1993–1994/95 (PFP)** to the IMF and the World Bank as a major step in implementing its economic policy. The Policy will be implemented in three overlapping phases: stabilization, structural reform and further structural reform.

60. It comprises a new macro-economic package which includes the devaluation of the Birr, improved incentives for the agricultural sector to produce and export a surplus, and the promotion of sustained growth of the economy. The PFP includes the formulation of a **Conservation Strategy** in its package of policies and strategies for structural adjustment.

61. Of the 18 policy areas covered in the Policy Framework Paper, eight are dealt with directly or indirectly by the Federal Policy on Natural Resources and the Environment. The linkages are shown in Table 2.

Table 2. ***Policy framework and its linkages with CSE***

PFP Policy Area		**Related CSE Sectoral and Cross-sectoral Programmes**
a)	***Sectoral Programmes***	
	Environment	Improved Land Husbandry, Forestry, Biodiversity, Environmental Education
	Agriculture	Sustainable Agriculture, Improved Land Husbandry, Forestry, Rangelands Management
	Water Supply & Sewerage	Water Resources Development, Urban Environment
	Mining	Mineral Resources Development
	Energy	Energy Development
b)	***Cross-Sectoral Programmes***	
	Human Resource Development:	
	– Education	
	– Population	Environmental Education Population and Resources
	Investment Policy and Industry	Mineral Development, Energy Development, Environmental Economics
	Pricing and Distribution	Water Supplies, Minerals, Energy, Forest Industries, Environmental Economics

1.6.3 The Long-Term Strategy of Economic Development for Ethiopia

62. **The Overall Strategy:** The country's long-term economic development strategy is termed **Agricultural Development-Led Industrialization (ADLI)** and has been formulated within the framework of the Transitional Economic Policy. The goal of this strategy is to achieve rapid and sustainable economic growth by improving the productivity of the agricultural sector and building up an agriculturally based industrial sector which is labour-intensive and utilizes local raw materials.

63. The export of firstly agricultural, but increasingly mineral products, will be the main initiators of growth, which will in turn provide the means for a self-generating process of interdependent agricultural and industrial development. The strategy thus has two layers: "an outer crust of export led growth and an inner core of ADLI".

64. **The Agricultural Development Strategy:** The ADLI strategy focuses primarily on agricultural development to be attained through improved productivity of peasant agriculture and the establishment of large-scale private commercial agriculture, particularly in the lowlands.

65. Peasant agriculture is envisaged to develop in three stages with stages 1 and 2 taking place in the short to medium-terms. Stage 1 involves the improvement of existing crop and land husbandry practices and techniques. Stage 2 consists of the development of agricultural infrastructure such as small-scale irrigation and the introduction of fertilizers and agrochemicals.

66. Stage 3 is a long-term strategy which envisages increasing farm sizes which will occur as the population moves out of agriculture to non-agricultural activities. The strategy sees that the sustainability of agriculture in the long-term can only be realized by sufficient industrial employment generation so as to absorb a rural population which is no longer able to enter into, or is moving out of, agriculture.

67. **The Industrial Development Strategy:** The industrial development strategy relies predominantly on an expansion of the manufacturing sector directed primarily at the domestic market, using labour-intensive technology and, as much as possible, domestically available raw materials. According to the ADLI strategy, people in the agricultural sector will become a major market for domestically produced consumer goods. Manufacture of goods for export will play a relatively minor role in the industrial development strategy.

1.6.4 The National Population Policy

68. The **National Population Policy** was issued in April 1993. The policy has the following general objectives:

a) Closing the gap between high population growth and low economic productivity through a planned reduction of population growth combined with an increase in economic returns;

b) Expediting economic and social development processes through holistic and integrated development programmes designed to expedite the structural differentiation of the economy and employment;

c) Reducing the rate of urban migration;

d) Raising the economic and social status of women by freeing them from the restrictions and drudgeries of traditional life and making it possible for them to participate productively in the community at large; and

e) Significantly improving the social and economic status of all vulnerable groups (women, youth, children and the elderly).

69. Specific objectives of relevance to the CSE are:

a) Making population and economic growths compatible and thus the over-exploitation of natural resources unnecessary;

b) Ensuring spatially balanced population distribution patterns with a view to maintaining environmental security and extending the scope of development activities;

c) Improving productivity in agriculture and introducing off-farm non agricultural activities for the purpose of employment diversification;

d) Mounting an effective country-wide population information and education programme addressing issues pertaining to the small family size and its relationship with human welfare and environmental security; and

e) Maintaining and improving the carrying capacity of the environment by taking appropriate environmental protection and conservation measures.

1.6.5 The National Policy on Women

70. The **National Policy on Ethiopian Women** was issued in March 1993 and has the following objectives:

a) To ensure and respect women's rights to equality in every aspect of life;

b) To create an environment which will enable women to equally initiate ideas and participate in the formulation and implementation of development and economic plans;

c) To eliminate, step by step, centuries old gender based discriminatory attitudes and practices towards women; and

d) To ensure the supply of basic services necessary for women as well as for the overall development of society.

71. The policy stresses three major objectives which must be part of all other policies, plans or laws:

a) Laws, regulations, systems, policies and development plans that are issued by the Government shall ensure the equality of men and women. Special emphasis shall be given to the participation of rural women;

b) Economic, social and political policies, programmes and activities shall ensure the equal access of men and women to the country's resources and in the decision making process so that they can benefit fully from all activities carried out by central and regional institutions; and

c) Development institutions, programmes and projects shall ensure women's access to and involvement in all interventions and activities.

1.6.6 The Constitution

72. The Constitution was approved by the Constituent Assembly in December 1994. It reaffirms all the developments which have so far been considered in this volume as positive for the environment. Among others, it addresses the following:

a) Maintains land under the ownership of the Ethiopian people and government but protects security of usufructuary tenure;

b) Reinforces the devolution of power and local participation in planning, development and decision taking;

c) Ensures the equality of women with men;

d) Ensures the appropriate management as well as the protection of the well-being of the environment; and

e) Maintains an open economic policy.

1.6.7 The Federal Democratic Republic of Ethiopia (FDRE)

73. On August 18, 1995 the Transitional Government of Ethiopia tenure came to an end and on August 21, 1995 state power was transferred to the first elected government, which formally established the Federal Democratic Republic of Ethiopia (FDRE).

The FDRE comprises of the Federal State and the Regional State members. The Federal State and Regional States have legislative, executive and judicial powers. The parliamentary system of government has two councils, the Council of Peoples Representatives and the Council of Federations.

The Council of Peoples Representatives, which is the highest legislative body in the Federation, has 550 seats of which 20 are reserved for the representation of minority nationalities. The Council of Federation is mandated to interpret the constitution and deal with issues related to constitutional matters. Each nation, nationalities and peoples in the country are represented by at least one deputy in the council with an additional one deputy for every one million population.

The President of the Republic, with a six year term of office, was elected by the joint session of the Council of Peoples Representatives and the Council of Federations. The Prime Minister, who is the Chairman of the Council of Ministers and Commander-in-Chief of the armed forces, was elected for a five year term. The Council of Ministers, which is composed of 14 Ministers, a Deputy Prime Minister who is also a Defence Minister, another Deputy Prime Minister and a Director of the Administration of Federal Revenue, took office on August 25, 1995.

The Federal Democratic Republic of Ethiopia has nine Member States, which are: Tigrai, Afar, Amara, Oromiya, Somali, Benshangul/Gumuz/, Southern Nations, Nationalites and Peoples, Gambela Peoples, and Harari Peoples.

The Addis Ababa Administration is responsible to the Federal Government.

1.7 THE FORMAT OF THE FEDERAL POLICY ON NATURAL RESOURCES AND THE ENVIRONMENT

74. This policy document comprises three main sections:

    a) Overall policy goals and objectives and a number of key guiding principles;

    b) Cross-sectoral policy objectives, principles and strategies; and

    c) Sectoral policy objectives, principles and strategies.

Within the last two sections, each cross-sectoral or sectoral area is presented as a logical sequence flowing from a "Situation Synopsis" which leads to a "Policy Objective". This leads to a set of "Guiding Principles" from which logically follows a set of "Strategies" for implementation. The strategies lead logically to a set of Prioritized Actions in Volume IV with a corresponding set of Investment Programmes, Components and Elements in Volume V.

CHAPTER II

THE FEDERAL POLICY ON NATURAL RESOURCES AND THE ENVIRONMENT

2.1 SITUATION SYNOPSIS

75. The Government of the Federal Democratic Republic of Ethiopia (FDRE)has established a macro-economic policy and strategy framework. Sectoral development policies and strategies have been, or are currently being, formulated. Environmental sustainability is recognized in the constitution and in the national economic policy and strategy as a key prerequisite for success. However, there is as yet no overall comprehensive cross-sectoral and sectoral policy framework on natural resources and the environment to detail these broad directions and guide the sustainable development, use and management of the natural resources and the environment. Therefore, given the current stage of the country's political and policy development, the time is most opportune for developing a comprehensive environmental policy on natural resources and the environment.

2.2 THE OVERALL POLICY GOAL

76. The overall policy goal is to improve and enhance the health and quality of life of all Ethiopians and to promote sustainable social and economic development through the sound management and use of natural, human-made and cultural resources and the environment as a whole so as to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

2.3 SPECIFIC POLICY OBJECTIVES

77. The policy seeks to:

a) Ensure that essential ecological processes and life support systems are sustained, biological diversity is preserved and renewable natural resources are used in such a way that their regenerative and productive capabilities are maintained and where possible enhanced so that the satisfaction of the needs of future generations is not compromised; where this capability is already impaired to seek through appropriate interventions a restoration of that capability;

b) Ensure that the benefits from the exploitation of non-renewable resources are extended as far into the future as can be managed, and minimize the negative impacts of their exploitation on the use and management of other natural resources and the environment;

c) Identify and develop natural resources that are currently under-utilized by finding new technologies, and/or intensifying existing uses;

d) Incorporate the full economic, social and environmental costs and benefits of natural resource development into the planning, implementation and accounting processes by a comprehensive valuation of the environment and the services it provides, and by considering the social and environmental costs and benefits which can not currently be measured in monetary terms;

e) Improve the environment of human settlements to satisfy the physical, social, economic, cultural and other needs of their inhabitants on a sustainable basis;

f) Prevent the pollution of land, air and water in the most cost-effective way so that the cost of effective preventive intervention would not exceed the benefits;

g) Conserve, develop, sustainably manage and support Ethiopia's rich and diverse cultural heritage;

h) Ensure the empowerment and participation of the people and their organizations at all levels in environmental management activities; and

i) Raise public awareness and promote understanding of the essential linkages between environment and development.

2.4 THE KEY GUIDING PRINCIPLES

78. Underlying these broad policy objectives are a number of key principles. Establishing and clearly defining these guiding principles is very important as they will shape all subsequent policy, strategy and programme formulations and their implementation. Sectoral and cross-sectoral policies and environmental elements of other macro policies will be checked against these principles to ensure consistency.

79. **The Key Guiding Principles are:**

a) Every person has the right to live in a healthy environment;

b) Sustainable environmental conditions and economic production systems are impossible in the absence of peace and personal security. The surest way of bringing this about is through the acquisition of power by communities to make their own decisions on matters that affect their life and environment;

c) The development, use and management of renewable resources should be sustainable;

d) The use of non-renewable resources should be minimized and where possible their availability extended (e.g. through recycling);

e) Appropriate and affordable technologies which use renewable and non-renewable resources efficiently should be adopted, adapted, developed and disseminated;

f) When a compromise between short-term economic growth and long-term environmental protection is necessary, then development activities should minimize degrading and polluting impacts on ecological and life support systems. When working out a compromise, it is better to err on the side of caution as rehabilitating a degraded environment is very expensive; and bringing back a species that has gone extinct is impossible;

g) Full environmental and social costs (or benefits foregone or lost) that may result through damage to resources or the environment as a result of degradation or pollution should be incorporated into public and private sector planning and accounting, and decisions should be based on minimizing and covering these costs;

h) Market failures with regard to the pricing of natural, human-made and cultural resources, and failures in regulatory measures should be corrected through the assessment and establishment of user fees, taxes, tax reductions or incentives;

i) Conditions should be created that will support community and individual resource users to sustainably manage their own environment and resources;

j) As key actors in natural resource use and management, women should be treated equally with men and empowered to be totally

involved in policy, programme and project design, decision making and implementation;

k) Security of land and resource tenure is a fundamental requirement for sustainable natural resource management;

l) Social equity should be assured particularly when allocating or alienating resource use and property rights;

m) Regular and accurate assessment and monitoring of environmental conditions should be undertaken and the information widely disseminated within the population;

n) Increased awareness and understanding of environmental and resource issues should be promoted by policy makers, government officials and by the population, and the adoption of a "conservation culture" in environmental matters among all levels of society should be encouraged;

o) Local, regional and international environmental interdependence should be recognized;

p) Natural resource and environmental management activities should be integrated laterally across all sectors and vertically among all levels;

q) Species and their variants have the right to continue existing, and are, or may be, useful now and for generations to come;

r) The wealth of crop and domestic animal as well as micro-organisms and wild plant and animal germplasm is an invaluable and inalienable asset that must be cared for; and

s) The integrated implementation of cross-sectoral and sectoral federal, regional and local policies and strategies should be seen as a prerequisite to achieving the objectives of this Policy on Natural Resources and the Environment.

NOTE: **The following information is in *DRAFT*. It is provided for instructional purposes to assist participants in the EA Training Course conducted for USAID/Ethiopia Title II partners and others in Mekele, Ethiopia, February 24-28, 1997.**

DRAFT PROVISIONAL EIA PROCEDURE FOR ETHIOPIA WITH SPECIFIC REFERENCE TO AGRICULTURAL AND INDUSTRIAL DEVELOPMENT PROJECTS

1. Introduction

Development planning in Ethiopia has in the past been rather rudimentary, and the little that existed paid little or no attention to environmental impacts. As a result, a serious degradation of natural resources and damage to the environment and human health have occurred. In some cases both the environmental complex of certain ecosystems and the well intentioned culprit development projects have been adversely affected in the process. In other case the negative social consequences of development projects have been significant.

Ethiopia, though basically a rural country, is launching a major Programme for the intensification of agriculture, including the large scale development of irrigation schemes, and industrialization through its Agricultural Development Led Industrialization (ADLI) Policy. If appropriate environmental monitoring and protection is not carried out, the development efforts of these projects could damage the environment and make development unsustainable.

Past experiences show that in the absence of any comprehensive Environmental Impact Assessment (EIA) procedure for the study of development projects, the content and scope as well as the procedures for conducting the studies have been mostly left to the discretion of the proponent as well as to various government organizations and other concerned bodies working without coordination.

The most effective and economic way of maintaining environmental quality in development is to anticipate and eliminate, or at least correct most problems as early as possible. The universally accepted strategy for environmentally sound development is the introduction of the Environmental Impact Assessment (EIA) procedure as a tool in the planning and decision making process.

The Environmental Protection Authority (EPA) has been established as an autonomous government body entrusted, among other things, with the major task of preparing an EIA procedure for Ethiopia. This would have importance in promoting the social and economic progress of the country and in utilizing its natural resources in a sustainable way. The development of an EIA system, complete with its legislation, takes a lot of data collection, evaluation, debate and drafting.

In view of this therefore, EPA has realized that there is a need to develop a provisional EIA procedure which could be used as an instrument to guide the writing of EIA reports of proposed projects by their applicants, and to evaluate them by EPA. In doing this, EPA has focused on agricultural and industrial development. This provisional EIA system is to be implemented on a voluntary basis while a more appropriate procedure and legislation are being developed and is thus not supported by legislation.

2. Background to the Provisional EIA Procedure

2.1 Definitions

2.1.1 *Environmental impact assessment*

An environmental impact assessment (EIA) is a process to improve decision making and to ensure that

a project/Programme under consideration is environmentally and socially sound and sustainable. It is concerned with identifying, predicting and evaluating the foreseeable environmental impacts both beneficial and adverse, of public and private (development) activities, alternatives and mitigating measures, and aims to eliminate or minimize negative impacts and optimize positive impacts. It is a formal study process and is applied to proposed development projects. Thus EIA is a tool for both planning and decision making with the objective of ensuring that potential problems with polices, programmes and projects and other development activities are foreseen and addressed at an early stage in a project cycle.

2.1.2 *Environmental impact statement*

An environmental Impact Statement is the report presenting the results of an EIA for proposed development projects.

2.2 Need for a draft provisional EIA procedure in Ethiopia with special reference to agriculture and the manufacturing industry.

Past experiences show that programmes and projects undertaken by these two sectors (Agriculture and Industry) of the economy have caused damage to the environment and to the health of the people. All too often, the effects of development projects, especially those of large scale irrigation and industries, are not taken into account at the planning phase. The traditional cycle of project preparation and decision is based on short term economic and technical feasibilities and neglects the environmental and social as well as the long term economic dimensions.

It is because of the prevalence of this short term view that EPA decided to undertake a quick development of this draft provisional EIA procedure focused on these two important development sectors.

2.3 Development of one procedure

Most of the issues which are raised in establishing the mechanism for the effective implementation of the provisional EIA procedure in the development projects of agricultural and industrial sectors, and in fact of all other sectors as well, are essentially similar.

For this reason, one procedure has been prepared which is relevant to all development projects. However, the technical aspects included deal mostly with agriculture and industry. Such details for other sectors can be covered in technical guidelines specific to those sectors.

3. The Need to Prepare an Environmental Impact Statement (EIS)

3.1 For any proposed agricultural or manufacturing industrial development project which falls within schedule 1, which is given at the end of this provisional procedure, a mandatory Impact EIS must be prepared. In some instances an EIS may be unnecessary either because of the technology to be used for processing or because of its location. The detailed lists specifying the types of development or activity requiring EIAs are to be prepared in collaboration with the responsible sectoral agencies.

3.2 The burden of proof for any claim that an EIA is not necessary for any project lies fully with the proposer of the project.

3.3 The proposer shall make his own initial assessment of the environmental impacts associated with the proposed project and, on the basis of the assessment, determine whether a full environmental impact statement (EIS) is required or not, i.e. whether it falls in schedule 1 or not. If he concludes that it does not require a full EIS, he shall apply for a recognition of the fact.

3.4 A project proposer seeking such exemption must submit full information to the concerned sectoral agency

showing that no significant impact is expected. The agency in consultation with EPA must make its decision within 1 month on whether the exemption is granted or not.

3.6 The information accompanying the application for exemption must be made available by the agency which has received it to the other concerned agencies. The agencies being consulted should be given 2 weeks in which to submit their comments to the sectoral agency.

3.7 It is required that an EIS be prepared by both public bodies and private individuals. This obligation should be extended to:

- all Ministries and government agencies
- all national regional state governments,
- all legal or natural persons or entities in the private sector proposing projects

4. Timing of EIS Preparation

4.1 In order to enable informed decisions before any resources are wasted, the preparation and circulation of an EIS has to begin at the conception of a project and has to be reviewed before other activities start.

5. Environmental Impacts of a Project's Evolutionary Stages:

- Conception: preliminary EIA
- Planning: Detailed studies of environmental impacts and design of safeguards
- Execution: Implementation of environmental safety measures
- Operation and maintenance: Monitoring of effectiveness of built-in safeguards

6. Responsibility for Preparation of an EIS

6.1 Preparation of the EIS is the responsibility of the project proposer. All costs shall be borne by the proposer.

6.2 The prposer must consider and assess reasonable alternatives to meet the objectives of the development project.

6.3 Environmental screening should be undertaken by the project proposer in order to determine whether the project does or does not require an EIA. This screening is essentially a desk exercise and should be done at the beginning of the project identification stage of the project cycle. The screening process should take into account the size/scale, nature as well as location of the proposed project.

6.4 A proposer should submit a brief report on the screening stage to the appropriate sectoral agency and to EPA for action.

7. Detailed EIA Requirements of Development Projects.

Projects that are to be implemented in the areas enumerated in 7.1, or are of the types described in 7.2-7.4 require detailed EIA.

7.1 The following list may indicate the areas which are considered to be environmentally sensitive and as a result, any development project in the said areas is strictly required to submit a detailed EIA:

- Land prone erosion
- Land prone to desertification
- Areas which harbour protected, threatened or endangered species

- Areas of particular scientific interest (e.g. fossil deposits)
- Areas of outstanding natural beauty
- Areas of particular historic or archaeological interest
- Areas of importance to threatened ethnic groups
- Primary forests
- Wetlands of national or international importance

7.2 The manufacture, handling and use of hazardous materials

7.3 Upstream development activities which could affect downstream areas negatively

7.4 Development activities which can significantly alter the land use pattern or the landscape and lead to the concentration of the working population;

8. **Ruling on the Need of EIA**

8.1 Unless there is need for a longer period and the proposer is informed accordingly, EPA must give its opinion regarding the need for preparing an EIS within two weeks from the receipt of the application of the proposer.

8.2 Where EPA believes that a particular project proposed requires EIS, it must provide a written statement giving clear and precise reasons for its opinion.

8.3 A proposer who is dissatisfied with the opinion that an EIS is required may refer the matter to the General Manager of EPA. The General Manager is expected to give his decision within two weeks of the proposer's application. The General Manager's decision is final.

9. **Submission of Environmental Impact Statements**

9.1 The EIS must be submitted to the EPA accompanying any application for authorization.

9.2 An EIS

a. shall be analytical and short;
b. shall discuss impacts in proportion to their significance;
c. shall give a range of alternatives which will be considered by EPA decision makers;
d. will be objective and free from editorial comment;
e. will be based on scientific information;
f. will identify any shortcomings in data and explain why these shortcomings arose.

10. **Review of Environmental Impact Statements**

10.1 EPA is legally mandated to review EISs. The Authority will review all EISs and inform the project proposer as to whether the EIS acceptable or not. The Authority shall indicate the nature and type of additional information required should an EIS be deemed defective.

10.2 EPA shall require proposers to revise EISs deemed inadequate. Notwithstanding other requests by the appropriate sectoral agency, EPA may request the project proposers to provide any additional information needed to enable it to make an informed decision on his proposal.

11. **Consultation and the Preparation of Terms of Reference**

11.1 The project proposer should undertake both formal and informal consultations with:-

- concerned ministries, and other public authorities;

- regional and local government authorities;
- concerned agencies, NGOs and the general public

in order to attempt to gain a consensus on the scope of the EIS and the alternatives to be assessed. By this means the EIA will focus on those issues of concern to all stakeholders and the resulting EIS will be made relevant for decision making.

11.2 In these consultations due regard must be paid to the "Checklist of potential Environmental Impacts" in the annex at the end of this procedure.

11.3 The annex provides a checklist of potential environmental impacts (issues) to be considered in the EIS. It should be made clear that the checklist is indicative only and not exhaustive. This condensed checklist is extracted from the more extensive discussion of potential environmental impacts of agricultural and industrial development projects (see Annex 1). Even the more extensive discussion is, however, itself indicative; it is not desirable and probably not possible to give an exhaustive listing of possible impacts.

The checklists are not going into great detail on technical aspects that are pertinent to projects of particular sectors. Such details can only be covered in sector specific technical guidelines which are planned to follow in the near future.

11.4 The project proposer must produce a Terms of Reference (TOR) for the EIS listing the scope of the EIA. This TOR must be submitted to EPA for approval. EPA is also available to assist the proposer in preparing the TOR if necessary. The task of determining the scope of the EIA is critical, and is therefore one in which EPA normally participates. It is important not only to cover the environmental issues known at the inception of the study, but it is also likely that new issues may be identified later, and they must be addressed.

11.5 No EIS will be accepted by EPA unless its TOR has already been approved.

12. Public Participation

12.1 On receipt of an EIS, EPA and/or its delegated body shall take such steps as may be necessary to ensure that it is available to the public. This is because without consultation and the reaching of consensus on the impacts of a project and on the acceptable mitigation measures, not only does the project risk failure but the procedure will also be seen to have failed. The approach to conducting consultations with the public on the draft EIS is by producing a non-technical summary of its findings.

It is to be noted that this consultation procedure can constitute a major exercise and would be inappropriate for smaller projects or for application at all stages of the project cycle. However for large projects at the project preparation stage full consultation will be essential.

12.2 The public will be given an opportunity to comment on an EIS and on the merits of the proposed development and these comments will be taken into account by EPA in making its decision.

13. Environmental Impact Statements and the Decision-Making Process

13.1 EPA and/or its delegated body must take EISs into account in arriving at its decisions on the proposed development project.

14. Content and Form of Environmental Impact Statements

14.1 The EIS will be presented in writing and will include such maps, plans, tables, graphs and other illustrative material as appropriate in order to enable the EPA and other concerned government agencies to easily

appreciate what the statement says.

14.2 An EIS should include:-

a) a description of the proposed development project covering:

- need
- objectives
- technical details

b) an outline of the main alternatives studied by the proposer

c) a description of the local environmental, socio-economic and health conditions summarizing the essential elements of the environmental/socio-economic systems in the locality and trends occurring. Elements to be assessed must include fauna, flora, habitats, soil, water, air, cultural artifacts, and socio - cultural, socio-economic and health consideration.

d) a description of the time span for which impacts are predicted and the geographic boundaries selected to define the study area.

e) an account of the prediction and assessment of each impact (derived from TOR) during the construction, and operation phases of development for each alt ernative. Wherever possible impact prediction should be expressed quantitatively. This information must be presented in a Technical Appendix to the EIS. For each impact, information must be provided on :

(i) the magnitude (expressed in appropriate units)
(ii) whether it is reversible or irreversible
(iii) whether it is adverse or beneficial
(v) likelihood of its occurrence
(vi) any other useful information

f) A discussion should be made of the distribution of these impacts in time and space to identify all their cumulative consequences on communities and the environment, and other components likely to be stressed by such impacts. An assessment of the overall significance of such cumulative impacts must be provided.

g) A description of measures to prevent or reduce significant adverse impacts or enhance beneficial effects and an assessment of their likely outcome.

h) A description of residual impacts which can not be mitigated or can only be mitigated partially.

i) A description of proposed monitoring schemes

j) A discussion of potential uses of the environment which will be prevented or rendered less productive due to adverse impacts.

k) A discussion of possible environmental impacts that will affect the ability of the project to achieve its objectives.

14.3 An executive summary must be included at the beginning of the EIS. This summary is to present and highlight the main issues pertinent to decision making on the proposed project.

15. EIA Procedure and the Project Cycle

15.1 In general it is important that the environmental consequences of a proposed project are recognized early in the project cycle since this makes it easier and less costly to expand, reject or substantially modify the proposal. As projects pass through successive stages of the cycle and are not "rejected" their scrutiny should go into more detail.

15.2 An EIA will recommend an element of monitoring of the actual environmental mpact of a project once implementation takes place in order to check that:-

- there has been compliance with environmental standards
- recommended amelioration/mitigation measures have been implemented
- no unexpected impacts have arisen .

Therefore, elements of EIA have to be operational at all stages of the project cycle.

16. Environmental Impact Surveillance

16.1 Once a year or as deemed necessary, EPA may conduct an environmental impact surveillance on the basis of data acquired from various sources, and/or supplied by the proposer.

16.2 The project owner shall develop specific environmental management rules and procedures, environmental impact inspections (audits), analysis of accidents and near accidents and a monitoring system together with relevant indicators and report to the EPA annually or as requested.

Annex 1

Potential Environmental Impacts of Agriculture and Industrial[1] Development Projects

I. AGRICULTURE

1. Introduction

Agriculture is the dominant sector of the economy accounting for about 50 percent of GDP and 85 percent of export revenue, and providing livelihood for 85 percent of the population. Agriculture in Ethiopia is mainly of mixed crop and animal production in the wetter highland and transhumant animal production in the drier lowlands.

In rainfed mixed agriculture, a family may grow a few acres of crops on a small holding usually in small scattered parcels using animal traction for power.

There is also some large scale mechanized agriculture; but in terms of overall production, the small peasant sector dominates.

The areas with rainfall and temperature adequate for crop production are in the highlands from about 1800m. to 3000 m. in the eastern parts and from about 800 to 3000 in the western parts.

1.1. Areas of the country which are of concern

1.1.1 *Highland agriculture*

The areas of Ethiopia with sufficient rainfall and temperature have been under agriculture for about 8000 years. A number of crops scarcely known elsewhere in the world are extensively cultivated in these area. Crops are often grown on precipitous slopes with inadequate measures for soil conservation. These methods of cultivation, practiced by a high and increasing human population, have already ruined once fertile and productive areas, especially in the north and east. All other areas of the country are rapidly going the same way.

1.1.2 *Lowland arid regions, and irrigated agriculture*

In the last few decades small, medium, and large scale irrigated agriculture mainly growing cash or industrial crops (sugar cane, cotton, fruits etc). In Ethiopia the arid regions are characterized by much sunshine and by soils prone to salinization.

1.2 Potential environmental consequences (impacts)

Major developments in the agricultural sector are crop production, irrigation development schemes, animal husbandry (such as poultry-rearing installations, cattle raring etc.) often involving the use of uncultivated land or semi-natural areas for intensive production. It is necessary to anticipate some of the potential

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[1] The section on industrial development is not included here.

environmental consequences (impacts) of agricultural development projects in order to incorporate some safeguards and/or mitigating measures. This provisional EIA procedure will benefit the investor and the country by steering the projects into sustainable development and by avoiding the careless use and destruction of Ethiopia's fragile environments and precious natural resources, on which present and future generations depend.

The possible impacts of development projects on the environment are both direct and indirect. It is often difficult to distinguish clearly between the two categories of impact. The causes of the direct environmental impacts can be linked to specific aspects of the projects themselves. Indirect impacts arise from development processes ensuing from the projects; or from changes of or effects on the socio-cultural conditions and the management of natural resources, brought about by the outcomes of the projects in some way or other.

In view of this therefore, the anticipated potential environmental problems of development projects are the following:

2. Crop Production

2.1 Impacts on air and climate

The possible impacts of crop production activities on the atmosphere and climate arise from burning biomass and the consequent emission of carbon dioxide Since photosynthesis changes the carbon dioxide into biomass, the net impact is insignificant. The significance increases with the burning of fossil fuel since its impact is cumulative.

2.2. Impacts on soil

2.2.1 Erosion - Physical damage. Following soil cultivation, soil compaction and water and wind erosion occur. The same effect also can occurs.

2.2.2 *Nutritional deficiency* - Nutrients are taken out through the crops cultivated.

2.2.3 *Acidity* - Most cultivated crops require neutral or near neutral PH. Old and leached types of soils have low PH, in which the plant roots may suffer from aluminum, iron and manganese poisoning.

2.3 Impacts on water resources

Agriculture may pollute surface water with nutrients, salts, environmental toxins and particles. In addition, the raised nutrient status of the drainage water supports high populations of microflora and fauna and will result in oxygen deficiency.

Pollution of ground water may also occur from the nitrates in fertilizers and from the decomposition of high amounts of organic matter caused by heavy nitrogen fertilization as well as from pesticides and fungicides.

2.4 Impacts on ecosystems, landscapes & historical monuments

The cultivation of virgin or partly virgin land may conflict with the wish to preserve biological diversity, to conserve continuos natural habitats for the benefit of particular migrating species, and to protect ecosystems and natural landscapes. Agriculture may disrupt the natural ecosystem beyond the cultivated areas through encouraging grazing, grass burning, felling, hunting etc.

2.5 Spreading of pest & diseases

Several tropical and infectious diseases are carried by water and may be disseminated through irrigation and flood control systems.

2.6 Impacts of the use of improved seed and biotechnology

Seed is normally imported for trials, for propagation, or for direct distribution to growers. There is always the danger of unwitting importation of plant diseases and pests and unwanted genetic material, especially weeds, together with the seed.

Transgenic seeds of unproven safety could also be ill-advisedly imported.

2.7 Changes in landuse and impact on lifestyles

Conflict between crop farming and other uses of land and the utilization of resources such as forestry, animal husbandry etc. is common. Under such condition the local populations may also be subject to limitations on their possibilities for their traditional utilization of the natural resources such as hunting, fishing, gathering fruits and fuel wood etc.

3. Animal Husbandry

3.1 Overgrazing

The most serious impact is indicated by reduced feed supply leading to the undernutrition and malnutrition of animals. As a consequence of over grazing, may occur.

- Increased surface runoff
- Erosion in steep terrain
- reduced ground water
- reduced water flow in streams and rivers.

3.2 Pollution of air, soil and water.

Manure can pollute air by the emission of smell, from hydrogen sulphide, and ammonia.

- Large concentrations of ammonia can do damage to vegetation.

- Hydrogen sulphide gas developing in manure with bad ventilation may cause poisoning and may even kill animals and humans.

- Methane contributes to green house effect and is 8 times stronger than carbon dioxide fifteen percent of the total methane emitted to the atmosphere comes from domestic animal (ruminants).

3.3 Special impacts of livestock-based industry

Some of the special impacts are:

- Increased water consumption
- Discharge of pollutants into the air, water and soil.
- Land use conflicts

. Socio-economic disruption.

3.4 Loss of valuable genes:

Modern agriculture uses homogenous crop varieties and animal breeds thereby causing genetic erosion .

3.5 Environmental Health

3.5.1. *Pollution of air, soil and water*

Manure can pollute air by the emission of methane and the smelling gasses, hydrogen sulphide, ammonia and some cyclic chemical compounds. Ammonia in large concentrations can do damage to the vegetation. Hydrogen suplhide gas developing in a manure cellar can, in cases of carelessness and bad ventilation, cause poisoning that may harm, and may even kill, animals and humans.

3.5.2 *Infection pressure and diseases*

When siting a livestock project, the risk of serious diseases should be taken into consideration. Some livestock diseases can be transmitted to humans and wild animals and thus pose a threat to society and to the environment. Generally speaking, the heavier the stocking rate in an area, the greater is the risk that infectious diseases may break out.

Chemical insecticides being used to fight ticks, flies, horseflies etc. are often either very persistent (not easily broken down) in nature (e.g. chlorinated hydrocarbons such as DDT, Lindane) or, if not safely used, extremely poisonous for the users (e.g phosphoric insecticides).

3.6 Other ecological impacts, and consequences for landscapes.

Well drilling for watering animals causes a lowering of the water table.

4. Irrigation and Drainage Projects

4.1. Hydrological impacts

4.1.1 *Low flow regime*

Changes to low flow regimes due to irrigation may have significant negative impacts on downstream users by reducing their water supply, and by increasing the concentrations of dissolved and suspended substances.

4.1.2 *High flood regime*

Uncontrolled floods may cause damage and flood control is therefore often an added social and environmental benefit of reservoirs. River banks may also be raised for flood protection. However, flood protection works, although achieving their purpose locally, may increase flooding downstream.

4.1.3 *Fall of water table*

Lowering the ground water table may adversely affect existing users of ground water whether it is required for drinking or to sustain plant life especially at dry times of the year. Springs are fed by ground water and may dry up if the level of ground water falls. Similarly, low flows in rivers may be reduced.

4.1.4 *Rise of water table*

One of the most frequent problems of irrigation schemes is the rise in the local water table (water logging) of the irrigated areas. Low irrigation efficiencies, as low as 20% to 30% in some areas, are among the main causes for the rise of water tables. Poor water distribution systems, poor main supply system management and inappropriate irrigation practices are the main reasons of rising water tables.

4.2 Water and air quality

4.2.1 *Concentration of dissolved and suspended substances*

Reduction in low flows results in increased pollutant concentration discharged into the water course either from point sources, such as industry, irrigation drainage etc. or from non-point sources such as agro-chemicals leaching into ground water and soil erosion.

4.2.2 *Toxic substances*

Pesticides are a common sources of poison associated with irrigation schemes. The soil is contaminated because of the use of chemicals and the following metals are usual contaminants: aluminum, arsenic, beryllium, chromium, cadmium, mercury, nickel, antimony and tin.

4.2.2 *Agrochemical pollution*

High levels of nitrates in drinking water can cause health problems. A high nutrient level may be toxic to some aquatic life and encourages rapid rates of algal growth which tends to decrease the oxygen level of water and thus lead to suffocation of fish and other aquatic biota.

4.2.4 *Anaerobic effects*

Most anaerobic conditions are the results of an oversupply of nutrients. The decaying of organic substances may result in anaerobic conditions. Anaerobic decomposition should be avoided as it produces gases such as hydrogen sulphide, methane and ammonia all of which are poisonous and some of which contribute to the green house effect.

4.2.5 *Contamination from industrial gas emission*

Irrigated areas can become contaminated by emissions from industry, particularly areas that are close to urban or industrial sites.

4.3 Soil properties and the effects of salinity.

4.3.1 *Soil salinity*

Four reasons are known for an increased soil salinity:

i. Salts carried in the irrigation water are liable to build up in the soil profile, as water is removed by plants and the atmosphere at a much faster rate than salts.

ii. Solutes applied to the soil in the form of artificial and to some extent even natural fertilizer will not all be utilized by the crop.

iii. Where the ground water level is both high and saline, water will rise by capillary action and then evaporate, leaving salt on the surface and in the upper layer of the soil.

iv. The change from a rainfed single crop per year production to irrigation or the change from a single to double crop per year irrigated production may create a "humidity/salinity bridge" in the soil, between a deep saline ground water and the salt free surface layers of the soils.

4.3.2 *Salinization and drainage*

Areas with flat topography or with high water tables are at risk from salinisation as are areas with soils of low permeability which are difficult to leach.

4.3.3 *Saline and alkaline intrusions*

The location of boundary between fresh and salt or alkaline water near salt or alkaline lakes is a function of the hydraulic potential of the freshwater. A lowered water table will result in the boundary moving inland as the pressure reduces. Large numbers of people may be affected by the decreased quality of their drinking water.

4.3.4 *Salinization or alkalization of lake water and outflow*

If flow of water into a moderately salty or alkaline lake is reduced through upstream irrigation or other diversions, the concentration in the lake of salts and alkalis will increase. This may affect users of the lake water and of rivers which originate from the lake.

4.3.5 *Soil property*

The accumulation of salts in the soil can lead to irreversible damage to soil structure essential for crop production. Effects are most extreme in clay soils where a high concentration of sodium can bring about a soil structural collapse.

The change from rainfed to irrigated crop production or the intensification of existing irrigated crop production requires a higher level of nutrient availability in the top soil. If this aspect is not given adequate attention, productivity will fall and the irrigation efficiency remain low. High water losses through the profile will result in useful cations being washed out from the soil complex. A general lowering of PH may result in a decrease of the plant's capability to take up nutrients. The decrease in PH may also result in an increased availability or release of heavy toxic metals in the soil profile.

4.4 Erosion and sedimentation

A major negative impact of erosion and the associated transport of soil particles is the sedimentation of reservoirs and water diversion points downstream, such as irrigation intakes and pumping stations.

Increased sediment load is likely to change the river morphology which together with the increased trubidity will affect the downstream ecology.

4.4.1 *Local erosion*

The method of irrigation profoundly affects the vulnerability of the land to erosion through increasing or reducing the mobilization of soil particles. Because irrigated land is wetter, it is less able to absorb rainfall and runoff will therefore be higher, increasing the risk of erosion both at the local level and downstream.

4.4.2 *Hinterland effects*

The development of irrigation schemes in developing countries is often associated with an increase in the intensity of human activity in areas surrounding the scheme. The increased human activity will have its

varied impacts.

4.4.3 *River morphology*

The capacity and shape of a river results from its flow, the materials of the river bed and bank, and the sediment carried by the flow. Diversion of water for irrigation will reduce the flow and may drastically change the river morphology.

4.4.4 *Channel structure*

The susceptibility of channel structure to damage is strongly related to changes in channel morphology and in sediment regime.

4.4.5 *Sedimentation*

Irrigation schemes fail if the sediment load of the water supply is higher than the capacity of the water flow in the irrigation canals to transport it.

4.5 Changes in Ecology and Biodiversity

The most obvious ecological changes arise from the impacts of changes in land use and water use on the terrestrial and the aquatic ecosystem affected by the project. Biological diversity areas of special scientific interest, animal migration and natural ecological process are among the important ecological phenomena that that can be affected as a result of these changes.

4.5.1 *The environment of the land and water body*

Irrigation, i.e. providing water to land that is short of it, will radically change both the agricultural and natural environments in the project area.

4.5.2 *Water bodies*

The use of reservoirs and channels creates new aquatic habitats. The consumption of water for irrigated agriculture and the reduced quality of return flows is likely to adversely impact on downstream ecosystems. Reduced flows are likely to have adverse impacts on downstream ecosystems. Reduced flows, increased salt concentrations, lower oxygen levels, higher water temperatures and increased pollution and silt loads all tend to favour a few vigorous pollution tolerant species (aquatic weeds).

4.5.3 *Surrounding areas*

Irrigation may have a positive impact, for example by settling migrant slash and burn farmers, or a negative impact, for example by raising the demand for fuel wood due to increases in localized concentrations of people.

4.5.4 *Wetlands and plains*

Irrigation can have a direct impact on wetlands by either changing the hydrological conditions or by reducing water amount and quality in downstream areas. The often high environmental and economic value of wetlands makes their study and preservation of key importance in an EIA.

4.6 Socio-economic impacts

Impacts of irrigation schemes are indicated by changes in migration and population distribution, changes

in income and amenities, change in the role of women and the care for and education of children, effects on minority groups, effects on regions (marketing, migration, physical infrastructure), in developing ways of user involvement, in developing recreation possibilities, in affecting sites of scenic, scientific or historical importance etc.

4.7 Ecological imbalances

There are four categories of imbalance and problems common to irrigation schemes.

4.7.1 *Pests and weeds*

Irrigation may double or even treble the time crops are in the field, and it usually enhances the ability of pests and weeds to multiply over a long period and spread effectively, often into new areas.

4.7.2 *Aquatic weeds.*

The main problems with aquatic weeds are that they reduce the storage and conveyance capacity of reservoirs, canals and drains and increase water loss through evapotranspiration.

4.7.3 *Crop diseases*

Irrigated agriculture often provides improved conditions for fungal and bacterial crop diseases to develop. Diseases and weeds can also spread quickly via the re-use of waste and drainage water.

4.7.4 *The effects of increases in the use of agrochemicals*

The increases in weeds and pests owing to irrigation is likely to elicit the increased use of agrochemicals. This, in turn, will increase the presence of toxic substance in the environment and result in ecological disruption.

4.8 Environmental Health

Agricultural development projects can have negative impacts on the health of the people as well as adverse effects on the environment unless appropriate control and preventive programmes are planned and implemented simultaneously.

The main categories of public and environmental health hazards that may commonly be encountered in agricultural development projects are summarized in the following paragraphs.

4.8.1 Water borne diseases

Ecological changes that may arise from development projects may create favourable conditions for the introduction and transmission of various diseases, e.g. malaria and schistosomiasis. Other communicable diseases, e.g. diarrhea, and helminthiasis may also spread widely. Likewise the threat of some endemic parasitic diseases e.g. onchocerciasis, leishmaniasis and arboviral diseases may be increased.

In general water related diseases fall into two main groups: those which have direct linkage through contamination of water, e.g. cholera, diarrhea in its various forms, and those which are transmitted through the agencies of parasite vectors, e.g. malaria, schistosomiasis.

4.8.2 Occupational diseases

With the process of mechanized farming to which this country is currently progressively moving, complex occupational and public health problems are inevitably going to crop up, and they need timely attention and consideration.

Among others the following are the major types of hazards which are expected to increase in the agricultural development projects:-

- hand tools used in crop husbandry will cause some accidents and musculoskeletal diseases,
- direct irradiation by the sun, heat, cold and rain encountered in outdoor work lead to some skin cancer, cataract, heat and cold syndromes;
- noise and vibration from machinery leading to noise induced deafness and other health problems;
- gases produced in handling fresh forage, stored grass silage and animal pens, will cause some silofilers lung and respiratory irritation.

4.8.3 Pollution by fertilizers and Pesticides

Inputs of fertilizers, pesticides, and herbicides are increasing. If these agricultural chemicals are either badly chosen or inappropriately used they will have deleterious effects on human and animal health.

Note: Section II on Industry is not included here, but can be obtained from NEPA.

9. USAID Environmental Procedures

Description/Objectives

To help you understand USAID environmental procedures and the special categorization process of the USAID's Bureau for Africa. This module covers elements of carrying out an Initial Environmental Examination (as defined by USAID's Regulation 16) or an Environmental Review (similar in content, but without need for as many levels of approval), including where applicable, the preparation and submission of necessary documentation.

This module also introduces you to recent Bureau efforts to increase responsibility of USAID field missions for environmental review. The use of Environmental Monitoring, Evaluation and Mitigation Planning processes also represents a more recent addition to the design of USAID programs and non-project assistance, but is discussed elsewhere in the Module Backgrounder for Session 16.

Readings

Module Backgrounder
Annexes to Module 9

MODULE BACKGROUNDER
Introduction to USAID Environmental Procedures

1. Introduction

This module introduces the process of environmental review of USAID funded activities for both program, program activity and non-project assistance and considers how environmental impacts are addressed in program and program activity design.

USAID's environmental regulations are embodied as 22 CFR 216 and commonly referred to as Regulation 16. The objectives of this session are to: 1) simplify and explain the regulations; 2) help field agents of USAID-supported activities understand how federal environmental law affects the program activity development and implementation process; 3) assist field agents in obtaining environmental clearances with the minimum cost and time expenditure practicable, consistent with the intent of the regulations; 4) apply environmental assessment principles based on USAID procedures; and 5) support the decentralization of responsibility for environmental review and decision-making for grants or subgrants under PVO/NGO large umbrella projects to the USAID Mission level.

This module also introduces you to recent Bureau efforts to increase responsibility of USAID field missions for environmental review. The use of Environmental Monitoring, Evaluation and Mitigation Planning (EMEMP) processes also represents a more recent addition to the design of USAID programs and non-project assistance, but is discussed elsewhere in the Module Backgrounder for Session 16. The full text of Regulation 216 is provided in Appendix A.

USAID, as a "re-engineered, learning institution," has introduced major changes in its new operations systems, for example, by replacing projects with "results packages." Suffice it to say here that this change is key to providing USAID operating units and collaborators the flexibility they need to adapt to changes during implementation. The underlying rationale is to focus on results, while still managing inputs and monitoring outputs properly, and to give those responsible for achieving results the flexibility to change approaches and tactics as situations change or lessons are learned.

Re-invention of USAID has heightened the focus on environmental sustainability as being integral to USAID's development goal. To meet this goal it is essential that environmental considerations be incorporated into results planning, achieving, and monitoring. The Agency's re-engineering can be expected to intensify the need to develop programming consistent with the Agency's Environmental Procedures and with principles of environmental soundness.

USAID Missions in Africa are in critical need of systems, guidelines, technical assistance and training to upgrade their capacity to carry out effective environmental review and program implementation. Over the past few years, the Africa Bureau Environmental Office (AFR/SD/PSGE/ENV), in conjunction with the Regional Environmental Offices (REDSO/ESA in Nairobi, and REDSO/WCA in Abidjan), has been developing various elements of an initiative for environmental management capacity building. This initiative is intended to support USAID/AFR Missions, their implementing agents and collaborators.

An important rationale for this course, which is part of the initiative to build environmental management capacity, is that Africa Bureau environmental and legal staff anticipate providing significantly enhanced responsibility ~~and authority~~ to carry out environmental reviews to those USAID Mission programs whose designers and/or implementors have successfully completed an Environmental Assessment course and/or participated in related capacity-building activities. Enhanced authority would be provided on an initial trial basis under the assumption that participating missions are better prepared to ensure that the program/program activity in question will be designed and implemented in an environmentally sound manner in accordance with all salient agency policies and procedures. While the specific details of this enhanced environmental authority will need to be worked out on a case by case basis, relevant agency experience has shown that such enhanced Mission authority can greatly facilitate field-level program activity design and implementation. These guidelines are consistent with USAID's new precepts of flexibility.

2. Origins of USAID Environment/Natural Resource Policy and Regulations

Concern for environmental planning and management among donors and host governments began in the 1970s with two parallel interests: how to reverse the process of environmental deterioration occurring in many developing countries; and how to prevent, or at least mitigate negative effects of agricultural development and other development activities on the environment.[1] Today USAID employs three key strategies to support host country efforts to address these issues: (i) the funding of development projects and programs that directly address environmental problems and protect natural resources; (ii) support to family planning initiatives in countries and regions where demographic pressures are primary contributors to environmental degradation; and (iii) USAID environmental review of all proposed USAID funded activities prior to their final approval. Where appropriate, plans are developed and implemented to mitigate possible negative environmental effects.

USAID's regulations related to environmental assessment and screening actually evolved out of litigation between the Agency and environmental groups in the mid 1970's over the Agency's use of pesticides in its development programs. The screening procedures adopted by USAID are a legal requirement within *22 CFR Part 216* otherwise known as Regulation 216, or "Reg. 16".

3. Existing USAID Policies and Regulations

USAID Environmental Procedures: 22 CFR Part 216

USAID's Environmental Procedures are Federal Regulations, and therefore represent a legal requirement as well as Agency policy. "Regulation 16" has three stated purposes:

- to ensure that environmental factors and values are integrated into the USAID decision-making process;

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1. USAID, *Environmental Assessments of Development Projects: A Preliminary Review of A.I.D.'s Experience,* A.I.D. Evaluation Occasional Paper No. 17, Center for Development Information and Evaluation, Bureau for Program and Policy Coordination, June 1988, Washington, D.C., p. 1

- to assign responsibility within the Agency for assessing the environmental effects of USAID's actions by the Agency since 1976; and

- to implement the requirements of the U.S. National Environmental Policy Act (NEPA) as they affect USAID programs.

Regulation 16 aims to identify in advance any "reasonably foreseeable impacts" of a given activity upon the environment.

The regulations are consistent with NEPA and Executive Order (EO) 12114 on "Environmental Effects Abroad of Major Federal Actions," but they are considerably less stringent in most respects than NEPA-related environmental legislation applicable to most U.S. domestic projects.[2]

USAID's experiences with integrating environment and development are articulated in the Agency's various policy documents including: *Strategies for Sustainable Development* (1994); *Environment Strategy* (1992); *Environment and Natural Resources* (1988); the Bureau for Africa's *Plan for Supporting Natural Resource Management in Sub-Saharan Africa: Environmental Strategy* (1992). These documents place emphasis on five long-term constraints to development: (i) unsustainable agricultural practices; (ii) degradation and depletion of water and coastal resources; (iii) environmentally unsound energy production and use; (iv) urban and industrial pollution; and (v) loss of tropical forests and other habitats critical for biological diversity.

In USAID's most recent Agency-wide policy document, *Strategies for Sustainable Development*[3], the focus of planning efforts is on five areas: (i) protecting the environment; (ii) building democracy; (iii) stabilizing world population growth; (iv) encouraging broad-based economic growth; and (v) providing humanitarian assistance and aid for post-crisis transition. In the chapter on the environment the Agency articulates a new strategic vision with two significant environmental goals: (1) reducing long-term threats to global environmental problems, including the loss of biological diversity; and (2) promoting "sustainable economic growth locally, nationally, and regionally by addressing environmental, economic and development practices that impede development and are unsustainable" (USAID, 1994, p.13). To achieve these goals, USAID now requires all of its country strategies to include assessment of:

(1) "agricultural, industrial and natural resource management practices that play a central role in environmental degradation;" and

(2) "public policies and institutions to protect the environment." (USAID 1994, pp. 16-17)

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2. Goodson, Jeffrey W., *USAID Environmental Regulations and Foreign Assistance Act Requirements, A Practical Guide and Strategy Tips for AID Project, Program and Technical Personnel,* REDSO/WCA, September 1987, p.1

3. Agency for International Development, *Strategies for Sustainable Development,* 1994, 56pp.

The Bureau for Africa's Environmental Strategy (1992) focuses on two of these five issues: unsustainable agricultural practices and loss of tropical forests and other critical habitats for biological diversity. The Bureau's technical priorities emphasize preventing loss and degradation of vegetation, curbing soil erosion, stemming decline in soil fertility and biological diversity and promoting integrated pest management. **Note:** A new Bureau Environmental Strategy - *Plan for Environmental and Natural Resource Management in Sub-Saharan Africa* (~~PERN~~ PENRM) is being developed, but the emphasis on the five long-term constraints listed above continues to apply.

Section 117 of the Foreign Assistance Act directs the President of the United States to make "special efforts...to maintain and where possible restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor." Compliance requires preparing and taking fully into account an environmental assessment of "...any proposed program or project...significantly affecting the environment of any foreign country" (Section 117). Section 118 and 119, respectively, place particular importance on the conservation and sustainable management of tropical forests and preservation of biological diversity. These sections require USAID to analyze, in any country strategy statements or plans, what is required to achieve these objectives and the extent to which actions the Agency proposes contribute to their achievement.

3.1 USAID Mission responsibilities in meeting Foreign Assistance Act requirements related to tropical forests and biodiversity

USAID Missions are legally obligated to conduct an assessment of tropical forestry and biological diversity in accordance with Section 118 and 119 of the FAA (See EPAT, November 1994). Amendments to Sections 118 (Tropical Forests) and 119 (Biodiversity) of the Foreign Assistance Act (FAA) require that Country Plans include an analysis of (a) the actions necessary in that country to conserve biological diversity and tropical forests, and (b) the extent to which current or proposed AID actions (if any exist in that country) meet those needs.[4] The Bureau suggests this analysis involve a team of tropical foresters and biodiversity specialists, using local technical expertise where feasible, and that it be conducted up to one year in advance of Country Strategic Plan (CPS) preparation.

In addition to Sections 117-119 of the Foreign Assistance Act, attention to natural and environmental resources management has been consistent with objectives of the Development Fund for Africa (DFA) and USAID's new approach to sustainable development. The DFA, which was developed and received congressional approval in late 1987, and was in force through 1995. Its goals remain directly applicable to USAID Africa Bureau Programming: "to help the poor majority of men and women in sub-Saharan Africa to participate in a process of long-term development through economic growth that is equitable, participatory, environmentally sustainable, and self-reliant" [Section 496(c)(1) of the Foreign Assistance Act as amended].

3.2 Responsibilities for USAID core "sustainable development countries"

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4. Originally summarized in a cable (State 032584) on "Guidance for Preparation of Background Assessments of Biological Diversity for Use in CDSSs or Other Country Plans" sent to all USAID Missions and regional offices in February 1988.

The Agency has identified certain core "sustainable development countries" with special environmental guidance and requirements in preparing five year Mission Country Strategic Plans (CSPs). Consult your USAID Mission or USAID/Washington AFR/SD/PSGE to determine if your country is a sustainable development country.

The CSP guidance on Environment supports three environmental objectives:

- *Safeguarding the environmental underpinnings of broad-based economic growth;*
- *Protecting the integrity of critical ecosystems;*
- *Ameliorating and preventing environmental threats to public health.*

In identifying environmental strategic objectives at the country level, core sustainable development countries are also required to assess the full range of environmental and natural resource threats and seek to prioritize them against these three objectives. Contained within the CSP guidance on environment are detailed guidelines for setting priorities. Step 1 is to assess the relative severity of environmental problems according to USAID's three country level objectives. Step 2 is to estimate the potential effectiveness and sustainability of strategies available to address the most severe problems. Step 3 is to identify USAID's best opportunities for sustainable impact.

3.3 Biodiversity Strategy

USAID's Strategy for Biodiversity Conservation (draft) sets out guidelines for USAID's biodiversity investments and biodiversity priorities. The major emphasis is on in situ conservation, i.e. assisting countries to maintain the variety of species, genetic resources and ecosystems in natural settings. These efforts are to be complemented by support for ex situ conservation activities designed to help conserve genetic diversity in managed environments, e.g., outside natural habitats in seed and sperm banks, herbaria and the like.

Biodiversity is considered important in every country, and USAID Missions, in consultation with local stakeholders and development partners, are to ensure that in situ biodiversity conservation needs are analyzed and considered for assistance. Biodiversity is also of global importance. To help conserve a representative sample of global biodiversity in situ, the strategy identifies sub-regions of particularly rich and diverse resources and ecosystems. USAID seeks to assure that assistance for in situ biodiversity conservation is available to at least one representative country in each identified sub-region.

In Africa, the identified sub-regions are the East African sub-region (including afro-montane ecosystems, Eastern Arc Mountains, Rift Lakes, savanna biomes and coral reefs); southern Africa sub-region (containing such unique areas as Cape Flora and Kafue Flats wetlands); Madagascar (a mega-diversity country, biodiversity hot spot and area of high endemism); and the Congo Basin Ecosystem (containing the world's second largest area of tropical forests). Additional information about the biodiversity strategy and names of key countries in each sub-region should be obtained from your USAID Mission.

An expanded summary o environmental regulations and statutory requirements applicable to USAID assistance is provided in Annex 4.

4. Regulation 16 Policy

USAID's environmental policy as stipulated in the regulations is to:

- ensure that the environmental consequences of USAID-financed activities are identified and considered by both USAID and the host country (HC) prior to the final decision to proceed, and that appropriate environmental safeguards are adopted;
- assist developing countries in their ability to evaluate the environmental effects of development strategies and projects, and to select, implement and manage effective environmental programs;
- identify environmental impacts of USAID actions; and
- define environmental limiting factors that constrain development, and identify and carry out activities that "assist in restoring the renewable resources base on which sustained development depends." (22 CFR 216.1 (b)).

5. General Applicability of the Regulations

The various procedures outlined in USAID's environmental regulations apply to all new activities authorized or approved by USAID, and to "substantive amendments or extensions to on-going activities." In practice, substantive amendments or extensions to ongoing activities are assessed for environmental impact only when 1) they include new components (e.g., addition of funds to construct a road not originally envisioned); 2) they represent a significant expansion of scope over and above the original project (e.g., an expansion of barrage construction into new geographical areas not envisioned in the original project paper); 3) the original activity was authorized prior to the existence of the regulations; 4) commodities to be imported under a project amendment are in addition to those reviewed during the original environmental review process; or 5) unforeseen adverse impacts may have occurred in the original design.

6. Environmental Review and the USAID Design Process

USAID Missions are required by law to follow rules outlined in Reg. 16. To help ensure sound design and implementation in a way that fully incorporates sustainability into USAID supported activities, USAID is attempting to increase the knowledge and involvement of not only the Mission Environmental Officer (MEO) and Foreign Service National (FSN) staff, but other in-country professionals who are engaged in program and program activity design and implementation, including but not limited to: PVOs/NGOs, host government professionals, contractors and university staff.

The work involved in preparation of IEEs or environmental reviews varies greatly. Simple IEE's or requests for categorical exclusions normally require less than a day to prepare and very little specialized knowledge of the environment. However the IEE's for complex natural resource activities can require the full-time participation of an environmental expert on the design team and they can involve extensive negotiations between the Mission, the regional offices and Washington.

USAID Mission's should draw on guidance provided by the New Automative Directives System (ADS) and New Management System (NMS).

It is best to examine environmental issues at the earliest stage in the design process in order to avoid adverse impacts and the costs which may be associated with unforeseen effects which may emerge at a later stage of design or implementation. The modification of an activity design to take foreseeable impacts, both direct and indirect, into account will raise the probability of the activity's success, help avoid adverse impacts and increase its contribution to sustainable development. Environmental review thus can be an aid and not necessarily an obstacle to program and activity design. It can only strengthen program and program activity proposals.

Regulation 16, or an IEE prepared pursuant to it, sets out the requirements for addressing environmental issues in the design process. It aims to identify in advance any "reasonably foreseeable impacts" of a given activity upon the environment. For a detailed description of the environmental review process, please refer to Regulation 16 itself. What follows is a summary (see also Figures 1 and 2 on the next page). The full text is provided in Appendix A.

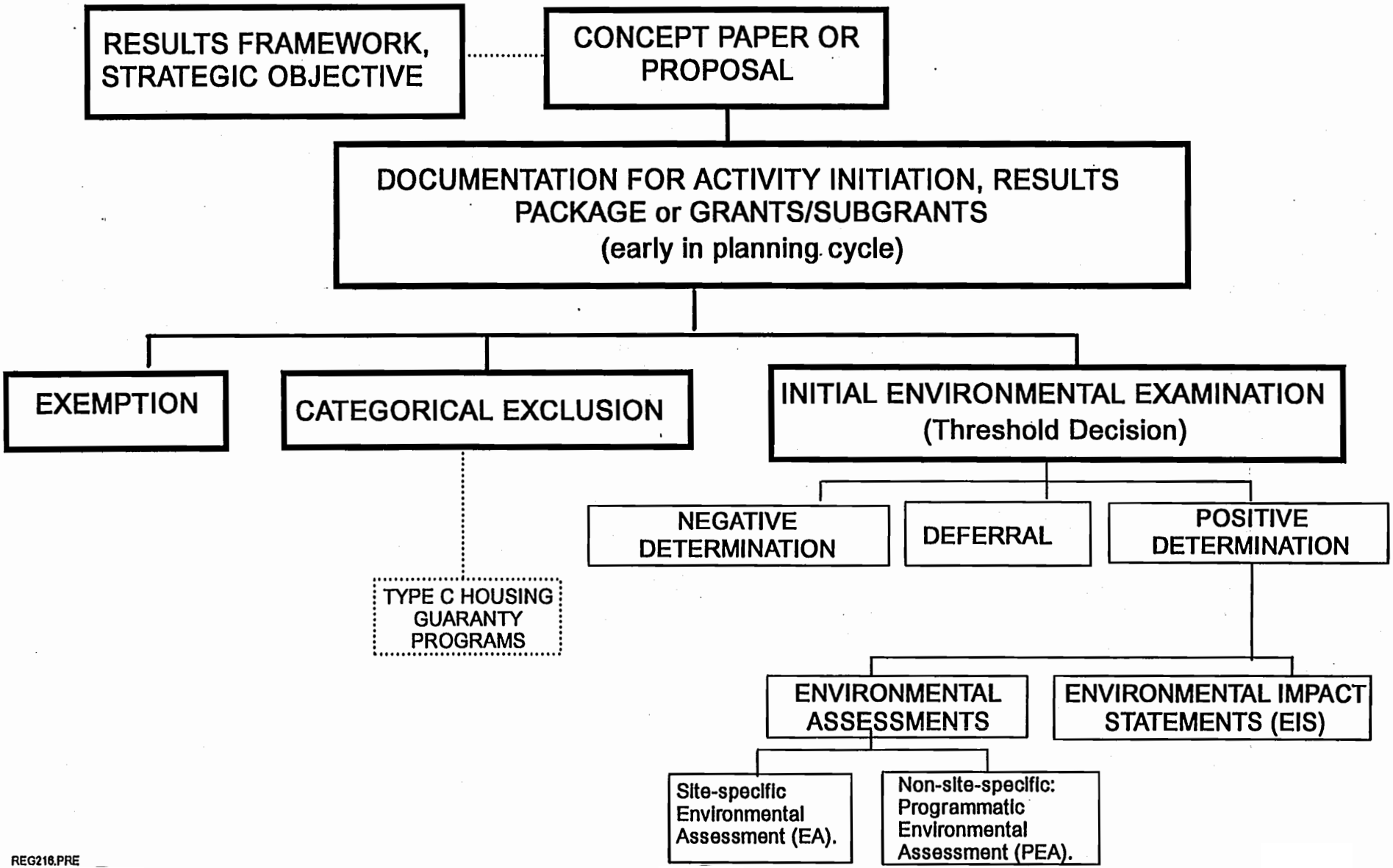
7. A Summary of Environmental Procedures

USAID Missions must prepare an Initial Environmental Examination (IEE) which makes a threshold determination as to whether the proposed program or program activity will have a significant impact on the environment. A negative determination means the program or activity will have no significant impact, and a positive determination indicates it will have one. A deferred determination is one which applies to sub-activities that, in practice, are insufficiently identified and thus, the IEE postpones analysis until they can be sufficiently identified. "A significant impact" is defined in Regulation 16 as one which does significant harm to the environment. So, an activity which has only beneficial impacts upon the environment would receive a negative determination. Activities which both benefit and harm the environment should receive a positive determination, because despite their benefits the potential damage to the environment will require mitigation.

Regulation 16 exempts or excludes a number of activities from the IEE process. Exemptions apply to activities undertaken in response to emergencies, such as famine relief. Exclusions apply to categories of activities which are considered by nature very unlikely to have any significant impacts on the environment. These activity types are eligible for "categorical exclusion," and for them the environmental review process ends there. Regulation 16 also lists specific activities which are expected to have significant impacts on the environment. For these, a comprehensive analysis, called an Environmental Assessment or EA, is typically required; although an IEE does not need to be performed to determine that there is a significant effect on the environment (i.e., reach a positive determination) or if there is a question about significance. The initial environmental examination process is summarized in the following figures.

USAID's Environmental Review Procedures

Under Regulation 216



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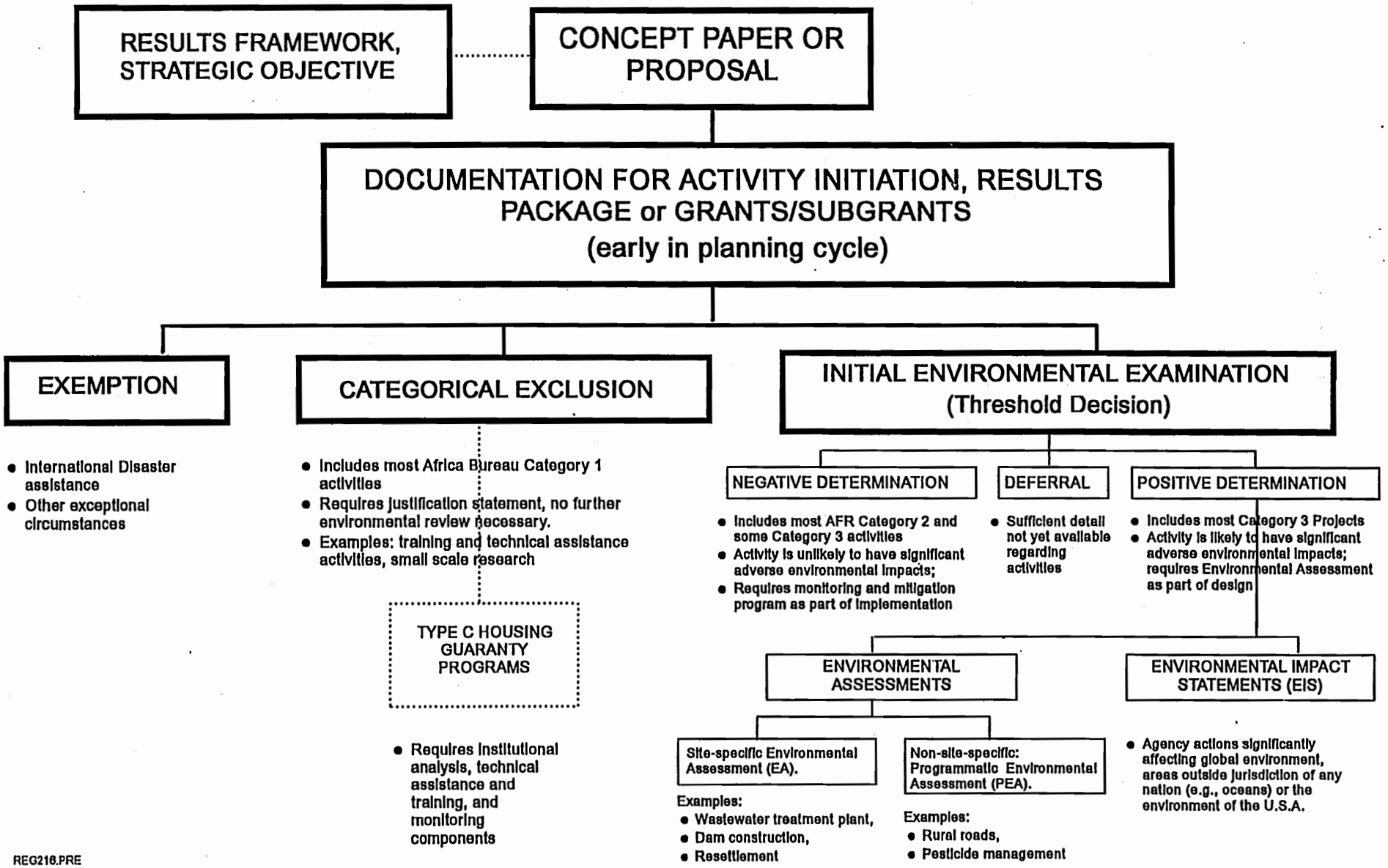
USAID's Environmental Review Procedures

Under Regulation 216



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IEEs should be prepared along with an initial proposal, so that any modifications can be made to the design with a minimum of delay or difficulty. IEEs are prepared in the field by USAID staff or consultants and approved by the field mission, the Regional Economic Development Services Office (REDSO), and the Regional Environmental Office (REO). Then, they are forwarded to Washington for approval by the Bureau Environmental Officer (BEO) and clearance by the General Counsel's office. Annex 1 provides an *Initial Environmental Examination or Categorical Exclusion* form followed by a summary of sample contents. Annex 2 provides a sample of the Environmental Screening/Report Form for NGO/PVO Activities and Grant Proposals.

When an IEE threshold is positive (the project is judged to have adverse impacts), the next step in the process is to perform an Environmental Assessment (EA) or an Environmental Impact Statement (EIS). In general, EISs are performed for projects affecting the United States or the global environment, while EAs are performed when the impacts are judged to be more limited in geographic scope. EAs and EISs are usually carried out by teams of outside consultants, strengthened by qualified local expertise and USAID regional environmental staff. More detail on the EA process is provided as Annex 3.

Non-Project Assistance

Special attention must be paid to non-project assistance (NPA) involving institutional or policy change and sectoral adjustment, as it is playing an increasingly important role in the activities funded by USAID and often little is known about the potential environmental impacts of NPA activities. USAID now requires that IEEs be completed for all NPA. To avoid unforeseen impacts from NPA, it is often especially important that an environmental monitoring plan be developed during the NPA design phase. Some of the problems and analytical issues discussed above regarding the design process are the same for NPA, so it is important to follow the same approach to integrating the analysis of potential environmental impacts into the NPA design process. An environmental specialist should be included on the NPA design team, and he or she should provide input on the later monitoring of activities as well.

Classification of Activities in Regulation 16

Exemptions:

- International disaster assistance;
- Other emergency situations [requires Administrator (A/AID) or Assistant Administrator (AA/AID) formal approval]; and
- Circumstances with exceptional foreign policy sensitivities [requires A/AID or AA/AID formal approval].

Note: Exemptions are not applicable to assistance for the procurement or use of pesticides; assistance for procurement or use is interpreted to include transport of pesticides or control equipment, disposal or ancillary support.

Categorical Exclusions (various caveats and nuances limiting the application of categorical exclusions are contained in Reg 16, reproduced in the Appendix):

- Education, training or technical assistance;
- Controlled experimental research of limited scope and carefully monitored;
- Analysis, studies, workshops, meetings;
- Projects in which USAID is a minor donor;
- Documents or information transfer;
- Contribution to international, regional or national organizations not for the purpose of carrying out specifically identifiable activities;
- Institution building grants to research and educational institutions in the US;
- Nutrition, health, population and family planning activities, except for their construction components and other activities directly affecting the environment;
- Commodity Import Programs (CIPs), when USAID has no knowledge of or control over use;
- Support to intermediate credit institutions if USAID does not review or approve loans;
- Maternal or child feeding programs under Title II of PL 480;
- Food for development programs under Title III, when USAID has no specific knowledge or control;
- Grants to PVOs where USAID has no specific knowledge or control;
- Studies or projects that develop the capability of countries to engage in development planning, except those resulting in activities directly affecting the environment;
- Activities that involve the application of USAID approved design criteria.

Note: Categorical exclusions are not applicable to assistance for the procurement or use of pesticides; assistance for procurement or use is interpreted to include transport of pesticides or control equipment, disposal or ancillary support.

Actions Affecting the Environment and normally requiring an Environmental Assessment (EA), if appropriate:

- River basin development; (Note: what is not in a river basin?)
- Irrigation or water management including dams;
- Agricultural land leveling;
- Drainage;
- Large scale agricultural mechanization;
- New land development;
- Resettlement;
- Penetration road building or road improvement;
- Power plants;
- Industrial plants;
- Potable water and sewage, unless small scale; (Note: what is the size limit?)
- Activities jeopardizing endangered and threatened plant and animal species and their critical habitat (wetlands, tropical forests, protected areas, and so forth);

- Pesticides (assistance for procurement or use always requires an IEE, see Sec, 216.3 (b), and often an EA).

Note: See Sourcebook *Appendix 1 - Text of Regulation 22CFR Part 216 ("Reg 16")*, Section 216 (3) (a) (4) and (5), 216.5 and 216.6 for applicable procedures.

"Gray areas":

When it is not obvious that a project falls into one of the above categories, it is necessary to prepare an IEE to make that determination. Mission Environmental Officers can assist in the preparation of the IEE.

Non-project assistance

Given the very different nature of NPA ...the focus of the environmental examination must be on the reasonably foreseeable (i.e. direct and predictable) impact of the policy and institutional reforms and other specific actions required by the program. For example, in a program designed to encourage a government to recognize and codify private ownership of land, the focus of the examination might be on the direct and predictable environmental impacts of private land ownership on land use patterns. In a fertilizer reform program, for example, the focus would be on the anticipated changes in fertilizer application as a result of the reform. To fully examine the potential environmental impacts, the IEE for a sector NPA needs to look at the planned objectives of, not solely the intermediate steps in, the reform process. Where an IEE indicates possible negative impact on the environment, the final design should included measures to mitigate those impacts.

Activities financed with local currency

Activities financed by host country-owned local currency could cause or contribute to adverse effects on the environment but they are not, as a legal matter, subject to Regulation 16 procedures. The Africa Bureau has dealt with local currency issues for many years under the Development Fund for Africa as a "common sense" issue, i.e. although local currency funded activities do not fall within the letter of the law, they must still be addressed within the spirit of the law. One reason for doing so, is the high visibility these activities (host countries or the US public draw no fine distinctions between grants and projects); the Bureau/Agency is deemed at fault if negative impacts result, regardless of funding mechanics). Thus, the Africa Bureau expects Missions to be sensitive to this issue in approving host country-owned , local currency activities whenever possible. When local currencies are programmed for general budget support, it may not be practical to do so; however, when they are approved for specific, project-type activities, it becomes feasible to take environmental impacts into consideration. A further consideration is that most governments now want to include environmentally sound practices within their development activities as matter of national, regional or local policy.

In the case of local currency use for development activities, Reg 16 does not apply. However, the Agency is no less committed to sound environmental review of their consequences. The guidance cable on this subject (88 State 066242) recommends that "responsible safeguards ensuring that environmental concerns be taken into account in the design and implementation of projects and programs supported by jointly programmed local currency and trust funds. In-country procedures to evaluate any long-term environmental impacts of activities funded with generated

local currency already exist in many countries. The Mission Environmental Officer will ensure that the responsible staff in the appropriate ministry for environment and/or natural resources will be made aware of U.S.A.I.D. concerns, and that they will be asked to provide occasional progress reports to the Mission. The cash grant program should also include some support for adequately training environmental staff within the host country to carry out monitoring and mitigation efforts related to these activities, and in developing an adequate response mechanism if adverse impacts are uncovered."

Intermediate credit

The following paragraphs represent current Bureau for Africa practice:

Under USAID environmental and legal practice, for credit components to qualify for a categorical exclusion under Reg. 16, Missions would need to affirm that our purpose is the equivalent of capitalizing an intermediate credit institution (ICI) (e.g., capitalizing a guaranty facility, as contrasted with the making of each guaranty), and that USAID does not retain the right to review and approve each loan (or equivalent) by the ICI. This is the case regardless of whether USAID's funds are used for loan guaranty or for actual loans.

If a categorical exclusion is not appropriate, the mission environmental officer (MEO) should provide a recommendation for a negative determination or a deferral of this component, together with supporting information. Identification of possible types of participating businesses, and the existence of or potential for environmental guidelines, for the loans guarantees is relevant. Resources could be used for technical assistance, training, and promotional support to test models, and provide close monitoring of each intervention to determine modifications necessary to arrive at the most acceptable approach.

Recommendation: Credit programs for agricultural inputs, the promotion of export crops, and other initiatives that might increase pesticide use even indirectly should ideally be funded concurrently with programs to provide farmers with alternatives to dependence on pesticides.

Environmental Impact Statement (EIS):

- Under USAID regulations, in accordance with US Council on Environmental Quality regulations implementing the National Environmental Policy Act (NEPA) an EIS is a detailed study of the reasonably foreseeable environmental impacts, both positive and negative of a proposed USAID action to be prepared when Agency actions significantly affect:

  (1) The global environment or areas outside the jurisdiction of any nation (e.g. the oceans);
  (2) The environment of the United States; or
  (3) Other aspects of the environment at the discretion of the Administrator.

Note: See Sourcebook *Appendix 1 - Text of Regulation 22CFR Part 216 ("Reg 16")*, Section 216.7 for further details on USAID's EIS regulations.

Other Categories of Activities Where Assistance May Be Denied, Or An IEE Or Environmental Assessment Is Required

Tropical Forests: Section 118 and of the Foreign Assistance Act as amended 1986.

Based on provisions of FAA Sections 118, assistance must either be denied or an Environmental Assessment pursuant to Regulation 16 must be carried out for any activities that:

- involve the procurement or use of logging equipment, unless an EA indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will produce positive economic benefits and sustainable forest management systems;
- have the potential to significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas;

Section 118 also states that assistance shall be denied for the following activities unless an EA indicates that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development:

- activities which would result in the conversion of forest lands to the rearing of livestock;
- entail construction, upgrading or maintenance of roads which pass through relatively undegraded forest lands;
- the colonization of forest lands; or
- entail construction of dams or other water control structures which flood relatively undegraded forest lands.

Biological Diversity: Section 119 and of the Foreign Assistance Act as amended 1986.

Under this section assistance must be denied for actions which significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such areas.

Commercial Extractive Forestry: Section 533(c)(3) of the Foreign Operations, Export Financing and Related Programs Act, 1991

Under Section 533 (c) (3) the expenditure of funds is prohibited for any activity, program, or project that "would result in any significant loss of tropical forests" or involve "commercial timber extraction of primary tropical forest areas" unless an environmental assessment:

(i) identifies potential impacts on biological diversity;
(ii) demonstrates that all timber extraction will be conducted according to an environmentally sound management system which maintains the ecological functions of the natural forest and minimizes impacts of biological diversity; and
(iii) demonstrates that the activity will contribute to reducing deforestation.

Note: For a detailed review of USAID's responsibilities related to biological diversity and tropical forests see Russo, Sandra, *Considerations of Biological Diversity and Tropical Forestry in the Context of Country Program Strategy Planning in the Bureau for Africa: Review and Guidelines*, Prepared by Environmental and Natural Resources Policy and Training (EPAT) Project for USAID AFR/SD/PSGE, November 1994, 117pp.

Classifying Activities With Multiple Components

In classifying actions that are part of an activity or program with several components, some actions may qualify for a categorical exclusion, others may qualify for a negative determination and yet others may necessitate a positive determination. Thus, within an activity or program, several classifications can apply, depending on the nature and mix of the particular actions. In practice, many activities or component actions thereof receive negative determinations *with conditions*; conditions typically invoked include specific ways of carrying out an activity in an environmentally preferable manner, subsequent environmental reviews of individual actions, mitigative measures, training or technical assistance related to environment, or monitoring requirements.

8. The Deferral Process

Environmental review may be deferred when programs, activities or sub-activities have not been specifically identified at the time of authorization. When possible, deferral should be minimized, since a number of USAID activities (as high as 20 percent in the past) have had unforeseen significant environmental impacts which might have been avoided or mitigated by completing the IEE during the design process.

In cases of deferral, Reg. 16 calls for the application of covenants or conditions precedent to ensure environmental review will be completed prior to irreversible commitment of resources.

Initial proposals where it is not possible to identify activities in sufficient detail to permit completion of the IEE shall contain:

(i) an explanation of why the IEE cannot be completed;

(ii) an estimate of the amount of time required to complete the IEE; and

(iii) a recommendation that a Threshold Decision be deferred until the IEE is completed.

The USAID Assistant Administrator acts on a deferral request concurrently with action on the initial proposal and designates a time for completion of the IEE. Normally this completion date will be sufficient for preparation of an EA or EIS, if required, before a final funding decision is made. Some exceptions are permitted (see Reg. 16, 216.3 (a) (7).

9. Africa Bureau Categorization Process for PVO/NGO Grants and Subgrants

USAID/AFR has been steadily increasing its funding to private voluntary organizations (PVOs) and non-governmental organizations (NGOs) over the past several years. Generally this

support occurs through "umbrella" projects which may result in considerable numbers of subgrants, usually with a variety of NGO/PVO grantees. Increased association with the PVO and NGO community has stimulated an interest in providing environmental management capacity building opportunities and guidelines to ensure that such activities are consistent with USAID's Environmental Procedures. These guidelines are fundamentally similar to those outlined for IEE process, but they are tailored to umbrella project subgrantees where the umbrella grant IEE has already received earlier approval, and therefore do not contain all of the IEE preparation requirements.

9.1 Screening and Environmental Review Procedures for PVO/NGO Grantees and Subgrantees

To ensure that individual interventions are designed in an environmentally sustainable manner, the Mission Environmental Officer (MEO) and/or USAID Project Officer or Manager provides the lead PVO/NGO under the umbrella grant (and, as appropriate NGOs and CBOs subgrantee applicants), with a copy of the *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities* and the Environmental Screening Form (Annex 2). Missions are to facilitate the refinement of this form with lead PVOs/NGOs, and the REDSO REO or REA in order to tailor the screening process to the umbrella project's purposes and to incorporate, as appropriate, information that will serve to identify any need for environmental assessment in accordance with host country environmental assessment policy and proposed legislation. Adherence to the procedures in the original umbrella project IEE, it must be emphasized, cannot be considered in lieu of host country requirements or vice versa. The proposals for subgrants will also spell out how potential negative impacts will be mitigated prior to activity implementation and during implementation, if they are detected during monitoring and evaluation.

All activities and subgrants not recommended for a categorical exclusion, will be individually reviewed according to the Screening Form, which utilizes a categorization process consistent with Africa Bureau Environmental Guidelines for Small-Scale Activities in Africa, as defined below.

Category 1: Subgrants that would normally qualify for a categorical exclusion under Reg. 16 (e.g., community awareness initiatives, training at any level, provision of technical assistance, controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored, etc.). The rehabilitation of water points for domestic household use, shallow, hand-dug wells and small water storage devices and construction or repair of facilities under 10,000 square feet (approximately 1,000 square meters) can be placed in this category.

Category 2: Subgrants that would normally qualify for a negative determination under Reg. 16, based on the fact that the grantee used an environmentally-sound approach to the activity design and incorporated appropriate mitigation and monitoring procedures. For example, the design followed, and the manager has access to and will follow, a series of guidelines for the design of small-scale environmentally-sound activities in forestry, water supply and sanitation, rural roads, etc.). Rehabilitation or construction of facilities or structures exceeding 10,000 square feet would normally fall under Category 2. Funding levels would

also normally not be in excess of $200,000 per discrete activity. In any case, an Environmental Review Report will be prepared for all the Category 2 projects.

Category 3: Subgrants where significant environmental impacts are likely such as those involving land development, forest harvesting, planned resettlement, penetration road building, substantial piped water supply and sewage construction, and projects involving the procurement and/or use of pesticides, or of large-scale or area-wide application of pesticides. Also, some light industrial plant production or processing (sawmill operation, agro-industrial processing of forestry products) could qualify.

Category 4: Activities not fundable or fundable only when specifically defined findings to avoid or mitigate the impacts are made, based on an Environmental Assessment[5] such as: 1) actions determined likely to significantly degrade protected areas, such as introduction of exotic plants or animals; 2) actions determined likely to jeopardize threatened and endangered species or adversely modify their habitat (esp. wetlands, tropical forests)[6]; 3) conversion of forest lands to the rearing of livestock; 4) planned colonization of forest lands; 5) procurement or use of timber harvesting equipment; 6) commercial extraction of timber; 7) construction of dams or other water control structures which flood relatively undegraded forest lands; 8) construction, upgrading or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands.

[In accordance with these FAA provisions, assistance must either be denied or an Environmental Assessment pursuant to Regulation 16 must be carried out.] All items listed in Regulation 16 (Sect. 216.2(d)(1)) are automatically included, unless such items qualify for a negative determination in accordance with the criteria listed under Category 2. All Category 3 and 4 activities under consideration must be passed to the REO and BEO and to the Regional and Bureau Legal Officers.

The lead PVO/NGO will use the Screening Form (Annex 2), as refined in consultation with the MEO and REDSO REO or REA, to review subgrant proposals to determine in which Category the activity falls. The MEO will then review and clear the draft category determination and any environmental review reports prepared as a result of the categorization. It is assumed that the majority of subgrants will fall within Categories 1 and 2, and will, therefore, be approvable locally by the USAID Representative without further external review, given that appropriate sound implementation and environmental monitoring and mitigation procedures will be in place. The MEO and/or Mission Project Officer or Manager shall on a routine basis, pass to the REO and BEO an updated list of grants, with a summary of activities and the disposition of the environmental categorization and review process in order to keep them apprised of the sector and scope of activities involved.

All Category 3 and Category 4 subgrants (if there are any) and possibly some Category 2 subgrants, if the MEO has questions, will be subjected to additional environmental assessment, as

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5. Per Foreign Assistance Act Sect. 118 & 119 relating to overseas assistance affecting Tropical Forestry and Biodiversity.

6. Per USAID Environmental Procedures 22 CFR 216.5, on Endangered Species.

deemed appropriate in consultation with the BEO and REO, and passed on to the Regional and Bureau Environmental and Legal Officers for further review and clearance.

Prior to the approval of any subgrant, results of the environmental categorization must be available and considered. For Category 2 projects, environmental review reports, including MEO review and, if needed REO or BEO review, must be performed prior to funding. For any Category 3 or Category 4 projects, approval cannot be considered until environmental documentation as determined by the BEO has been prepared.

9.2 Promotion of Environmental Review and Capacity Building Procedures

The environmental review procedures specify how the subgrants covered by these procedures, and associated mitigation actions, will be identified and reviewed on an individual basis after project authorization in accordance with Regulation 16, Section 216.3(a)(2). Specifically, these procedures are intended to ensure environmental accountability and soundness, on the assumption that Missions will have the following elements in effect to promote environmental review and capacity building within the umbrella grant PVOs/NGOs and CBOs:

a. **Subgrants will be individually reviewed and screened according to a Screening Form** (Annex 2), which will categorize each subgrant or subactivity. The 4-tier categorization process is according to the AFR *Environmental Guidelines for NGO and PVO Field Use in Africa,* or as further defined in the umbrella project IEE;

b. PVOs, NGOs and CBOs will help design and conduct, participate in, and apply, appropriate **environmental assessment and management training,** in conjunction with USAID and host country resource organizations and authorities;

c. The lead PVO, and as appropriate, the indigenous NGOs and CBOs, will be encouraged to **develop and apply host country environmental policies;**

d. A **monitoring and evaluation** process will be put in place and used by the lead PVO, NGOs and CBOs, in collaboration with host country authorities and USAID project management; and

f. The Mission will **keep the BEO and REO apprised of subgrants provided,** including the type/nature, scale, funding levels and status of the individual subgrants approved under the process described in the umbrella grant IEE.

9.3 Environmental Responsibilities

The USAID Mission is to assume responsibility for environmental review and decision-making for all sub-grants as outlined below:

- The lead PVO and NGOs or CBOs, as appropriate, will submit proposals that take into consideration potential environmental impacts and their mitigation, including avoidance, and will design the activities with an environmental monitoring system in place.

- The lead PVO will use the Screening Form to categorize proposals and the MEO will review and pass on to REO and BEO any Category 3 or Category 4 and, as he/she determines, some Category 2 activities.

- The lead PVO, NGOs and CBOs, as appropriate, will ensure implementation of mitigating measures and long-term environmental impact monitoring.

- The USAID MEO and the Project Officer and/or Project Manager will be ultimately responsible for monitoring environmental impacts of the grants.

- Periodic visits of the REO or REA will also be requested for advice and validation of the process in place.

- All parties are to utilize the Screening Form, prepared for each proposal and/or grant. The form is formatted as a checklist and will serve as a tool to summarize on a routine basis the area and scope of activities of each subgrant and the overall project.

9.4 Environmental Monitoring and Mitigation

In drafting proposals, designers must address the way in which their interventions will be monitored and evaluated during the course of the activity. Indicators to be used in monitoring should be spelled out in the grant designs. **The implementing agents involved will be fully responsible for monitoring and evaluating all activities under each program or project, and for sending to the Bureau and/or Regional Environmental Officer any evaluations, reviews, and/or mitigation plans, especially for Category 3 activities.** By planning for monitoring and mitigation in project and program designs, planners can assure that funding will later exist for such activities. Proposals should also spell out how negative impacts will be mitigated, if and when they are detected during monitoring and evaluation. An example would be PVOs/NGOs involved in agricultural production, who could adopt a policy to encourage integrated pest management and other sustainable agricultural practices.

Annex 1

INITIAL ENVIRONMENTAL EXAMINATION
OR
CATEGORICAL EXCLUSION

PROGRAM/ACTIVITY DATA:

Program/Activity Number:

Country/Region:

Program/Activity Title:

Funding Begin: _____ **Funding End:** _____ **LOP Amount:** $_____
Sub-Activity Amount: $_____
IEE Prepared By: _____ **Current Date:** _____

IEE Amendment (Y/N):_____ If "yes", Number & date of original IEE _____ ; __/__/__

ENVIRONMENTAL ACTION RECOMMENDED: (Place X where applicable)
Categorical Exclusion: _____ Negative Determination: _____
Positive Determination: _____ Deferral: _____

ADDITIONAL ELEMENTS: (Place X where applicable)
EMEMP: _____ CONDITIONS _____ PVO/NGO: _____

SUMMARY OF FINDINGS (Please Limit Text to This Page):

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED: (Type Name Under Signature Line)

CLEARANCE:
Mission Director: _____ Date: _____

CONCURRENCE:
Bureau Environmental
Officer: _____ Date: _____
Approved: _____
Disapproved: _____

File No: _____ (AID/W)

CLEARANCE:
General Counsel
(Africa Bureau) _____ Date: _____

ADDITIONAL CLEARANCES: (Type Name Under Signature Line)

Mission Environmental Officer: _____ Date: _____

Project Manager: _____ Date: _____

Regional Environmental Officer: _____ Date: _____

INITIAL ENVIRONMENTAL EXAMINATION

PROGRAM/ACTIVITY DATA:
Program/Activity Number:
Country/Region:
Program/Activity Title:

1.0 BACKGROUND AND PROJECT DESCRIPTION

Note: This is a break-down of all components corresponding to the level and complexity of environmental examination which they will require. For example, separate those eligible for exemption, those eligible for categorical exclusion, those to be deferred, etc.

2.0 COUNTRY AND ENVIRONMENTAL INFORMATION (BASELINE INFORMATION)

Note: These are short descriptions that give a good idea of current environmental status of the country and that of the project area. However, the environmental background information should cover only information relevant to the proposed activity, such as:

- Location
- Land Use
- Topography, Geology and Soils
- Climate and Hydrology
- Vegetation and Wildlife (Terrestrial and Aquatic Ecology)
- Fisheries (if relevant)
- Agriculture
- Protected Areas and Biodiversity Issues
- Socio-economic Characteristics (Population, Economic Activity)
- Cultural Heritage
- Relevant National (or Local) Environmental Policy or Legislation

3.0 EVALUATION OF PROJECT/PROGRAM ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

Note: This addresses only environmental issues related to project activities that are not exemptible and are not subject to categorical exclusion. It describes how project activities affect different sectors or components of the environment. A good and thorough environmental analysis is made at this level under each subheading listed under Section 2 or others that may be relevant (Checklists from Session 10 should be used as a guide).

4.0 RECOMMENDED MITIGATION ACTIONS (INCLUDING MONITORING AND EVALUATION)

Note: Environmental determinations are made only in an IEE, environmental reviews normally will not require an environmental determination.

Language regarding determinations provides recommendations on how the activity should be legally handled under USAID environmental regulation. It summarizes the findings and conclusions of the IEE and states the recommended threshold decision. If an activity component has no reasonably foreseeable significant (adverse) environmental impacts the threshold decision recommended is a Negative Determination. If an activity component has reasonably foreseeable significant environmental impacts the threshold decision recommended is a Positive Determination; then the preparation of an EA or an EIS is required.

5.0 SUMMARY OF FINDINGS (copy also onto Face Page)

Includes a summary of the determinations and principal mtigative measures.

ENVIRONMENTAL SCREENING/REPORT FORM FOR NGO/PVO ACTIVITIES & GRANT PROPOSALS

BACKGROUND

USAID, as a "re-engineered, learning institution," has introduced major changes in its new operations systems, with a strengthened focus on results (not activities), greater accountability and empowerment, teamwork, participation and customer orientation. For example, projects are replaced with "results packages" provide USAID operating units and collaborators the flexibility they need to adapt to changes during implementation. The underlying rationale is to focus on results, while still managing inputs and monitoring outputs properly, and to give those responsible (including the host country partners) for achieving results the flexibility to change approaches and tactics as situations change or lessons are learned.

USAID's Africa Bureau Environmental Office, in conjunction with the Regional Environmental Offices, has been developing an initiative for environmental management capacity building. This initiative is intended to support USAID/AFR Missions, their implementing agents and collaborators. An important rationale for this initiative is that Africa Bureau environmental and legal staff anticipate providing significantly enhanced responsibility to carry out environmental reviews to those USAID Mission programs whose designers and/or implementors have successfully completed an Environmental Assessment course and/or participated in related capacity-building activities. Relevant agency experience has shown that such enhanced Mission authority can greatly facilitate field-level program activity design and implementation. These NGO Environmental Guidelines are consistent with USAID's new precepts of flexibility.

The present Environmental Screening and Reporting Form (ESF) is designed to be consistent with the Initial Environmental Examination process, and to assist USAID Missions and their implementing partners design and implement activities in an environmentally sound manner in accordance with all salient agency policies and procedures. Use of the ESF will greatly reduce the need for review and approval of NGO grant activities at the regional or Washington levels.

INTRODUCTION TO USE OF THIS FORM

This form is to be utilized to screen activities to be performed by all applicants for grants under USAID funding, including grantees of the PVO umbrella projects, and proposals submitted for consideration for funding under other USAID programs including grants management units. This is a *generic* form , illustrative only, and its final contents are to be refined and jointly determined among the affected partners -- NGO, USAID, host country agencies, etc. To the extent possible, the form should reflect host government environmental policies and procedures, e.g., accounting for existing designated protected areas.

Typically, two broad categories of projects will be funded: (a) those designed to strengthen local institutional capacities to manage the natural resource base and (b) those designed to support the development of appropriate infrastructure needed for sustainable natural resource management. Activities could include training, technical assistance and other institutional support, income-generating activities through the exploitation of natural resources in a self-sustaining and environmentally sound manner or development of physical infrastructure to further natural resource management at the district level. Under other components of USAID-funded programs, training, technical assistance, research, studies, and information-related activities and other types of activities can be funded.

This form is intended to be adaptable to unique circumstances. In using it, adjustments can be made in consultation with the Regional and Bureau Environmental Offices. It is strongly advised that the Mission Environmental Officer make on-site visits prior to finalization of the ESF, and that the ESF be rational and fully defensible and without ambiguity as to how the conclusion was reached that the activity(ies) will have no significant impact.

This form is intended to be adaptable to unique circumstances. In using this form, adjustments as needed can be made in consultation with the Regional and Bureau Environmental Offices. It is strongly advised that the Mission Environmental Officer make on-site visits prior to finalization of the ESF, and that the ESF be rational and fully defensible and without ambiguity as to how the conclusion was reached that the activity(ies) will have no significant impact.

ENVIRONMENTAL SCREENING/REPORT FORM
FOR NGO/PVO ACTIVITIES & GRANT PROPOSALS

PVO/NGO (Grantee): _____

Grant/Sub-grant to PVO/NGO:

_____

Grant/Activity Name:

_____

Duration (proposed start and completion dates): _____

Geographic Location:

_____

Activity Description (paragraph(s) describing purpose/outputs and potential environmental impacts):

[add space as needed]

Determine the Nature of the Activity or Grant

a. **Environmental Review Report Needed.** Does the grant include funds to support any physical natural resource management activities, or any community and rural development services, infrastructure, public facilities or road rehabilitation? Does it involve development of income-generating or resource management systems, or certain kinds of applied ecological or natural resources research? It will likely require an Environmental Review of the kind described in Step 4 of this form. Determine which Category the grant falls under, to establish the need for the Environmental Review.

b. **No Further Environmental Review Required.** Is the grant exclusively to provide technical assistance, training, institutional strengthening, or research, education, studies or other information analysis, awareness-building or dissemination activities *with no foreseeable negative impact on the biophysical environment*? This probably qualifies as a Category 1 activity -- no further environmental review or action may be necessary. Complete form to establish this circumstance.

c. **Emergency Circumstances Apply.** Does the grant involve an emergency circumstance (e.g. drought)? Under specific conditions, the grant may be *exempt* from further environmental review. Must be determined by Bureau Environmental Officer with input from Regional and Mission Environmental Officers. Sound environmental implementation principles are to be applied to any urgent programs. Note that exemptions *cannot* be applied in the case of assistance for use or procurement of *pesticides*.

d. **Multiple Categories.** Many grant proposals will have activities in more than one category. Simply mark all that apply. The form will guide you to the appropriate next steps.

Step 1. Determine Category of Grant:

- **Africa Bureau *Category 1* -- no further environmental review needed:**

  - ***Does the grant involve (yes, no, N/A):***

_____ Provision of education, technical assistance, or training. Does *not* qualify for "Category 1" if such programs

include activities directly affecting the environment.

_____ Community awareness initiatives.

_____ Controlled experimentation exclusively for the purpose of research and field evaluation confined to small areas (normally under 4 ha., i.e., 10 acres) and carefully monitored (when no protected or other sensitive environmental areas could be affected).

_____ Technical studies and analyses and other information generation activities not involving intrusive sampling of endangered species or critical habitats.

_____ Document or information transfers.

_____ Nutrition, health care or family planning. Such programs do *not* qualify for "Category 1" if (a) some included activities could directly affect the environment (construction, water supply systems, etc.) or (b) biohazardous (esp. HIV/AIDS) waste is handled or blood is tested.

_____ Rehabilitation of water points for domestic household use, shallow, hand-dug wells or small water storage devices (when no protected or other sensitive environmental areas could be affected).

_____ Construction or repair of facilities if total surface area to be disturbed is under 10,000 sq. ft. (approx. 1,000 sq. m.) (*and* when *no* protected or other sensitive environmental areas could be affected).

_____ Support for intermediate credit arrangements (when *no* significant biophysical environmental impact can reasonably be expected).

_____ Programs of maternal and child feeding conducted under Title II of Public Law 480.

_____ Food for development programs under Title III of P.L. 480, when *no* on-the-ground biophysical interventions are likely.

_____ Studies or programs intended to develop the capability of recipients to engage in development planning. Do *not* mark "yes" if these involve activities directly affecting the environment.

- **Africa Bureau *Category 2* — Negative environmental impacts possible, environmental review required (specific conditions, including monitoring, may be applied):**

Note: The Environmental Review (Step 4 below) must address why there will be no potential adverse impacts on protected areas, endangered or threatened species or their critical habitat; or relatively undegraded forest, i.e., justify your conclusion that the proposed Category 2 activities do not belong in Category 3 or 4. Even for activities designed to protect or restore natural resources, the potential for environmental harm exists (e.g., re-introduction of species, controlled burning, fencing, wildlife water points, spontaneous human population shifts in response to grant activities undertaken, etc.). *If you do not find an exact match listed here for the activity you are undertaking, and it is not in Category 1, 3 or 4, then use the last item in Category 2 to describe the activity and treat it as Category 2 for purposes of environmental review.*

▸ ***Does the grant involve (yes, no, N/A):***

_____ Small-scale activities in agriculture, NRM, sanitation, etc. (*list and scale to be defined mutually among the appropriate partners* -- NGO, donor, host country agencies, REDSO, etc.).

_____ Controlled experimentation exclusively for the purpose of research and field evaluation *(areas of 4 ha. or more,* i.e., 10 acres) and carefully monitored, when neither protected or other sensitive environmental areas could be adversely affected nor threatened and endangered species and their habitat jeopardized.

_____ Small-scale construction or rehabilitation of facilities or structures in which the surface area to be disturbed exceeds 10,000 sq. ft and funding level is not in excess of $200,000 and where no protected or other sensitive environmental areas could be affected.

_____ Minor construction or rehabilitation of rural roads less than ca. 10 km (with no change in alignment or right of way), with ecologically sensitive areas at least 100 m away from the road and not affected by construction or changes in drainage; likewise, no protected areas or relatively undegraded forest should be within 5 km of the road.

_____ Nutrition, health care or family planning, *if* (a) some included activities could directly affect the environment (construction, water supply systems, etc.) or (b) biohazardous (esp. HIV/AIDS) *waste is handled or blood is tested.*

_____ Construction or rehabilitation of small-scale water points or water storage devices for domestic or non-domestic use, not covered in Category 1, when neither protected or other sensitive. environmental areas could be adversely affected nor endangered and threatened species jeopardized

_____ Quantity imports of commodities such as fertilizers.

_____ Food for Development programs under Title II or III, involving known biophysical interventions with potential to cause environmental harm (e.g., roads, bore holes).

_____ Support for intermediate credit institutions when indirect environmental harm conceivably could result .

_____ Institutional support grants to NGOs/PVOs when the activities of the organizations are known and raise the likelihood of some environmental impact.

_____ Technical studies and analyses and other information generation activities that could involve intrusive sampling, including aerial surveys, of endangered species or critical habitats.

_____ Small-scale use of USEPA-registered least-toxic *general-use pesticides*, limited to NGO-supervised use by farmers, demonstration, training and education, or emergency assistance. Environmental review must be carried out consistent with USAID Pesticide Procedures as required in Reg. 16 [22 CFR 216.3(b)(1)].

_____ Other activities not in Category 1 and not in Category 3 or 4. Specify: _____

_____

▸ ***Were the following used by the PVO/NGO in designing the above Category 2 activities (yes, no, N/A)?***

_____ *USAID/AFR's Environmental Guidelines for NGO and PVO Use in Africa*

_____ Any applicable Programmatic Environmental Assessments: _____

_____

_____ Other(s):_____

- **Africa Bureau *Category 3* -- Significant environmental impacts likely. Environmental review required, and Environmental Assessment likely to be required:**

  ▸ ***Does the grant activity involve (yes, no, N/A):***

_____ River basin or new lands development

_____ Planned resettlement of human populations

_____ Penetration road building, or rehabilitation of roads (primary, secondary, some tertiary) over 10 km length, and any roads which may pass through or near relatively undegraded forest lands or other sensitive ecological areas

_____ Substantial piped water supply and sewerage construction

_____ Major bore hole or water point construction

_____ Large-scale irrigation

_____ Water management structures such as dams and impoundments

_____ Drainage of wetlands or other permanently flooded areas

_____ Large-scale agricultural mechanization

_____ Agricultural land leveling

_____ Procurement or use of <u>restricted use</u> pesticides, or wide-area application in non-emergency conditions under non-supervised conditions

_____ Light industrial plant production or processing (sawmill operation, agro-industrial processing of forestry products)

_____ Potential to significantly degrade protected areas, such as introduction of exotic plants or animals

_____ Potential to jeopardize threatened & endangered species or adversely modify their habitat (esp. wetlands, tropical forests)

The above Category 3 activities are consistent with USAID criteria for activities that normally require a USAID-specific document with a defined format and procedure, called the Environmental Assessment (EA). It is recognized that some of these categories are ambiguous. Mark "yes" if they apply, and show in the Environmental Review (Step 4) the extent and magnitude of activities and their impacts, so that USAID and its partners can determine if an EA is necessary or not.

Africa Bureau *Category 4* – Activities not fundable or fundable only when specifically defined findings to avoid or mitigate the impacts are made, based on an Environmental Assessment[1]:

- ***Does the grant activity involve (yes, no, N/A):***

_____ Actions determined likely to significantly degrade protected areas, such as introduction of exotic plants or animals
_____ Actions determined likely to jeopardize threatened & endangered species or adversely modify their habitat (esp. wetlands, tropical forests)[2]
_____ Conversion of forest lands to rearing of livestock
_____ Planned colonization of forest lands
_____ Procurement or use of timber harvesting equipment
_____ Commercial extraction of timber
_____ Construction of dams or other water control structures which flood relatively undegraded forest lands
_____ Construction, upgrading or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands.

Step 2. **Summarize and Itemize Activities.** List activities under this grant by all categories to which *Yes* was answered.

Category of Grant/subgrant activities as determined below (add entries as required):

Activity/Sub-Activity	Funding:	Category

Step 3. **Determine Need to Prepare Environmental Review.**

If all activities are in Category 1, sign and date the form. For any activities in Category 2 and 3, prepare an Environmental Review Report assessing all of these activities' impacts. For Category 3 activities, further

[1] Per Foreign Assistance Act Sect. 118 & 119 relating to overseas assistance affecting Tropical Forestry and Biodiversity

[2] Per USAID Environmental Procedures, § 22 CFR 216.5, on Endangered Species

documentation would be required, once USAID has confirmed the applicability of Category 3, based on the Review. If Category 4 is possible, consult USAID before proceeding with the Environmental Review to determine if activities can be funded and/or whether required EA findings could be made.
For all Category 2 and 3 activities, proceed to Step 4 to prepare Environmental Review.

Step 4. Prepare Environmental Review

Suggested Format for Environmental Review

The Environmental Review should be about 3-5 pages long (more if required) and consist of following sections:

1. **Background, Rationale and Outputs/Results Expected** -- summarize and cross-reference proposal if this review is contained therein.

2. **Activity Description** -- Succinctly describe location, siting, surroundings (include a map, even a sketch map). Provide both quantitative and qualitative information about actions needed during construction, how intervention will operate and any ancillary development activities that are required to build or operate the primary activity (e.g., road to a facility, need to quarry or excavate borrow material, need to lay utility pipes to connect with energy, water source or disposal point or any other activity needed to accomplish the primary one but in a different location). If various alternatives have been considered and rejected because the proposed activity is considered more environmentally sound, explain these.

3. **Environmental Situation** -- Affected environment, including essential baseline information available for all affected locations and sites, both primary and ancillary activities.

4. **Evaluation of Activities and Issues with Respect to Environmental Impact Potential** -- Include impacts that could occur before construction starts, during construction and during operation, as well as any problems that might arise with restoring or reusing the site, if the facility or activity were completed or ceased to exist. Explain direct, indirect, induced and cumulative effects on various components of the environment (e.g., air, water, geology, soils, vegetation, wildlife, aquatic resources, historic, archaeological or other cultural resources, people and their communities, land use, traffic, waste disposal, water supply, energy, etc.). Indicate positive impacts and how the natural resources base will be sustainably improved.

5. **Environmental Mitigation Actions** (including **monitoring and evaluation**) -- For example, indicate means taken to avoid, reduce or compensate for impacts, such as restoration of borrow or quarry areas, replanting of vegetation, compensation for any relocation of homes and residents. Indicate how mitigative measures will be monitored to ensure that they accomplish their intended result or what monitoring might be needed for impacts that one is uncertain about.

6. **Other Information** (as appropriate) -- where possible, include photos of the site and surroundings; list the names of any reference materials or individuals consulted.

Note: Specific plans for monitoring of key environmental indicators and mitigation of impacts during activity implementation are especially important; these must be addressed in the review. Information on monitoring results and mitigation of impacts are to be included in all progress reports. Important information and a criterion for evaluation of environmental soundness is showing how the activity is part of or guided by an integrated, community-based resource and land use plan or planning and management framework that considers the appropriate use of multiple resources.

Drafted by: _____ Date:

Reviewed by: _____ Date:

PVO/NGO Grant Manager: _____ Date:

Clearances: (modify as appropriate)

USAID Activity/Program Administrator or Designee: _____

MEO (including recommendation that an EA be prepared, if called for)
USAID Mission Director
Other Mission officers (as appropriate)
REDSO REO, REDSO RLA (if appropriate)

Attachment: [applicable umbrella PVO project IEE]

Date last revised: Sept. 20, 1996
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Summary of Environmental Regulations Affecting USAID Activities

Environmental Regulations and Statutory Requirements Applicable to USAID Assistance

In addition to the general guidelines and strategies applicable to USAID as a whole, the Agency operates under a number of regulations to implement its environmental program activities. Some of the more important regulations are briefly described below.

USAID Environmental Procedures: 22 CFR Part 216 (Regulation 216, or "Reg. 16")

USAID's Environmental Procedures are Federal Regulations, and therefore represent a legal requirement as well as Agency policy. These environmental procedures shall be used by USAID to ensure that environmental factors and values are integrated into the USAID decision-making process. These procedures also assign responsibility within the Agency for assessing the environmental effects of A.I.D.'s actions. They are intended to implement the requirements and the purposes of the National Environmental Policy Act of 1970 as they affect USAID development assistance programs.

It is A.I.D. policy to:

(1) Ensure that the environmental consequences of USAID-financed activities are identified and considered by USAID and the host country prior to a final decision to proceed and that appropriate environmental safeguards are adopted;

(2) Assist developing countries to strengthen their capabilities to appreciate and effectively evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement and manage effective environmental programs;

(3) Identify impacts resulting from A.I.D.'s actions upon the environment, including those aspects of the biosphere which are the common and cultural heritage of all mankind; and

(4) Define environmental limiting factors that constrain development and identify and carry out activities that assist in restoring the renewable resource base on which sustained development depends.

Foreign Assistance Act Amendments (P.L. 87-185 as amended):
Environmental and Natural Resources (Section 117 of the Foreign Assistance Act)

Section 117 emphasizes the need for the United States to exercise leadership in reassessing policies related to the environment and natural resources and in "cooperating extensively with developing countries in order to achieve environmentally sound development." To achieve this goal, the section indicates that: "Special efforts shall be made to maintain and where possible to restore

the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially of the poor."

The section also requires USAID to "take fully into account" the impact of its activities on the environment and natural resources of developing countries. Where appropriate, Section 117 (c)(1) encourages USAID to use local technical resources in preparing environmental assessments or impacts statements that may be necessary.

Tropical Forests (Section 118 of the Foreign Assistance Act)

In Section 118, the U.S. Congress recognizes the importance of tropical forests in developing countries. Congress is particularly concerned that the continuing destruction and loss of tropical forests will impair the economic development of these countries. If properly managed, tropical forests can provide a sustained flow of resources which are essential to economic growth. Tropical forests can also maintain genetic resources which are important to both developed and developing countries.

According to this Section, tropical forest destruction may result in:

- shortages or wood resources (e.g., fuelwood, non-timber forest products);
- loss of biologically productive wetlands;
- extinction of plant and animal species;
- reduced capacity for food production;
- loss of genetic resources; and
- desertification and destabilization of the earth's climate.

Under Section 118 (c) the following language pertains to circumstances when USAID assistance would be denied:

"(14) Deny assistance under this chapter for—

"(A) the procurement or use of logging equipment, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an environmentally sound manner which minimizes forest destruction and that the proposed activity will produce positive economic benefits and sustainable forest management systems; and

"(B) actions which significantly degrade national parks or similar protected areas which contain tropical forests or introduce exotic plants or animals into such areas.

"(15) Deny assistance under this chapter for the following activities unless an environmental assessment indicates that the proposed activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development:

"(A) Activities which would result in the conversion of forest lands to the rearing of livestock.

"(B) The construction, upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively undegraded forest lands.

"(C) The colonization of forest lands.

"(D) The construction of dams or other water control structures which flood relatively undegraded forest lands.

Endangered Species (Section 119 of the Foreign Assistance Act)

In Section 119, the U.S. Congress finds that the survival of many animal and plant species is endangered by over-hunting, by the presence of toxic chemicals in water, air and soil, and by the destruction of habitats. Congress further finds that the extinction of animal and plant species is an irreparable loss with potentially serious environmental and economic consequences for developing and developed countries alike. Accordingly, the preservation of animal and plant species through the regulation of the hunting and trade in endangered species, through limitations on the pollution of natural ecosystems, and through the protection of wildlife habitats should be an important objective of the United States development assistance.

In order to preserve biological diversity, the President is authorized to furnish assistance under this Section to assist countries in protecting and maintaining wildlife habitats and in developing sound wildlife management and plant conservation programs. Special efforts should be made to establish and maintain wildlife sanctuaries, reserves, and parks; to enact and enforce anti-poaching measures; and to identify, study, and catalog animal and plant species, especially in tropical environments.

Biological diversity is defined as the variety and variability among living organisms and the ecological complexes in which they occur. It can be measured at four levels: biomes (e.g., tropical moist forests, coastal wetlands, etc.), ecosystems (a portion of a biome in which living organisms seem to be self-sustaining), species, and genetic varieties within species.

Country Analysis Requirements Under Sections 118 and 119 of the Foreign Assistance Act

All USAID Missions are required under these Sections to provide information on tropical forests and biological diversity as appropriate in their country development strategy. The information should contain an analysis of the:

(i) actions necessary in that country to achieve conservation and sustainable management of tropical forests; and

(ii) extent to which the actions proposed for support by the Agency meet the needs identified.

Non-Project Assistance (NPA) and Environmental Impacts (Section 496(h)(2)(b) of the Foreign Assistance Act Amendment)

The 1992 Foreign Assistance Act Amendment (Section 496, H.R. 5368) requires that institutional and policy reforms include provisions to protect long-term environmental interests from

possible negative consequences of policy reforms. The requirement calls for analyses of policy reforms that are likely to have a long-term impact on the environment. The amendment's provisions are a particular challenge to implement by USAID, because of the Agency's limited responsibility, vis-a-vis the host country government, for the mitigation of potential environmental impacts associated with policy initiatives. The approach being promoted by USAID Africa Bureau involves encouraging improved environmental monitoring processes by the host country institutions, which can lead to better-informed mitigation actions. Programmatic environmental monitoring, evaluation and mitigation planning (EMEMP) may be a particularly useful mechanism for helping USAID and host governments avoid possible negative environmental consequences from proposed non-project assistance policies or activities.

Protection of Vulnerable Groups in light of Policy Reforms (1990 Amendment of FAA)

Assisted policy reforms shall also include provisions to protect vulnerable groups (especially poor, isolated, and female farmers, the urban poor, and children including displaced children) and **long-term environmental interests from possible negative consequences of the reforms.** This is to be treated as design factor, especially with respect to Non-Project Assistance. *Source:* Amendment to the Foreign Assistance Act, 1990 Chapter 10-Development Fund for Africa. Section 496(h)(2)(B). Dated 27 October 1990.

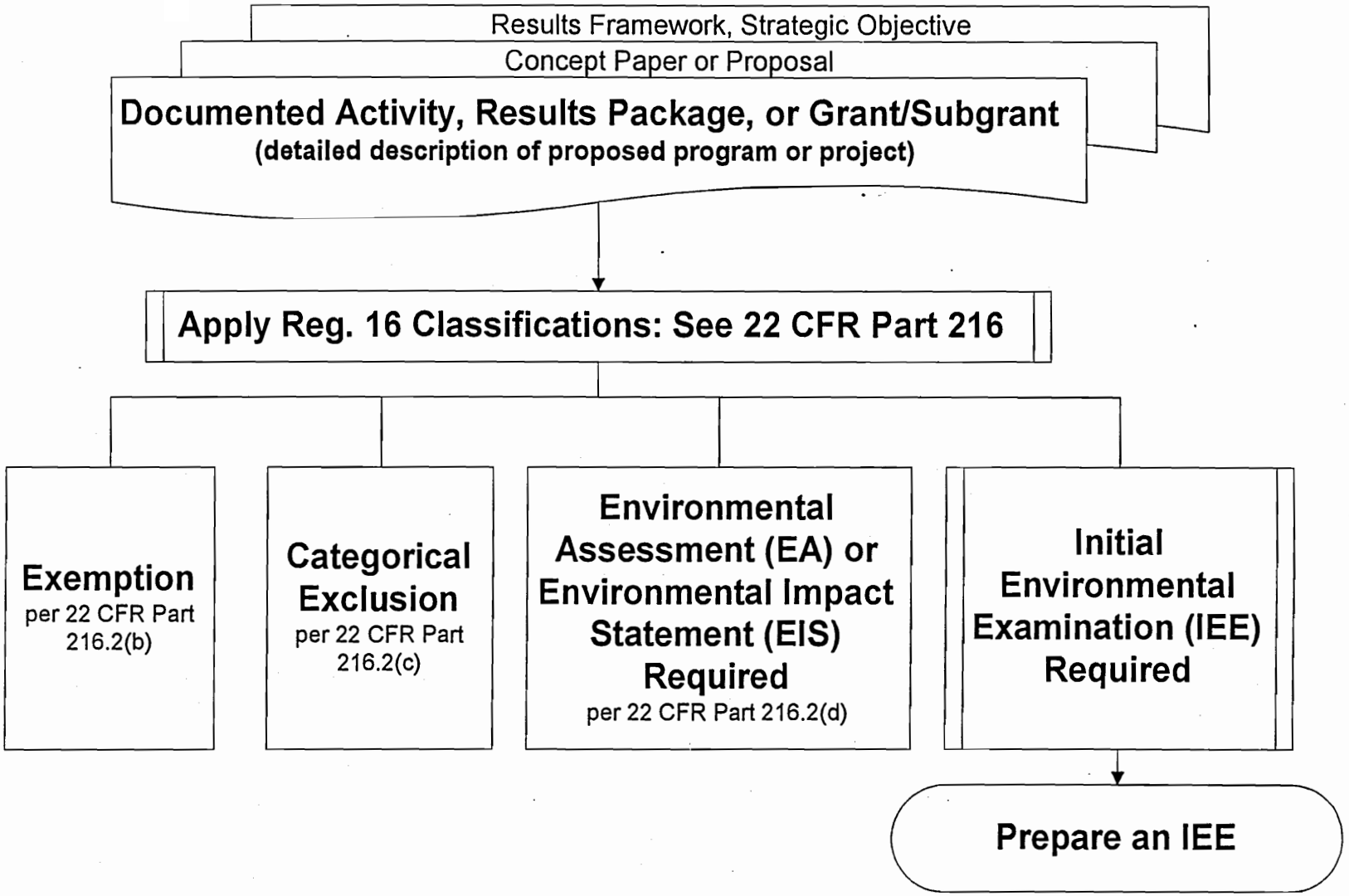
Commercial Extractive Forestry: Section 533(c)(3) of the Foreign Operations, Export Financing and Related Programs Act, 1991

In addition to imposing requirements on USAID through amendments to the Foreign Assistance Act, the Congress can also do so through legislation that provides appropriations to the agency. Section 533(c)(3) provides such an example. It prohibits the expenditure of funds for any activity, program, or project that "would result in any significant loss of tropical forests" or involve "commercial timber extraction of primary tropical forest areas" unless an environmental assessment:

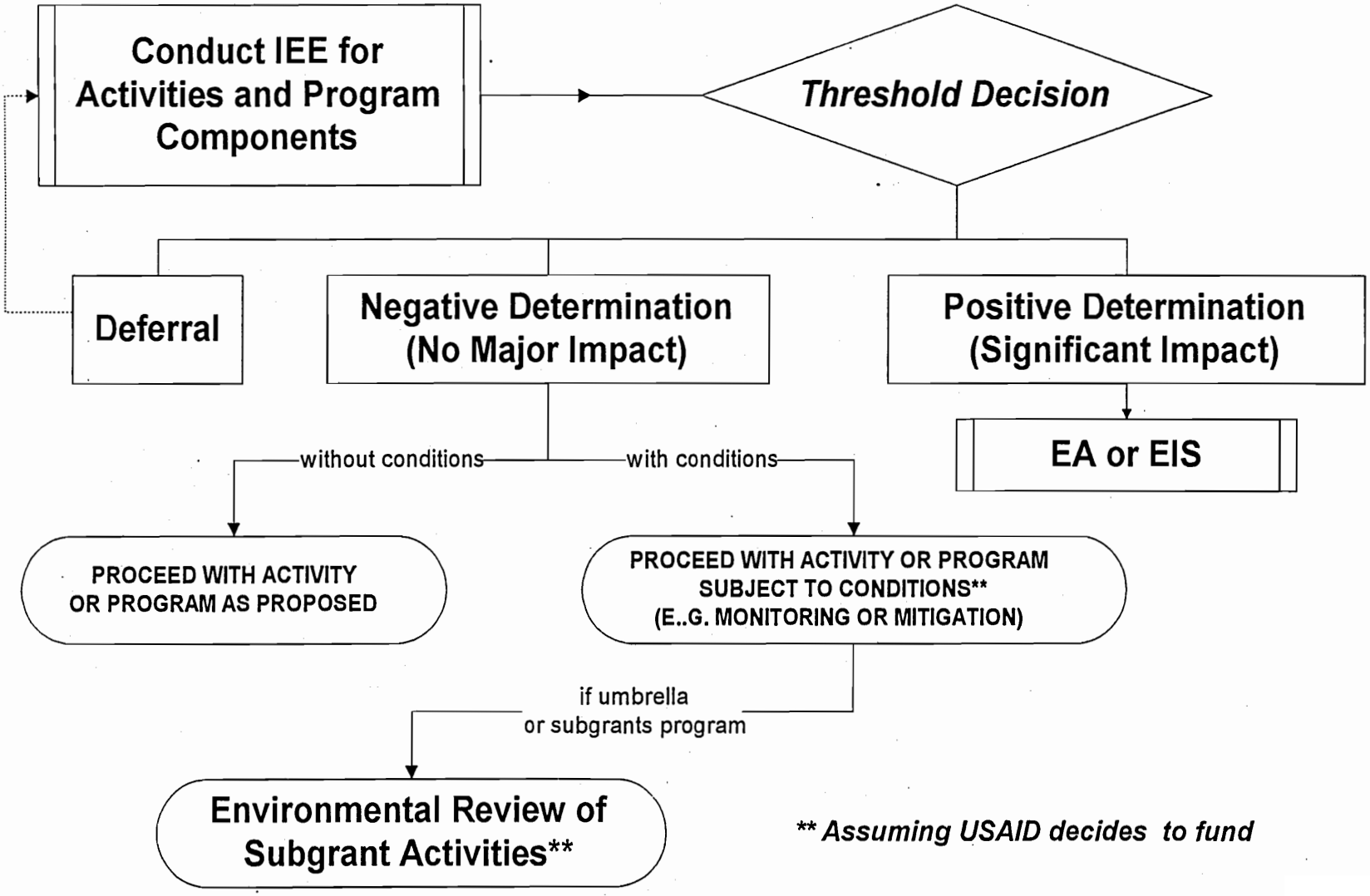
(i) identifies potential impacts on biological diversity;
(ii) demonstrates that all timber extraction will be conducted according to an environmentally sound management system which maintains the ecological functions of the natural forest and minimizes impacts of biological diversity; and
(iii) demonstrates that the activity will contribute to reducing deforestation.

Note: For a detailed review of USAID's responsibilities related to biological diversity and tropical forests see Russo, Sandra, *Considerations of Biological Diversity and Tropical Forestry in the Context of Country Program Strategy Planning in the Bureau for Africa: Review and Guidelines*, Prepared by Environmental and Natural Resources Policy and Training (EPAT) Project for USAID AFR/SD/PSGE, November 1994, 117pp.

The Full Reg. 16 Approach



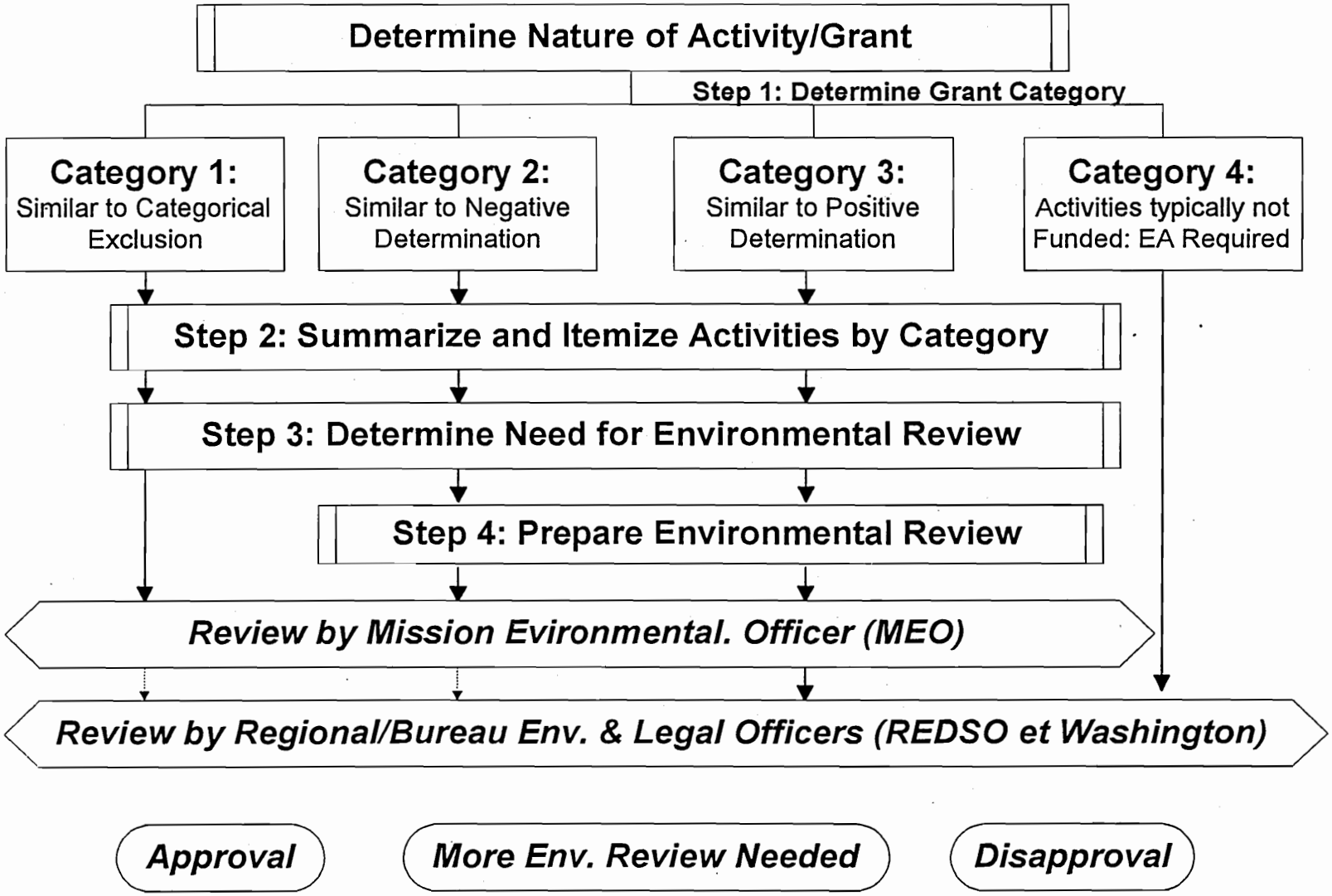
Prepare IEE and Make Threshold Decision



*** Assuming USAID decides to fund*

Apply Environmental Screening Form

for Umbrella NGO/PVO Grant and Activity Proposals where Umbrella IEEs Exist



10. Basic Tools and Methods for Environmental Review and Assessment: Checklists and Information Gathering

Description/Objectives

Checklists, maps, and basic information gathering techniques are important tools for identifying potential environmental impacts at an early stage of activity project or program design. Unlike more complex methods, they generally do not require particular expertise to use. This module will present basic information gathering techniques and tools, focussing on checklists and maps, to provide you with tools that you can use for the course field trip as well as your own activities. These and other tools and methods are discussed in greater detail in Module 18.

Readings

Module Backgrounder: "Basic Tools and Methods for Environmental Review and Assessment: Checklists and Information Gathering"

See Module 18, Backgrounder and Readings for "Additional Issues in Environmental Review"

Attachments

Selected checklist(s) for use in the field

You should review the material in this session Backgrounder, which describes checklists and information gathering, as well as the more extensive material for the later session on detailed environmental assessment, which covers matrices, overlays, and other tools and techniques. In most cases, it is likely that the emphasis should be placed on the use of checklists and maps, *especially the utility of collecting and using available maps to identify and chart the location and movement of human and natural resources.*

You should also review the checklists included in the Sourcebook for this session, and determine whether these should be supplemented or replaced with other useful tools, such as locally developed checklists if they exist.

MODULE BACKGROUNDER
Basic Tools and Methods of Environmental Assessment: Checklists and Information Gathering

In this module, we will introduce you to specific types of information needed to assess environmental impacts as well as some practical basic tools and methods that you can use.

(Much of the following material was drawn from CCIC, 1994: *Environmental Screening of NGO Development Projects*)

1. What type of Information Should You Acquire?

To screen a project for potential environmental impacts, certain information about the community and physical environment at the project site will be needed. Some of this information will already have been collected to develop the project objectives. But additional data will likely be necessary to identify alternative methods of accomplishing the project objectives and to evaluate their respective impacts on the environment. The data will vary depending on the project but, in general, the following environmental data will be needed at the reconnaissance level:

- General climatic information (e.g., annual rainfall patterns, flood and drought cycles, wind patterns);
- Land-use patterns (e.g., residential, recreational, protected area);
- Resource use by the people (e.g., forestry, aquaculture, agriculture, fishing, natural grasslands for grazing);
- Type of habitats present (e.g., mangrove, forest, desert, grassland);
- Physical characteristics (e.g., soil type, topography, erosion potential, presence of streams, ground water characteristics); and
- Biological characteristics (e.g., animal and plant species present and their significance, i.e., food source for the people, endangered species).
- Status (location, characteristics, condition, use, etc. of any protected areas (national or other parks, reserves, or other as defined by national or other law) that could be affected by the action, including protected areas in any possible zone of impact (direct or indirect, upstream, downstream, construction activities, transport of construction materials, etc.)
- Location and information about designated, classified, or gazetted forests (if not defined as a protected area per se under national or other law) as well as identification of any relatively undegraded forest, even if not classified or gazetted.

Some of the above data already exist. Sources of information include:

- Direct observation during a site visit;
- Local counterparts;
- Local villagers, farmers, and residents;
- Regional meteorological stations;

- Local government agencies, such as the Ministry of Agriculture or Forestry, or local agricultural extension workers;
- Airport;
- Local university or training centers;
- Local NGOs, consultants, and experts;
- National Conservation Strategy for Sustainable Development (IUCN);
- National Environmental Action Plan;
- National Report on Environment and Development prepared for the UNCED Rio 1992 conference;
- Tropical Forestry Action Plan;
- USAID Environmental Sector Assessment (sometimes referred to as Environmental Threats Assessment) or Biodiversity Assessment (in place or likely in process);
- GIS data bases (consult Ministry of Environment or Natural Resources or equivalent);
- FAO (which has supported international soils and water resource inventories in many areas).

Similarly, information on the local culture, socio-economic conditions, and gender relations of the area that will be useful for screening purposes include:

- Crops and livestock raised, and associated agricultural practices (e.g., tillage and harvesting methods, pesticide and fertilizer use);
- Agriculture, rain-fed or irrigated;
- Local water sources and usage;
- Community resources (e.g., raw building materials, land ownership and distribution, work patterns, role of women);
- Local sanitation facilities and hygiene practices;
- Population size and demographics (e.g., principal diseases, birth controls, sex/age distribution);
- Local religion, culture, and traditions; and,
- Literacy levels and educational training facilities; and community organization, leadership, communication, and types of occupations.

Some sources of this information include direct observation, local counterparts, local farmers and villagers, and local NGOs.

An emphasis should also be placed on collecting and using available maps to identify and chart the location and movement of human and natural resources. Map resources include:

Topographical and physical maps at the scale 1/10000 to 1/20000 providing information on:

- inhabited areas;
- major wind directions;
- waterways and water bodies;
- different types of vegetation cover;
- sensitive and fragile areas;
- protected forests; and,
- classified forests.

Maps, plans and sketches of activities providing information on:

- land use around the selected site;
- areas disturbed during construction, and type of disturbance;
- existing or planned solid waste collecting systems, especially for urban projects; and,
- existing or planned liquid waste collecting systems.

Compare the maps of information about the setting with maps or plans that you have of the proposed action to see how or if various kinds of resources or areas overlap with the geographic area affected by the proposed action. You will need to be careful about comparing maps of different scales, so you will often not have a precise indication of areas of overlap, but you will be able to see areas of potential conflict that need to be investigated further. Use of map information of environmental features has been refined with the use of transparent overlays (overlay method) and now with the use of computer generated maps that present multiple features from a variety of sources (see Figure 1.1 at end of Module).

2. Simple Checklists for Assessing Environmental Impacts

It is not always easy, even given the right data, to appreciate the various subtle and indirect ways in which certain project activities can affect the environment. Checklists are useful tools for guiding decision-making especially during the prefeasibility and planning phases when it is most critical to anticipate negative impacts and to include mitigating measures in projects. Checklists are designed:

- to help ***identify significant negative impacts*** by providing the right questions to ask regarding the various project activities and the respective environmental components that may be affected;
- to provide a ***systematic approach*** to the environmental screening of development projects;
- to indicate ***how and why certain project activities have environmental impacts*** which will allow planners to transfer those principles to screen projects not specifically addressed by the checklists;
- to assist in ***identifying appropriate mitigation measures*** to be incorporated into the project design; and,
- to ***increase environmental awareness and understanding*** of the relationship between environmentally sound practices and sustainable development.

Checklists offer the advantage of simplicity for gathering and classifying information that is necessary for assessing environmental impacts. The technique is a structured way to help you begin to organize information, identify potential environmental impacts, think about possible mitigation options, and make tentative conclusions on the extent of environmental impact. It is important to note that, no matter what the structure of the checklist, a variety of sources can be used to develop the checklist; local individuals, experts, and other concerned parties. At the end of this Module, we present a simple checklist that is comprised of the following categories:

- ***Project activity***. In this column, you identify the nature of the proposed project and the scope of its activities and tasks.

- ***Potential environmental impacts.*** In this column, list the potential impacts of the proposed project such as threats to a particular species, reduced visibility, materials soiling, etc.
- ***Recommended mitigation strategies.*** This column is for some potential remedies to the identified impacts. Mitigation options can refer to either the pre- or post-construction phase.
- ***Degree of Environmental Impact.*** In this column, synthesize the assessment of impacts and potential remedies and indicate the environmental impact of the proposed project, ranging from severe to acceptable.

Chapter 3 of *Environmental Guidelines for Small-Scale Activities in Africa (1996),* "Implementation Guidelines by Sector," examines key sectors using a consistent outline: identifying the problem; describing potential environmental impacts; and possible causes of negative impacts of activities. Key questions and suggested actions are provided to facilitate review of project design, implementation, mitigation and monitoring/evaluation issues.

3. Interaction Matrices (after Takawira, 1995)

Interaction Matrices involve two checklists, one for environmental features and the other for project activities, arrayed on each axis of a two-dimensional matrix (Figure 1.2). An interaction matrix allows the identification of cause-effect relationships between specific activities and impacts, but does not easily distinguish between direct and indirect impacts. The entries in the cells of the matrix can be either qualitative or quantitative estimates of impact. Each cell can also be divided diagonally to display an estimate of both impact severity and significance.

Matrices are useful for impact identification and for displaying the results of both impact analysis and impact assessment.

4. Network Analyses (after Takawira, 1995)

Network Analysis relies upon an understanding of the ecological relationships among the environmental features in a project area. Environmental features are generally interconnected in some functional manner and the connections, displayed in a network or "web," depict which features are related to others. A project will directly impact one or more features and the network is used to indicate what other features may be subsequently affected indirectly. An "impact network" can then be constructed (Figure 1.3) to display the project actions and which features may be affected directly and through secondary, tertiary and higher-order impacts. Network analysis is useful for impact identification.

5. Map overlay method (map of constraints & opportunities)
GIS

6. Journalists method
Who
What
When
Where
Why
How

Sample Checklist for Project Analysis

Project Activity	Potential Environmental Impacts	Recommended Mitigation Action	Environmental Determination

5. Information Resources for Environmental Review or IEE Preparation

Environmental information must be available to the Environmental Review or IEE preparer. Information resources should include:

* Topographical and physical maps (preferably at the scale 1/10000 to 1/20000) showing:

- 0.5 meter contours,
- inhabited areas,
- major wind directions,
- waterways and water bodies,
- different types of vegetation cover,
- sensitive and fragile areas.

* Maps, plans or sketches of activities:

- Indications of land use around the selected site,
- Map of areas disturbed during construction and type of disturbance (including tree removal and any grading, land leveling, removal of soil o rock, etc.),
- Description or sketch of existing or planned solid waste collecting system, especially for urban projects,
- Description or sketch of existing or planned liquid waste collecting system.

Overlays (Impact Identification and Prediction):

This technique has always been extremely useful in identifying areas that have high environmental sensitivity. The technique entails the separate mapping of various critical environmental features - wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, and cultural resources - at the same scale as the project's site plan. The environmental features are mapped on transparent plastic in different colors. The several environmental maps can then be overlaid on the project map to highlight the areas of highest environmental sensitivity (EPA, 1993).

Geographical Information Systems (GISs) are essentially computerized graphical overlays and interacting data files. Environmental features are mapped, and the mapping digitized and stored in the GIS data base. The mapped features can be combined to produce computer-generated displays of one or more environmental features in a specified geographical area. If the GIS mapping is conducted systematically, information acquired on specific projects can be combined, and the GIS data base becomes more detailed over time (EPA, 1993).

Compare the maps of information about the setting with maps or plans that you have of the proposed action to see how or if various kinds of resources or areas overlap with the geographic area affected by the proposed action. You will need to be careful about comparing maps of different scales, so you will often not have a precise indication of areas of overlap, but you will be able to see areas of potential conflict that need to be investigated further. Use of map information of environmental features has been refined with the use of transparent overlays (overlay method) and now with the use of computer generated maps that present multiple features from a variety of sources.

A CLASSIFICATION OF EIA TASKS AND ASSOCIATED METHODS

Tasks	Methods (examples only)
1. Description of proposed development	
a) Identify aspects of project for which information is to be sought distinguishing, where necessary, between different stages in the proposed development (e.g. construction and operating phases) and between different levels of screening.	Checklists, consultations with developer.
b) Determine resources to be used in construction and initial operating phase, wastes to be created, physical form of the development.	Data sheets, engineering drawings, etc., prepared by developer; mass balance analysis; accident and uncertainty analysis (this continues through a number of assessment stages).
c) Forecast future resource use, waste generation, etc., over the expected life of the development.	The same methods apply as in b), but methods of production and technological forecasting are also relevant.
2. Description of existing and projected environmental conditions	
a) Identify aspects of existing and projected environmental conditions for which information is to be sought.	Checklists, consultations with environmental agencies; alternatively, may be linked with 1a) through the use of matrices or through more elaborate representations of relationships such as networks.
b) Collate existing environmental data and identify gaps in information.	Consultation with environmental agencies and voluntary organisations; use of data bank and retrieval systems.
c) Obtain additional environmental data to meet remaining deficiencies.	Review of existing monitoring systems; special surveys using a variety of techniques (aerial photography, field sampling, etc.).
d) Predict future environmental conditions (without the proposed development).	Variety of available methods, ranging from simple forms of extrapolation to complex modelling studies; consultation with environmental agencies.
e) Summary and presentation of environmental data.	Mapping, overlay methods, summary sheets.
3. Assessment of probable impact of development	
a) Assess magnitude of impact (in present and future conditions) on:	
i) air, water and land;	diffusion and resource utilization models, physical intrusion assessment;
ii) receptors within the environment.	ecological modelling, damage functions
b) Assess importance of impact by:	
i) investigating response of affected parties;	social surveys, agency consultation and public participation;
ii) aggregating individual environmental impacts,	scaling and weighting systems, overlay methods, use of panel of experts.
4. Compliance with other environmental plans, policies and controls	
Assess likely compliance of development with existing and proposed controls.	Agency consultation, checking of extant plans.
5. Review of alternatives to the proposed development	
a) Identify alternatives to be considered.	Checklist (of types of alternatives to be reviewed), consultation and survey methods.
b) Describe project alternatives and assess their impacts.	Same methods as in 1, 2, 3 above, combined with screening methods.
6. Preparation of non-technical summary of the assessment	
Determine salient features of assessment and most effective means of presentation.	Communication methods

Reproduced from: Wathern,

Checklist of impact categories for land development projects (summarized from Schaenam 1976).

1 *Local economy*
Public fiscal balance
Employment
Wealth

2 *Natural environment*
Air quality
Water quality
Noise
Wildlife and vegetation
Natural disasters

3 *Aesthetics and cultural values*
Attractiveness
View opportunities
Landmarks

4 *Public and private services*
Drinking water
Hospital care
Crime control
Feeling of security
Fire protection
Recreation – public facilities
Recreation – informal settings
Education
Transportation – mass transit
Transportation – pedestrian
Transportation – private vehicles
Shopping
Energy services
Housing

5 *Other social impacts*
People displacement
Special hazards
Sociability/friendliness
Privacy
Overall contentment with neighbourhood

Reproduced from:
Wathern, 1988

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from:
Wathern
1988

Instructions

1. Identify all actions (located across the top of the matrix) that are part of the proposed project
2. Under each of the proposed actions, place a slash at the intersection with each item on the side of the matrix if an impact is possible
3. Having completed the matrix, in the upper left-hand corner of each box with a slash, place a number from 1 to 10 which indicates the MAGNITUDE of the possible impact; 10 represents the greatest magnitude of impact and 1, the least, (no zeros). Before each number place + (if the impact would be beneficial). In the lower right-hand corner of the box place a number from 1 to 10 which indicates the IMPORTANCE of the possible impact (e.g. regional vs. local); 10 represents the greatest importance and 1, the least (no zeros)
4. The text which accompanies the matrix should be a discussion of the significant impacts, those columns and rows with large numbers of boxes marked and individual boxes with the larger numbers

Sample matrix

	a	b	c	d	e
a		2/1			8/5
b		7/2	5/8	3/1	9/7

			A. Modification of regime													B. Land transformation and construction																					C. Resource extraction							
			a. Exotic flora or fauna introduction	b. Biological controls	c. Modification of habitat	d. Alteration of ground cover	e. Alteration of ground water hydrology	f. Alteration of drainage	g. River control and flow modification	h. Canalization	i. Irrigation	j. Weather modification	k. Burning	l. Surface or paving	m. Noise and vibration	a. Urbanization	b. Industrial sites and buildings	c. Airports	d. Highways and bridges	e. Roads and trails	f. Railroads	g. Cables and lifts	h. Transmission lines, pipelines and corridors	i. Barriers including fencing	j. Channel dredging and straightening	k. Channel revetments	l. Canals	m. Dams and impoundments	n. Piers, seawalls, marinas and sea terminals	o. Offshore structures	p. Recreational structures	q. Blasting and drilling	r. Cut and fill	s. Tunnels and underground structures	a. Blasting and drilling	b. Surface excavation	c. Subsurface excavation and retorting	d. Well drilling and fluid removal	e. Dredging	f. Clear cutting and other lumbering	g. Commercial fishing and hunting
		Proposed actions																																										
CHEMICAL CHARACTERISTICS	1 Earth	a. Mineral resources																																										
		b. Construction material																																										
		c. Soils																																										
		d. Land form																																										
		e. Force fields and background radiation																																										
		f. Unique physical features																																										
	2 Water	a. Surface																																										
		b. Ocean																																										
		c. Underground																																										
		d. Quality																																										
		e. Temperature																																										
		f. Recharge																																										
		g. Snow, ice and permafrost																																										

A section of the Leopold matrix (Courtesy US Geological Survey).

BEST AVAILABLE

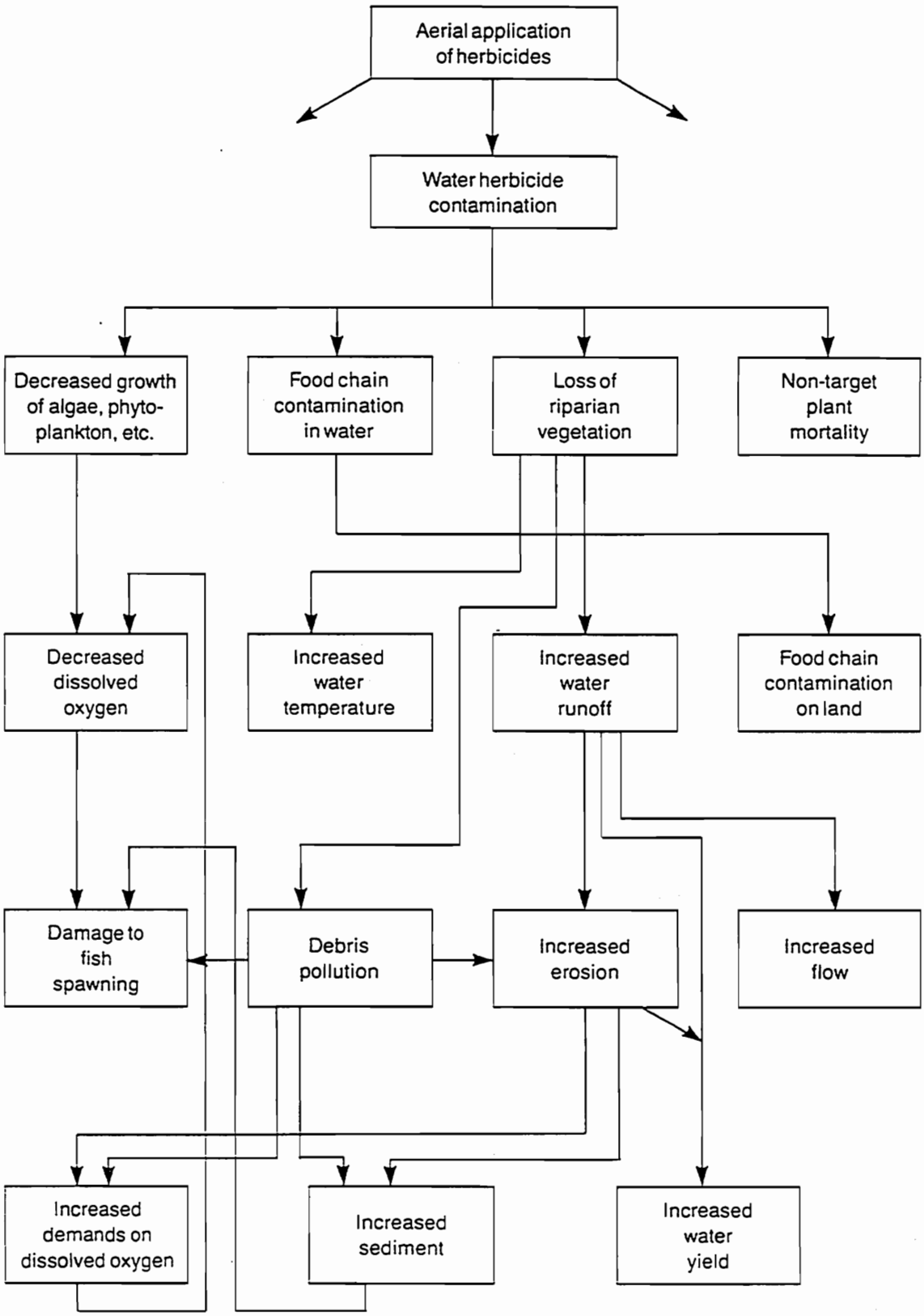
PROJECT IMPACT MATRIX

PROJECT COMPONENTS (Depends on Characteristics of Project / Envi.)	ENVIRONMENTAL COMPONENTS →	PHYSICAL ENVIRONMENT										BIOLOGICAL ENVIRONMENT												SOCIAL ENVIRO					
		AGRICULTURAL LANDS	SOIL EROSION	SLOPE STABILITY	ENERGY / MINERAL RESOURCES	SURFACE WATER QUANTITY	SURFACE WATER QUALITY	GROUND WATER QUANTITY	GROUND WATER QUALITY	AIR QUALITY	NOISE	AQUATIC ECOSYSTEMS	WETLAND ECOSYSTEMS	TERRESTRIAL ECOSYSTEMS	ENDANGERED SPECIES	MIGRATORY SPECIES	BENEFICIAL PLANTS	BENEFICIAL ANIMALS	PEST PLANTS	PEST ANIMALS	DISEASE VECTORS	PUBLIC HEALTH	RESOURCES / LAND USE	DISTRIBUTION SYSTEMS	EMPLOYMENT	AT-RISK POPULATIONS	MIGRANT POPULATIONS	COMMUNITY STABILITY	CULTURAL/RELIGIOUS VALUES	TOURISM / NU
PLANNING & DESIGN																													
CONSTRUCTION																													
OPERATION																													

Recommissioning

(Develop according to subject/discipline)

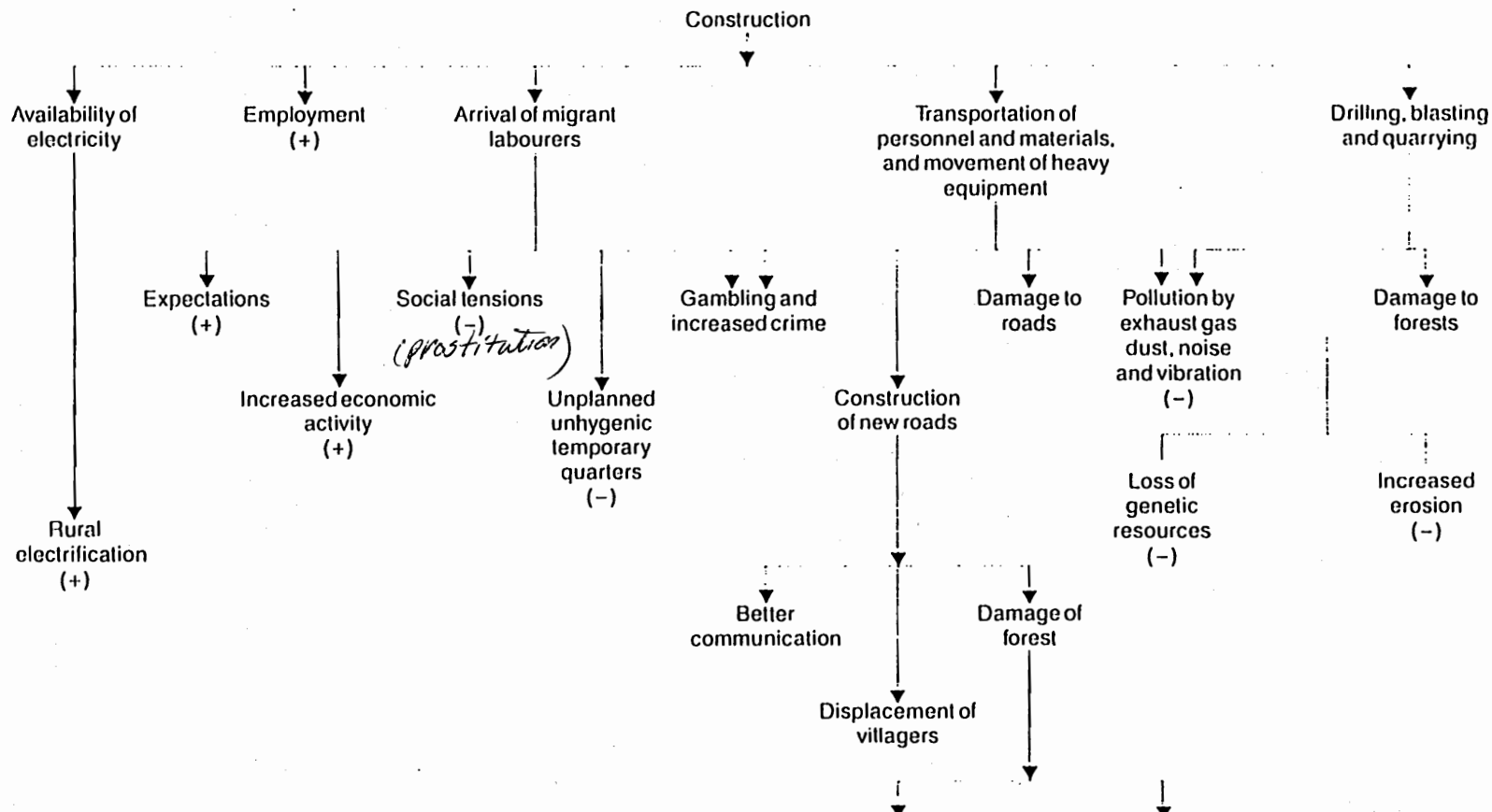
Section of the IMPACT network



Source: Thor *et al.* (1978)

Reproduced from:
Bisset, 1987

Potential impact of the construction period



Source: Institute of Ecology, Padjadjaran University (1979)

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GUIDELINE DOCUMENT 5

CHECKLIST OF ENVIRONMENTAL CHARACTERISTICS

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G.P.-S.

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1 INTRODUCTION

This checklist identifies environmental characteristics which may potentially be affected by development actions, or which could place significant constraints on a proposed development. The effect a development could have on an environmental attribute may be either positive or negative.

While the checklist has endeavoured to include the major characteristics and linkages which should be considered by the environmental analyst or planner, it is not exhaustive and the user should be aware that other characteristics, significant to a particular situation, may occur. Assistance of experts may be required to assess certain potential impacts and to identify unlisted characteristics which may be affected in specific cases. It is important to stress that cumulative effects should always be borne in mind (see section 12).

2 PHYSICAL CHARACTERISTICS OF THE SITE AND ITS SURROUNDINGS

Could the proposed development have a significant impact on, or be constrained by, any of the following?

2.1 Land

- the nature of surface (e g old weathered surfaces)
- the nature of substrata (eg rock, soil deposit)
- unstable bedrock or faultlines
- seismic activity
- slope of the land
- waterlogging of depressions
- the binding or bonding of soils
- stability of site
- surface subsidence
- compressive strength of soils
- rates of erosion or siltation by wind or water
- the potential of soils to be used for formal/informal agricultural purposes
- the potential of soils to be used for commercial purposes
- access to mineral deposits
- the availability of or access to construction materials such as rock and gravel
- the availability of topsoil or fill material
- the management of excess soil or spoil material
- unique geological or physical features
- mobile sand dunes
- prominent landscape features
- existing physical degradation of the local environment

2.2 Freshwater systems

- streams or river channels
- river flow
- natural drainage patterns
- engineered drainage patterns
- drainage limitations
- the water-table
- run-off as a result of the hardening of surfaces, or loss of the sponge effect of vegetation
- ability to absorb run-off
- changes to floodplains
- the quality or quantity of surface water, groundwater or public water supplies
- conservational or recreational value of rivers, streams, lakes, wetlands, dams or islands
- threats to hydrological functioning through existing or altered:
  - — pollution
  - — turbidity
  - — salinity
  - — chemical processes or nutrient balances
  - — changes in sediment flows and siltation rates
  - — canalisation
  - — impoundment construction
  - — water extraction

2.3 Marine and estuarine systems

- prominent coastal features such as coastal cliffs
- existing or altered processes such as:
  - — wave and tidal action
  - — deposition/removal of sand

- — sedimentation rates and patterns
- — turbidity
- — salinity
- — chemical processes or nutrient balances
- inherently unstable ecosystems such as mobile sand dunes
- sand sources such as mobile sand dunes
- rocky and sandy shorelines
- the seabed and subtidal areas
- coastal islands
- functioning of estuary systems
- river mouths

2.4 Climate

- wind strength, direction and frequency
- frequency of flash-floods
- rainfall patterns
- fluctuations in temperature or humidity
- intensity of inversions
- dispersal or influx of pollutants
- global warming and sea-level rise

3 ECOLOGICAL CHARACTERISTICS OF THE SITE AND ITS SURROUNDINGS

Could the proposed development have a significant impact on, or be constrained by, any of the following?

3.1 Vegetation

- survival of rare or endangered plant species
- diversity of plant communities
- sand-trapping vegetation such as that found on foredunes
- vegetation communities of conservation or scientific importance
- conservation of vegetation communities of particular recreational value
- the introduction or spread of invasive alien seeds and plants
- natural replenishment of existing species
- frequency of veld fires
- frequency of use of off-road vehicles
- amount of trampling of special areas of vegetation
- firewood collection
- overgrazing
- overexploitation
- genetically engineered organisms

3.2 Animals

- survival of rare or endangered animals
- diversity of animal communities
- animal communities of particular scientific, conservational or educational value
- natural migration of species
- survival of animal communities of particular recreational value
- non-resident or migrant species
- alien species (including invasive and domestic species)
- survival of animal communities due to:
  - — frequency of veld fires
  - — threat from poaching
  - — frequency of use of off-road vehicles
  - — intrusion of roads and fencing
  - — overexploitation
- genetically engineered organisms

3.3 Natural and semi-natural communities

- local, regional or national importance of the natural communities (e g economic, scientific, conservational, educational)
- compatibility of the development and the natural communities
- appropriateness of conservation methods to be employed
- ecological functioning of natural communities due to:
  - — physical destruction of the habitat
  - — reduction in the effective size of the community
  - — quality and flow of groundwater
  - — quality of standing or flowing water
  - — oxygen content of the water
  - — salinity
  - — turbidity
  - — flow rate
  - — temperature
  - — level of chemical and other forms of pollution
  - — eutrophication

— toxins such as effluents or poisons
— siltation patterns
— air quality
— levels of dust pollution and deposition
— availability of food
— the construction of access routes, roads and pathways
— recreational pressure
— secondary or cumulative impacts affecting other natural communities
— presence or introduction of invasive alien species
— rehabilitation potential
— predator:prey relationships
— barriers to animal movement or migration
— altered fire regime

4 CURRENT AND POTENTIAL LAND USE AND LANDSCAPE CHARACTER

Could the proposed development have a significant impact on, or be constrained by, any of the following?

4.1 General considerations applicable to all development proposals

- compatibility of land uses within the area
- aesthetic quality of the landscape
- sense of place within the area
- character of the area
- compatibility with the scale of developments in the area
- compatibility with building materials used in the area
- preservation of scenic views and valued features
- revitalisation of run-down areas
- landscaping plans and/or site restoration proposals
- need for buffer zones to allow for natural processes such as coastal erosion, windblown sand and changes in river channels
- political considerations such as land claims and historical rights
- legal considerations such as servitudes and rights of way

4.2 Urban open space, protected and recreational areas

- urban open space systems or recreational areas
- natural features such as streams and ridges
- natural heritage sites
- change in use or intensity of use
- pressures on recreational facilities and open space systems
- enhancement or linkage of facilities and open space systems
- rehabilitation of disturbed or degraded sites
- improved public amenity
- potential for harbouring vagrants and criminals

4.3 Residential areas

- need to displace people or affect existing housing
- lifestyle, neighbourhood character or stability
- quality of life within the residential area
- effect on views, overlooking and privacy
- effect of overshadowing causing loss of sunlight hours
- compatibility with the surrounding residential developments
- community cohesion
- the needs of the elderly, handicapped or other special interest groups
- community safety aspects such as lighting, open areas and policing
- adequacy of infrastructure to service the area (see also section 7)
- access and movement patterns
- change in the volume of through traffic
- property values and local tax base

4.4 Commercial areas

- character of urban centre
- volume of traffic and adequacy of vehicular access
- inappropriate siting
- provision of parking
- adequacy of pedestrian walkways

- conflicts between vehicular and pedestrian traffic
- safety of the area and surveillance
- the rate of decay or change in character of the area

4.5 Industrial areas

- volume of traffic and adequacy of vehicular access
- provision of parking
- levels of pollution — gas emissions, effluent or solid waste
- polluted street run-off
- aesthetic quality of the area

4.6 Agricultural and sylvicultural areas

- use of high-potential farmland
- use of areas available for commercial forests
- a need for buffer zones or greenbelts to contain urban sprawl
- availability of water
- pollution levels of air and local water supplies by fertilisers, pesticides or feedlots
- disease control activities such as crop-spraying
- levels of toxins, dust and bad smells in the air
- rate of soil erosion and sedimentation
- bush encroachment
- damaged land due to overgrazing or bad farming methods
- spread of invasive alien plants
- provision of housing and educational facilities

5 CULTURAL RESOURCES

Could the proposed development have a significant impact on, or be constrained by, any of the following?

- structures and sites of architectural, cultural or historic heritage
- sites of archaeological or palaeontological importance
- special attraction of local sites, traditions or events
- sites or areas of religious or spiritual significance
- sites or areas of special social or cultural interest
- the integrity of cultural resources

6 SOCIO-ECONOMIC CHARACTERISTICS OF THE AFFECTED PUBLIC

Could the proposed development have a significant impact on, or be constrained by, any of the following?

6.1 Demographic aspects

- growth rate of the local population
- location, distribution or density of the population
- existing age or gender composition of the population
- existing biographical composition of the population
- existing migration movements
- inflow of tourists

6.2 Economic and employment status of the affected social groups

- economic base of the area
- distribution of income
- local industry
- rate and scale of employment growth
- labour needs and the spare labour capacity of the area
- movement of labour away from existing employment in the area
- competition through non-local labour moving into the area
- non-local labour remaining in the area after completion of the development
- pressure placed on particular skills, age range or gender needs
- job opportunities for school-leavers
- short- and long-term unemployment trends

6.3 Welfare profile

- incidence of crime, drug abuse, or

violence
- extent of homelessness and overcrowding
- adequacy of services
- adequacy of support systems such as crèches and shelters for destitute children
- quality of life (see also section 7 on infrastructure and section 8 on community services and facilities)

6.4 Health profile

- availability of clinics/health services
- incidence of disease
- incidence of mental illness
- threats to health from pollution (see also section 9 on pollution)

6.5 Cultural profile

- existing lifestyles, household composition and family network
- religious and cultural attitudes, outlooks and expectations of the local population
- cultural or lifestyle diversity
- cultural or lifestyle stability

7 INFRASTRUCTURE SERVICES

Could the proposed development have a significant impact on, or be constrained by, any of the following?

7.1 Energy supply

- the demand for power and its effect on peak and base loads
- planned provision of power for the area
- power generation and associated infrastructure
- the need for new transmission lines
- the adequacy of emergency power facilities
- the danger to the local community and the environment or processing units in the case of a major power failure
- availability of alternative fuel source

7.2 Water

- water rights
- wasteful or excessive water requirements
- planned provision for water supply to the area
- adequacy and reliability of water supply
- adequacy of groundwater reserves
- adequacy of emergency supply system
- need for additional abstraction schemes or construction of new supply reservoirs
- need for additional purification systems
- need for inappropriately sized or located impoundments
- need for new pipelines
- danger to local people and industry in the event of a major water supply failure

7.3 Waste management

- efficiency and capacity of existing waste management facilities
- extent of contribution to centralised waste-processing facilities
- ability to provide necessary facilities
- need for new pipelines
- risk associated with waste transport
- adequacy of emergency waste disposal facilities
- risk to the community and the local environment should the facility break down
- hazard of groundwater pollution
- danger of rodents and scavengers at waste sites
- potential for windblown or waterborne refuse pollution
- visual and smell effects of waste sites and treatment works
- hazard of birds to air traffic near sewage ponds and landfill sites
- utilisation of treated waste water and recycled materials
- on-site waste management potential

7.4 Transport networks

- existing transport systems
- present patterns of circulation or movement of people and/or goods
- generation of more private and public traffic
- adequacy of existing road network
- adequacy of existing parking facilities
- adequacy of existing traffic management schemes
- need for and desirability of additional road schemes over and above those which have been planned
- temporary access roads used for the development
- viability of the rail service
- rail capacity
- need for additional rail links
- adequacy of harbour facilities
- need for expanded harbour and related facilities
- adequacy of air transport facilities
- ability of commerce and social facilities to locate along route

7.5 Education

- demand for specific types of technical skills training
- demand for specific types of industrial training
- adequacy of existing technical institutions
- adequacy of nursery, junior and secondary education facilities
- need for additional education facilities
- demand which exceeds the planned provision of educational facilities
- preschool facilities

7.6 Housing

- property values and levels of rates
- potential conflict over land use
- availability of housing stock
- need to release additional land for housing developments
- acceptability of such land release
- adequacy of infrastructure for further housing developments
- ability of private or local authority to provide housing
- compatibility of planned development with existing housing
- location for suitable housing sites
- sites suitable for construction camps
- standard of provision of facilities required by authority
- design and layout of site facilities
- use to which construction camp may be put after termination of the construction period

7.7 Telecommunication

- existing telecommunication network
- installation of additional telecommunication transmission lines or facilities

7.8 Financial implications to region

- job creation and economic opportunity
- enhancement of regional self-sufficiency
- financial programmes of responsible authority
- comparative wage rates between those of existing employment in the local area and those offered by the new development
- movement away from existing employment due to higher wage rates offered in the new development
- insurance rates
- cost implications of the supply of energy, water, waste management, transportation, education, housing and telecommunication

8 SOCIAL AND COMMUNITY SERVICES AND FACILITIES

Could the proposed development have a significant impact on, or be constrained by, any of the following?

8.1 Health service facilities

- adequacy of temporary facilities during construction phase of developments

- adequacy of on-site health facilities
- adequacy of facilities for primary health care (e g screening facilities for tuberculosis or AIDS, family planning advice)
- adequacy of the existing health services to cope with increased population
- projected provision of health service facilities
- need for additional facilities

8.2 Emergency services

- adequacy of existing emergency services (e g fire and ambulance services)
- projected provision of services to meet increased demand
- need for additional emergency services
- adequacy of the emergency and safety services provided by the developer
- ability of the local resources to deal with emergencies

8.3 Recreational facilities

- adequacy of existing facilities
- projected provision of facilities to meet increased demand
- need for additional facilities
- recreational and service facilities in the workplace

9 THE NATURE AND LEVEL OF PRESENT AND FUTURE ENVIRONMENTAL POLLUTION

Could the proposed development have a significant impact on, or be constrained by, any of the following?

9.1 Air pollution

- existing levels of atmospheric pollution
- the nature of air pollution, such as ozone-depleting gases, acidic compounds and toxic substances
- extent of the local build-up of pollutants due to inversions
- compounding of effects with existing pollutants or other chemicals in the atmosphere (e g photochemical smog production)
- smog formation and reduction in visibility
- quantity and type of particulate matter produced with reference to size, composition and chemical stability
- production of offensive odours
- pollution of adjacent sensitive areas
- effects on human health, crops, wildlife, livestock and other potentially affected organisms
- effects on stonework, buildings or works of art

9.2 Water pollution

- level of water pollution
- high localised levels of pollution
- pollution of surface waters from polluted underground waters
- the concentration of pollutants due to variations of water flow
- localised pollution build-up through changes in salinity gradients and/or current movements
- effective dispersal mechanisms
- salinization of fresh waters
- synergistic or compounding effects with existing pollutants
- production of offensive odours
- effect of treated or untreated effluent on the flora and fauna of river, lake, canal, estuary or coastal waters
- effects on dependent natural communities through changes in aquatic fauna and flora
- effect on irrigation schemes
- effect on recreational activities

9.3 Noise, vibration and lighting

- increase in ambient noise, vibration or illumination levels
- length of time that there will be noise, vibration or lighting impacts
- exacerbation of "creeping" ambient noise levels
- peace and quiet of residential areas

either during day- or night-time
- change in the quality of life due to artificial lighting
- functioning of schools, hospitals and old people's homes or informal recreation areas
- the need for individual protection against noise
- levels of annoyance and discomfort due to vibration caused by such activities as blasting and pile-driving
- structural damage caused to buildings by vibration
- effects on wildlife of nature reserves, sites of special scientific interest, or high-quality habitat of local significance
- reduction of wilderness quality in declared wilderness areas

9.4 Visual pollution (see also section 4 on land use and landscape character)

- existing level of visual pollution
- reduction in aesthetic quality of the environment through:
  - — sign-boards and advertising
  - — overhead transmission cables and telephone wires
  - — unsightly or inappropriate walls, buildings, roads or other installations

9.5 Solid or liquid waste and by-product disposal

- existing or proposed water disposal plans
- choice of alternative means of disposal
- alternative treatment technologies
- choice of disposal sites
- biological and chemical characteristics of the leachates generated within the disposal site
- the quantity of leachates produced
- measures to reduce or treat leachates
- potential pollution of nearby surface waters
- potential groundwater pollution
- waste minimisation potential of process
- containment and treatment of wastes at site of generation
- final disposal option
- gas emissions from landfill
- allowance for physical and chemical variation in waste generated
- visual intrusion caused by waste disposal site or disposal plant
- potential health hazard to nearby residents
- suitability of traffic to transport the waste materials
- volume of traffic to transport the waste materials
- proposed after-use of the site and its management

10 RISK AND HAZARD

Could the proposed development have a significant impact on, or be constrained by, the following?

- the level and identity of hazard to the public
- probability of occurrence
- extent of effect — local, regional or panoramic
- standards required for process equipment in chemical and processing industries:
  - — safety and design reviews
  - — safety audits
  - — hazard and operatability reviews
  - — failure mode and effect analysis
- workers' safety/degree of risk
- the level of risk and hazard for other living organisms

11 HEALTH AND SAFETY

Could the proposed development have a significant impact on, or be constrained by, any of the following?

- effects in the workplace through:
  - — dust, fume and particulate matter
  - — noise
  - — odours
  - — gases
  - — vapours
  - — use of dangerous chemicals
  - — lighting

- heat
- cold
- noise
- vibration
- radiation
- protective clothing and equipment
- access to recreational facilities
- risk of workplace accidents
- risk of major disasters involving multiple loss of life or injury
- availability of services such as crèches, factory-based health services, canteens, change-rooms, toilets

- effects in the surrounding areas through:
  - dust
  - fumes
  - particulate matter
  - noise
  - vibration
  - radiation
  - odours
  - gaseous emissions
  - vapours
  - use of dangerous chemicals
  - lighting
  - risk of major disasters involving explosions or major leaks of toxic liquids or gases
  - solid waste disposal techniques
  - liquid waste effluent and disposal

12 CUMULATIVE AND SYNERGISTIC EFFECTS

Could the proposed development have a significant impact on, or be constrained by, any of the following?

- the ability of the natural and social environments to assimilate cumulative stresses placed on them
- the likelihood of negative synergistic effects
- existing or future development rights because of a precedent being set

13 ENHANCEMENT OF POSITIVE CHARACTERISTICS

Could the proposed development be modified to enhance the positive aspects of the following?

- any of the characteristics listed in points 2 to 12 above

PROJECT ENVIRONMENTAL IMPACT CHECKLIST
A REFERENCE GUIDELINE FOR ENVIRONMENTAL ASSESSMENTS

MISSION ENVIRONMENTAL OFFICERS TRAINING
ON REG 16

March 9 to 11, 1992

REDSO/WCA
ABIDJAN

A. COUNTRY AND DATE: _____ : _____

B. PROJECT NAME & NUMBER: _____ : _____

C. POTENTIAL IMPACTS of PROJECT DECISION :

1. Agricultural Lands

a) Are there cultivable lands in the project area?	Yes	No	Unk
b) Will project decision result in more or improved cultivable land?	Yes	No	Unk
c) Will project decision result in less or damaged cultivable land?	Yes	No	Unk

ESTIMATED IMPACT ON AGRICULTURAL LAND:

ND HA MA LA O LB MB HB

2. Soil Erosion

a) Will project decision help to prevent soil loss or erosion?	Yes	No	Unk
b) Will project decision directly cause or worsen soil loss or erosion?	Yes	No	Unk
c) Could project decision indirectly lead to practices that could cause soil loss or erosion?	Yes	No	Unk
d) Is it necessary to consult a soils scientist	Yes	No	Unk

ESTIMATED IMPACT ON SOIL EROSION:

ND HA MA LA O LB MB HB

3. Slope Stability

a) Does project decision involve actual modification of slopes?	Yes	No	Unk
b) Will project decision affect stability of slopes indirectly?	Yes	No	Unk
c) Will project decision result in other conditions that could affect slope stability?	Yes	No	Unk
d) Could project decision cause people livestock or property to be located where existing unstable slopes could be a hazard?	Yes	No	Unk
e) Is it necessary to consult a geotechnical engineer?	Yes	No	Unk

---

ND=not determinable LA=low adverse MB=medium beneficial
HA=high adverse O=none or insignificant
MA=medium adverse LB=low beneficial HB=high beneficial

ESTIMATED IMPACT ON SLOPE STABILITY:

ND HA MA LA O LB MB HB

4. Energy-Mineral Resources

a) Do engery-mineral resources exist in project area?	Yes	No	Unk
b) Will project decision help to develop, now or in the future, important engergy-mineral resources?	Yes	No	Unk
c) Will project decision cause significant consumption of additional energy-mineral resources such as engine fuels?	Yes	No	Unk
d) Could project decision prevent or impede future development of essential energy-mineral resources?	Yes	No	Unk
e) Is it necessary to consult with a minerals agency or mining engineer?	Yes	No	Unk

ESTIMATED IMPACT ON ENERGY/MINERAL RESOURCES:

ND HA MA LA O LB MB HB

5. Surface Water Quantity

a) Do engery-mineral resources exist in project area?	Yes	No	Unk
b) Is information available on present and future demands on water resources as result of the project?	Yes	No	Unk
c) Will project decision help to increase or preserve available surface water supplies by such things as improved drainage/run-off conditions?	Yes	No	Unk
d) Will project decision increase demand or cause loss of available surface water directly or indirectly?	Yes	No	Unk
e) Is it necessary to consult a hydrologist?	Yes	No	Unk

ESTIMATED IMPACT ON SURFACE WATER QUANTITY:

ND HA MA LA O LB MB HB

6. Surface Water Quality

a) Is information available on present water quality?	Yes	No	Unk
b) Will project decision lead to additional natural or man made discharges into surface waters?	Yes	No	Unk
c) Will project decision help to improve or protect surface water quality?	Yes	No	Unk
d) Could project decision cause deterioration of surface water quality either directly or indirectly?	Yes	No	Unk
e) Is it necessary to consult a water quality engineer or agency?	Yes	No	Unk

ESTIMATED IMPACT ON SURFACE WATER QUALITY:

ND HA MA LA O LB MB HB

7. Ground Water Quantity

a) Do ground water resources exist in project area?	Yes	No	Unk
b) Is information available on present and future demands on water resources as result of the project?	Yes	No	Unk
c) Will project decision help to increase or preserve available ground water supplies by such things as improving recharge conditions?	Yes	No	Unk
d) Will project decision increase demand or cause loss of available ground water either directly or indirectly?	Yes	No	Unk
e) Is it necessary to consult a hydrogeologist?	Yes	No	Unk

ESTIMATED IMPACT ON GROUND WATER QUALITY:

ND HA MA LA O LB MB HB

8. Ground Water Quality

a) Is information available on present water quality?	Yes	No	Unk
b) Will project decision cause any natural or man made discharges into ground aquifers?	Yes	No	Unk
c) Will project decision help to improve or protect ground water quality?	Yes	No	Unk
d) Could project decision cause deterioration of ground water quality either directly or indirectly?	Yes	No	Unk
e) Is it necessary to consult a ground water quality specialist?	Yes	No	Unk

ESTIMATED IMPACT ON GROUND WATER QUALITY:

ND HA MA LA O LB MB HB

9. Air Quality

a) Is information available on existing air quality?	Yes	No	Unk
b) Will project decision produce any air emissions directly?	Yes	No	Unk
c) Will project decision help to reduce existing air pollution sources such as open burning operations?	Yes	No	Unk
d) Could project decision lead to practices that worsen air quality such as causing increased road traffic or industrialization?	Yes	No	Unk
e) Could project decision lead to a change in engine use or fuel combination that could cause serious air problems?	Yes	No	Unk

ESTIMATED IMPACT ON AIR QUALITY:

ND HA MA LA O LB MB HB

10. Noise

a) Is noise now a problem in project area?	Yes	No	Unk
b) Will project help in reducing undesirable noise conditions?	Yes	No	Unk
c) Will project cause temporary or sustained increases in noise generating conditions such as heavy machinery or road travel?	Yes	No	Unk
d) Could project cause movements of people to high noise level locations?	Yes	No	Unk
e) Is it necessary to consult a noise specialist?	Yes	No	Unk

ESTIMATED IMPACT ON AIR QUALITY:

ND HA MA LA O LB MB HB

11. <u>Aquatic Ecosystems</u>

a) Are there any aquatic ecosystems of which the types listed below which, by nature of their size, abundance or type, can be considered significant or unique?

river?	Yes	No	Unk
streams?	Yes	No	Unk
lakes?	Yes	No	Unk
ponds?	Yes	No	Unk

b) Are these systems essentially:

pristine?	Yes	No	Unk
moderately degraded?	Yes	No	Unk
severely degraded?	Yes	No	Unk
ponds?	Yes	No	Unk

c) Are these systems used by the local people:

i) Consumptively

For drinking water?	Yes	No	Unk
For irrigation?	Yes	No	Unk
For livestock?	Yes	No	Unk

ii) Non-consumptively

For Washing and Bathing?	Yes	No	Unk
For Waste Disposal?	Yes	No	Unk
For Transportation?	Yes	No	Unk
For Harvest of non-domesticated plants or animals as food, fiber fur or other useful product?	Yes	No	Unk

d) Will the project directly affect consumption use of water? Yes No Unk

e) Will the project directly or indirectly affect either non-consumptive or consumptive uses of these ecosystems by:

Use or production of toxic materials (both during construction and/or operation) which might enter these systems?	Yes	No	Unk
Alteration of drainage patterns?	Yes	No	Unk
Increasing erosion?	Yes	No	Unk
Causing increase in populations so as to place added stress on their systems?	Yes	No	Unk

ESTIMATED IMPACT ON AQUATIC ECOSYSTEMS:

ND HA MA LA O LB MB HB

12. Wetland Ecosystems

a) Are there any aquatic ecosystems of the types listed below which, by nature of their size, abundance or type, can be considered significant or unique?

Marsh?	Yes	No	Unk
Swamp?	Yes	No	Unk
Bog?	Yes	No	Unk
Flood Plain?	Yes	No	Unk
Estuary	Yes	No	Unk

b) Are these systems:

Pristine?	Yes	No	Unk
Moderately degraded?	Yes	No	Unk
Severely degraded?	Yes	No	Unk

c) Are these systems used by the local people for:

Drinking water?	Yes	No	Unk
Livestock Water?	Yes	No	Unk
Washing and Bathing?	Yes	No	Unk
Waste Disposal?	Yes	No	Unk
Agriculture?	Yes	No	Unk
Harvest of non-domesticated plants or animals as food, fur, or fiber.	Yes	No	Unk

d) Is there currently a trend towards draining wetlands in the project area for conversion to some other use? Yes No Unk

e) Will the project either directly or indirectly affect wetlands by:

Changing population or land use practices so as to increase drainage of wetlands for use as agricultural, industrial or urban land?	Yes	No	Unk
Use or production (either during construction and/or operation) of toxic materials which might enter wetlands?	Yes	No	Unk
Use the water directly?	Yes	No	Unk
Alter drainage patterns so as to affect wetlands?	Yes	No	Unk
Increase erosion so as to affect wetlands?	Yes	No	Unk

ESTIMATED IMPACT ON WETLAND ECOSYSTEMS:

ND HA MA LA O LB MB HB

13. Terrestrial Ecosystems

a) Are there any aquatic ecosystems of which the types listed below which, by nature of their size, abundance or type, can be considered significant or unique?

Forest?	Yes	No	Unk
Savanna?	Yes	No	Unk
Grassland?	Yes	No	Unk
Desert?	Yes	No	Unk

b) Are these ecosystems:

Pristine?	Yes	No	Unk
Moderately degraded?	Yes	No	Unk
Severely degraded?	Yes	No	Unk

c) Are these present trends towards alteration of these ecosystems through cutting, burning, etc. to produce agricultural, industrial, or urban land? Yes No Unk

d) Does the local population use these ecosystems to obtain non-domesticated:

Food plants?	Yes	No	Unk
Medicinal plants?	Yes	No	Unk
Wood products?	Yes	No	Unk
Fiber?	Yes	No	Unk
Fur?	Yes	No	Unk
Food Animals?	Yes	No	Unk

e) Will the project require clearing or alteration of:

Small areas of land in these ecosystems?	Yes	No	Unk
Moderate areas of land in these ecosystems?	Yes	No	Unk
Large areas of land in these ecosystems?	Yes	No	Unk

f) Does the project rely on any raw materials (wood, fiber) from these ecosystems? Yes No Unk

g) Will the project decrease use of products from these ecosystems by producing or providing substitute materials? Yes No Unk

h) Will the project cause increased population growth in the area, bringing about increased stress on these ecosystems? Yes No Unk

ESTIMATED IMPACT ON TERRESTRIAL ECOSYSTEMS:

ND HA MA LA O LB MB HB

14. Endangered Species

a) Is the existence of endangered species in the project area:			
Very unlikely	Yes	No	Unk
Probable	Yes	No	Unk
Highly probable	Yes	No	Unk
Documented fact	Yes	No	Unk
b) Are these species:			
Of scientific interest only?	Yes	No	Unk
Of scientific interest and highly sought after by local people for food, hides, sale to animal dealers.	Yes	No	Unk
c) Will the project affect the habitat of these animals:			
Directly by destruction of habitat?	Yes	No	Unk
Indirectly by altering habitat through changing drainage, land use.	Yes	No	Unk
d) Will the project increase ease of access to these habitats?	Yes	No	Unk
e) Will the project increase population in the project area, thus placing increased pressure on these species and/or on their habitat?	Yes	No	Unk

ESTIMATED IMPACT ON ENDANGERED SPECIES:

ND HA MA LA O LB MB HB

15. Migratory Species

a) In the project area are there any:			
Migratory fish	Yes	No	Unk
Migratory birds	Yes	No	Unk
Migratory animals	Yes	No	Unk
b) Are these species used by local people for food, fur, or other products?	Yes	No	Unk
c) Will the project require any dams, roads, pipelines or other alignments which could interfere with these migratory animals?	Yes	No	Unk
d) Will the project destroy any habitat (resting, feeding reproductive) which are critical to these species?	Yes	No	Unk
e) Will increased population place additional stress on these species?	Yes	No	Unk

ESTIMATED IMPACT ON MIGRATORY SPECIES:

ND HA MA LA O LB MB HB

16. Beneficial Plants

a) Do non domesticated plants occur in the project area which are used or sold by local people as:

Food?	Yes	No	Unk
Fiber?	Yes	No	Unk
Ornament?	Yes	No	Unk
Medicine?	Yes	No	Unk
Forage?	Yes	No	Unk
Building Material?	Yes	No	Unk

b) Do these plants occur in:

Undisturbed habitats?	Yes	No	Unk
Moderately disturbed habitat?	Yes	No	Unk
Severely disturbed habitat?	Yes	No	Unk

c) Are these plants:

Utilized heavily?	Yes	No	Unk
Utilized moderately?	Yes	No	Unk
Utilized only occasionally?	Yes	No	Unk

d) Is this use:

Peculiar to the local population?	Yes	No	Unk
Universal in the region/country?	Yes	No	Unk

e) Will the project:

Decrease habitat for these plants?	Yes	No	Unk
Increase habitat for these plants?	Yes	No	Unk
Increase access to these plants?	Yes	No	Unk
Provide substitute products or the necessary money to replace the use of these plants?	Yes	No	Unk
Increase use of these plants through increased population?	Yes	No	Unk

ESTIMATED IMPACT ON BENEFICIAL PLANTS:

ND HA MA LA O LB MB HB

17. Beneficial Animals

a) Do non domesticated animals occur in the project area which are used or sold by local people as:

Souvenir products?	Yes	No	Unk
Food?	Yes	No	Unk
Fur?	Yes	No	Unk
Pets?	Yes	No	Unk

b) Do these animals occur in:

Undisturbed habitats?	Yes	No	Unk
Moderately disturbed habitat?	Yes	No	Unk
Severely disturbed habitat?	Yes	No	Unk

c) Are these animals:

Utilized heavily?	Yes	No	Unk
Utilized moderately?	Yes	No	Unk
Utilized only occasionally?	Yes	No	Unk

d) Is this use:

Peculiar to the local population?	Yes	No	Unk
Universal in the region/country?	Yes	No	Unk

e) Will the project:

Decrease habitat for these animals?	Yes	No	Unk
Increase habitat for these animals?	Yes	No	Unk
Increase access to these animals?	Yes	No	Unk
Provide substitute products or the necessary money to replace the use of these animals?	Yes	No	Unk
Increase use of these animals through increased population?	Yes	No	Unk

ESTIMATED IMPACT ON BENEFICIAL ANIMALS:

ND HA MA LA O LB MB HB

18. <u>Pest Plants</u>

a) Are there currently any pest plant problems in the project area?	Yes	No	Unk
b) Are there any potential pest plant species known to exist in the project area?	Yes	No	Unk
c) Are these pest plants associated with:			
Severely disturbed land?	Yes	No	Unk
Agricultural land?	Yes	No	Unk
Stagnant or polluted water?	Yes	No	Unk
d) Will the project?	Yes	No	Unk
Increased habitat for pest plants?	Yes	No	Unk
Decreased habitat for pest plants?	Yes	No	Unk
Provide opportunity for control of pest plants?	Yes	No	Unk
Increase the possibility of introduction of pest plants through increased commerce?	Yes	No	Unk

ESTIMATED IMPACT ON PEST PLANTS:

ND HA MA LA O LB MB HB

19. <u>Pest Animals</u>

a) Are there currently any problems with pest animals in the project area?	Yes	No	Unk
b) Are there any animals in the project area which, under altered ecological conditions, have the potential for becoming pest species?	Yes	No	Unk

c) Are these species associated with:

Severely disturbed land?	Yes	No	Unk
Agricultural land?	Yes	No	Unk
Aquatic Habitats?	Yes	No	Unk

d) Will the project?

	Yes	No	Unk
Increased habitat for pest animals?	Yes	No	Unk
Decreased habitat for pest animals?	Yes	No	Unk
Provide opportunity for control of pest animals?	Yes	No	Unk
Increase the possibility of introduction of pest animals through increased commerce?	Yes	No	Unk
Provide the opportunity for control of pest animals?	Yes	No	Unk

ESTIMATED IMPACT ON PEST ANIMALS:

ND HA MA LA O LB MB HB

20. <u>Disease Vectors</u>

a) Are the known disease problems in the project area transmitted through vector species such as mosquitoes, flies, snails, etc.?	Yes	No	Unk
b) Are these vector species associated with:			
Aquatic habitats?	Yes	No	Unk
Forest habitats?	Yes	No	Unk
Agricultural habitats?	Yes	No	Unk
Degraded habitats?	Yes	No	Unk
Human settlements?	Yes	No	Unk
c) Will the project:			
Increase vector habitat?	Yes	No	Unk
Decrease vector habitat?	Yes	No	Unk
Provide opportunity for vector control?	Yes	No	Unk
d) Will the project work force be a possible source of introduction of disease vectors not currently found in the project area?	Yes	No	Unk
e) Will increased access to an commerce with the project area be a possible source of disease vectors not presently occurring in the project area?	Yes	No	Unk
f) Will the project provide opportunities for vector control through improved standards of living?	Yes	No	Unk

ESTIMATED IMPACT ON DISEASE VECTORS:

ND HA MA LA O LB MB HB

21. Disease Vectors

a) Are vector-borne diseases an important part of the local public health situation? Yes No Unk
b) Are these clinics or other disease control programs in operation or planned for the area? Yes No Unk
c) Will the project decision result in an increase in disease vector density or distribution? Yes No Unk
d) Will the project decision result in workers or other persons entering the area with contagious or vector borne diseases? Yes No Unk
e) Will the project decision result in clearing operations that could expose workers to disease vectors? Yes No Unk
f) Will the project decision increase the hazard of accident to the local population? Yes No Unk
g) Will the project decision improve opportunities for the local population to receive health care? Yes No Unk
h) Is it necessary to consult with a public health specialist? Yes No Unk

ESTIMATED IMPACT ON PUBLIC HEALTH:

ND HA MA LA O LB MB HB

22. Resource/Land Use

a) Are the natural resources of the area under intensive use pressure? Yes No Unk
b) Are lands in the project area intensively developed? Yes No Unk
c) Will the project decision increase pressure on land resources? Yes No Unk
d) Will the project decision result in decreased holdings by small land holders? Yes No Unk
e) Will the project decision increase depletion rates of natural resources? Yes No Unk
f) Should a land use planner be consulted? Yes No Unk

ESTIMATED IMPACT ON RESOURCES AND LAND USE:

ND HA MA LA O LB MB HB

23. Conventional/Nonconventional Energy Sources

a) Will the project increase the demand for conventional energy sources (petroleum, hydropower)?	Yes	No	Unk
b) Will the project increase the demand for nonconventional energy sources (fuelwood, dung, agricultural wastes)?	Yes	No	Unk
c) Should an energy planner be consulted?	Yes	No	Unk

ESTIMATED IMPACT ON ENERGY SOURCES:

ND HA MA LA O LB MB HB

24. Distribution Systems

a) Are the production/distribution networks for agricultural and manufactured commodities fully understood?	Yes	No	Unk
b) Will the project decision enhance the equitable distribution of these products?	Yes	No	Unk
c) Will the project decision increase the demand for certain commodities within or outside the area?	Yes	No	Unk
d) Will the project decision decrease the demand for certain locally produced goods?	Yes	No	Unk
e) Will the project decision improve the ease with which consumers in the area obtain commodities?	Yes	No	Unk
f) Will the project decision decrease the production of certain vital commodities?	Yes	No	Unk
g) Is it necessary to consult a social anthropologist?	Yes	No	Unk

ESTIMATED IMPACT ON DISTRIBUTION SYSTEMS:

ND HA MA LA O LB MB HB

25. Employment

a) Is the potential work force in the area fully employed?	Yes	No	Unk
b) Will the project decision substantially increase the rate of employment?	Yes	No	Unk
c) Will the project decision remove job opportunities in the area?	Yes	No	Unk
d) Will the project decision result in drawing workers from other local employers?	Yes	No	Unk
e) Is it necessary to consult with a socioeconomist?	Yes	No	Unk

ESTIMATED IMPACT ON EMPLOYMENT:

ND HA MA LA O LB MB HB

26. At-Risk Population

a) Are the adverse impacts of the project unequally distributed in the target population?	Yes	No	Unk
b) Have the at-risk groups been identified?	Yes	No	Unk
c) Have all possible actions been identified that would lessen the impact on at-risk groups?	Yes	No	Unk
d) Is the assistance of a social anthropologist required to adequately answer these questions?	Yes	No	Unk

ESTIMATED IMPACT ON AT-RISK POPULATION:

ND HA MA LA O LB MB HB

27. Migrant Population

a) Are there presently certain mobile groups in the target population?	Yes	No	Unk
b) Will the project decision result in immigration of people to the area?	Yes	No	Unk
c) Are local institutions and agencies adequately geared to handle this influx?	Yes	No	Unk
d) Will the project decision result in the movement of people out of the area?	Yes	No	Unk
e) Can their probable destinations be predicted?	Yes	No	Unk
f) Are local institutions and agencies or receiving agencies able to handle these migrant groups?	Yes	No	Unk
g) Is it necessary to consult a social anthropologist?	Yes	No	Unk

ESTIMATED IMPACT ON MIGRANT POPULATION:

ND HA MA LA O LB MB HB

28. Community Stability

a) Are the interrelationships of various social groups in the project area understood? Yes No Unk
b) Will the project decision establish institutions that will improve these interrelationships? Yes No Unk
c) Will the project decision create competition among social groups that would reduce community cohesion? Yes No Unk
d) Is it necessary to consult a social anthropologist? Yes No Unk

ESTIMATED IMPACT ON COMMUNITY STABILITY:

ND HA MA LA O LB MB HB

29. Cultural and Religious Values

a) Have studies been conducted of the cultural values of the project area? Yes No Unk
b) Are the cultural characteristics unique to the project area adequately known? Yes No Unk
c) Will the project decision adversely affect the religious attitudes of area residents? Yes No Unk
d) Are there special superstitions or religious taboos that will affect the acceptance of the project by the target population? Yes No Unk
e) Is it necessary to consult a social anthropologist? Yes No Unk

ESTIMATED IMPACT ON CULTURAL AND RELIGIOUS VALUES:

ND HA MA LA O LB MB HB

30. Tourism and Recreation

a) Is there at present a significant degrees of tourism in the area? Yes No Unk
b) Is there unexploited tourism or recreation potential in the area? Yes No Unk
c) Will the project decision result in more effective utilization of present or future tourism opportunities? Yes No Unk
d) If so, will this adversely affect an existing or potential tourist or recreation attraction? Yes No Unk
e) Will the project decision adversely affect an existing or potential tourist or recreation attraction? Yes No Unk

ESTIMATED IMPACT ON TOURISM AND RECREATION:

ND HA MA LA O LB MB HB

31. <u>Nutrition</u>

a) Have adequate data been gathered on the nutritional levels in the project area?	Yes	No	Unk
b) Do these data differentiate among various population subgroups, by age, sex or social level?	Yes	No	Unk
c) Will the project decision result in changed food habits in the target population?	Yes	No	Unk
d) Will these changes result in higher caloric levels and improved nutritional characteristics?	Yes	No	Unk
e) Are the services of a nutrition specialist required?	Yes	No	Unk

ESTIMATED IMPACT ON NUTRITION:

ND HA MA LA O LB MB HB

11. What is an Initial Environmental Examination (IEE) or Environmental Review?

Description/Objectives

This session provides you with the opportunity to hear directly from a practitioner how that individual has dealt with the Environmental Review or IEE process, and to receive some initial exposure to the methods and realities of IEE preparation and the use of the environmental screening form for preparation of PVO/NGO sub-grant environmental reviews. You will gain familiarity with describing activity, project or program purpose/outputs and potential environmental impacts including: (i) determining the type of grant; (ii) identifying the environmental category the grant falls under [categorical exclusion, negative determination, or positive determination], and (iii) the content and appropriate use of environmental review reports.

Attachments

Example IEE or Environmental Review and Environmental Screening Form

DRAFT (Instructional Purposes Only) **INITIAL ENVIRONMENTAL EXAMINATION**
OR
CATEGORICAL EXCLUSION

PROGRAM/ACTIVITY DATA:

Program/Activity Number: 663-0020-G-00-5501-00

Country/Region: Ethiopia

Program/Activity Title:The Ethiopian NGO Sector Enhancement Initiative

Funding Begin: FY 95 **Funding End:** FY 99 **LOP Amount:** $5 million in planned LOP authorization ($3.7 million in planned obligation for Cooperative Agreement) **Sub-Activity Amount:** $_____

IEE Prepared By: Carla Barbiero/Ashton Douglass, PRM **Current Date:** February 14, 1997
Amended by Charlotte Bingham
IEE Amendment (Y/N): X If "yes", Number & date of original IEE _____ ; 5/ /95

ENVIRONMENTAL ACTION RECOMMENDED: (Place X where applicable)
Categorical Exclusion: X Negative Determination: X
Positive Determination: _____ Deferral: _____

ADDITIONAL ELEMENTS: (Place X where applicable)
EMEMP: _____ CONDITIONS: X PVO: X

SUMMARY OF FINDINGS: This amended Initial Environmental Examination (IEE) brings the **Ethiopian NGO Sector Enhancement Initiative** IEE of May 1995 into conformity with the Africa Bureau environmental procedures for umbrella activities. It also reflects new conditions regarding delegation of environmental review responsibility to Missions for PVO/NGO umbrella type projects (Cable STATE 257896). Based on the use of a pro-active approach, incorporation of environmental review procedures, promotion of environmental review, capacity building, and monitoring, evaluation and mitigation procedures specified in this IEE, to which the Mission commits itself, the following environmental determinations are recommended:

1. A **Categorical Exclusion** is recommended for project-financed technical assistance, training and education, institutional strengthening, regional communications and information exchange activities that have no physical interventions and no direct effects on the environment pursuant to 22 CFR 216.2(c)(1)(i) and 216.2(c)(2)(i), (iii) and (v). **The screening form will be used to confirm this determination for each activity.** This categorical exclusion does **not** apply to education, technical assistance or training if such include activities directly affecting the environment, such as construction of facilities, per 216.2(c)(2)(i), **nor** to studies, projects or programs intended to develop the capability of recipient countries to engage in development planning when designed to result in activities directly affecting the environment, per 216.2(c)(2)(xiv).

2. A **Negative Determination with Conditions** is recommended for all other activities entailing community development. This IEE specifies a set of steps, in accordance with the Africa Bureau's *Environmental Guidelines for Small-Scale Activities in Africa*, to ensure adequate environmental review of USAID-supported activities, including capacity-building elements. This negative determination is also conditioned on the provision of supplemental project technical assistance and training support to augment existing efforts. These capacities will be developed and implemented in close collaboration with USAID/Ethiopia and the Initiative's partners.

DRAFT -- For Instruction Purposes Only

APPROVAL OF ENVIRONMENTAL ACTION RECOMMENDED:

CLEARANCE:
Mission Director: _____ Date: _____
Margaret P. Bonner

CONCURRENCE:
Bureau Environmental
Officer: _____ Date: _____
Carl Gallegos Approved:_____
Disapproved: _____

CLEARANCE:
General Counsel
(Africa Bureau) _____ Date: _____

ADDITIONAL CLEARANCES:

Project Manager: _____ Date: _____
Ron Bonner, HID

Regional Environmental
Officer: _____ Date: _____
Charlotte Bingham, REDSO/ESA

INITIAL ENVIRONMENTAL EXAMINATION

PROGRAM/PROJECT DATA:
Program Number:
Project Number: 663-0020-G-00-5501-00
Country/Region: Ethiopia
Program/Project Title: The Ethiopian NGO Sector Enhancement Initiative

1.0 BACKGROUND AND PROJECT DESCRIPTION

1.1 Background

In November 1994, the Mission received an unsolicited concept paper from the U.S. registered PVO, PACT. The concept paper was reviewed by the Mission Project Review Committee (PRC) using criteria and adapting procedures presented in the AFR/ONI Guidance dated 10/8/92 on unsolicited proposals. The PRC determined that the concept paper was acceptable and PACT was asked to develop a full proposal. The overall goal of PACT's Ethiopian NGO Sector Enhancement Initiative, as stated as that time, was to strengthen the capacity of Ethiopian NGOs by providing or upgrading their skills in order for them to play an effective role in the economic development and democratic evolution of the country.

1.2 Current Activity Description

The goal for the Initiative is to strengthen the capacity of Ethiopian NGOs, as noted above. PACT will do this through a program of training and technical assistance in organizational development, targeted training and technical assistance, mentoring and tutorial guidance for individual NGOs, and possibly the establishment of an NGO training and resource center. PACT will also assist and encourage a positive environment for local organizations to work together with public sector institutions.

PACT's program focuses on four major sectors: rural development/food security; education; democracy and governance/human rights; and orphans and street children. Under this activity, USAID grant financing to PACT supports training and technical assistance activities, financing for Strategic Action Grants, conduct of organizational needs assessments and mentoring and tutorial guidance of Ethiopian NGOs.

The Initiative will be financed under a cooperative agreement awarded to the U.S. registered PVO, PACT Inc. The bulk of the funding will be used to finance technical assistance, staff support and training to strengthen PVO/NGO capacities to execute development programs in Ethiopia. International Institute of Rural Reconstruction (IIRR), a US-based PVO, implements the food security/rural development component of the Ethiopian NGO Sector Enhancement Initiative. The project will also include a Strategic Action Grants (SAG) component with an LOP amount of $800,000 out of a total cooperative agreement cost of approximately $3.7 million. (Note: Total authorized LOP funding will be set at $5 million.) The purpose of the SAG component is to strengthen an organization's ability to develop and deliver an effective program that responds directly to local needs. The SAG aims to strengthen an NGO's capacity (organizational, technical, decision making, administration, etc.) and provides the NGO an opportunity to gain experience in both project and grant management. An indirect purpose of the SAG will be to stimulate or expand critical, innovative, field activities relevant to the Initiative's areas of emphasis.

PACT has identified three categories of the SAG component under which grants will be awarded:

- Personnel Grants to assist qualifying NGOs to employ needed personnel. A Personnel Grant could for example, contribute to the cost of an Accountant to work with an NGO for a fixed period of time.

- Commodity Grants to enable NGOs to acquire needed office facilities and equipment. For example, such a Grant could be used to purchase a computer and train NGO staff in its use.

- Activity Grants to provide funding to NGO projects and activities. Illustrative uses of the Activity Grant mechanism are: external evaluation of NGO development programs; an NGO resource and/or learning centers; NGO networking; planning and design of a field project; workshops, training, seminars, etc. on relevant development issues; project implementation costs, for example, a literacy program for rural women or non-formal education for out of school girls; model and innovative micro-credit program for poor women, youth, etc.; and model agroforestry and soil and water conservation projects.

By and large, the SAG program will finance personnel, equipment, documentation preparation/purchase, training and workshops. Grants classified as "Activity Grants" (probably less than $15,000 each) can be used to fund a range of activities, including the implementation of community development activities in the Initiative's focus areas.

1.3 Purpose and Scope of Amended IEE

The purpose of this amended IEE is to revise the 1995 IEE, which provided a process for grant and subgrant review according to practices in effect at that time, to comply with the processes and procedures set out in *Environmental Guidelines for Small-Scale Activities in Africa* (Section 5.3, June 1996) and State 257896 Cable. USAID/Africa Bureau has developed these procedures specifically for undertakings like the Ethiopian NGO Sector Enhancement Initiative that encompass a variety of activities that can be undertaken by several implementing agents, such as various NGOs. These procedures are consistent with USAID's environmental regulations (22 CFR Part 216) and enable broader delegation of responsibility for approval of environmental documentation to USAID/Ethiopia.

This amended IEE applies to any **new** activities and those for which environmental documentation has not been prepared or any activities for which a **deferral** (under the original IEE) is still outstanding.

2.0 COUNTRY AND ENVIRONMENTAL INFORMATION (BASELINE INFORMATION)

Because not all locations for future interventions covered under this IEE are known and because of the variety of environmental situations encompassed by potential activities, this IEE provides neither comprehensive nor detailed baseline environmental information. The information in this section is derived from *The National Conservation Strategy* (Ministry of Natural Resources Development and Environmental Protection, December 1994) and the Ethiopian Forestry Action Program (EFAP, December 1994). Any statistics or percentages cited below should be taken as approximate, as some of the data upon which these and other sources rely may date from a period when Eritrea was included in the statistics. More detailed information can be found in the Ethiopia National Conservation Strategy (National Environment Action Plan).

Widespread poverty (estimated GNP per capita of $120 per year) is made worse by periods of serious drought. In past years, there has been negative economic growth. Recovery is slow as a consequence of economic policies, destruction of infrastructure and loss of natural assets due to environmental damage. The annual population growth rate has been estimated at 3.3%.

Ethiopia is a country of high altitude with both mountainous and lowland areas supporting both agricultural and pastoral populations. Ethiopia's land surface approaches 110 million hectares. Highlands above 1500 meters (m) constitute about 45%, which are inhabited by four-fifths of the population. Here volcanic soils, relatively fertile and deep, and a growing period which exceeds 180 days over 75% of the area permit a wide range of farming and land use systems. Below 1500 m are the lowlands of the northwest, east and south, more or less free of tsetse fly; these

semi-arid and arid areas support nomadic pastoralists, who also cultivate maize and sorghum on plains watered by flash floods. In the southwest and west, the tsetse-infested humid and sub-humid lowlands are sparsely populated by shifting cultivators, although there are some large irrigated farms as well. Approximately 50% of Ethiopia's land is estimated to be non-arable with limited growing periods and shallow and/or stony soils. Another 18% is either steep or considered marginal.

Historical research has indicated that, from 1500 to the present, Ethiopia's forests were most extensive during the 19th century. Deforestation accelerated towards the beginning of this century; in 1960 closed natural forest was estimated to cover about 3.4% of the country. More recently, high forest was estimated to cover about 4.4%, an indication of the lack of accurate statistical data. Plantation forestry, based on estimates of the Forestry Action Programme, accounts for 95,000ha in industrial plantations and 35,000 ha in peri-urban plantations. Rapid deforestation is caused by an escalating demand for fuelwood and land for cropping and grazing.

The groundwater potential of the country is not known with great certainty. While estimates indicate approximately 2.9 billion cubic meters, only a fraction of this resource is in use, typically for local water supplies. The annual runoff from the major drainage basins is estimated at about 111 billion cubic meters of which nearly three-quarters goes into rivers flowing into Sudan, Egypt, Kenya and Somalia. The irrigation potential of 3.5 million ha has less than a 5% utilization. The hydroelectric generation potential is less than 2% utilized.

Soils in the Ethiopian highlands have an inherently high fertility; nevertheless, there is a very low level of fertilizer use to replace nutrients. The steep and dissected terrain, coupled with a high intensity rainfall, have led to accelerated soil erosion. Reduction in soil depth and in moisture-holding capacity compounds the problems of drought in those areas of the country where rainfall is low and variable.

The livestock population of Ethiopia is considered the largest in Africa. Livestock are an integral part of most farming systems and the mainstay of pastoralists. Those regions where the greatest number of livestock live are heavily cultivated for crop production and as a result are largely deficient in livestock feed resources other than agricultural residues. In general, the country is overgrazed and stocked beyond its carrying capacity. The burning of crop residues and dung for fuel is placing further pressure on grazing areas.

Because of diverse ecological conditions, Ethiopia supports a wide variety of flora and fauna. About 12% of the plants are considered endemic, particularly in the high mountains and in the Ogaden. In addition to its natural fora, Ethiopia has historically been an important center of crop genetic diversity. The Plant Genetic Resources Center of Ethiopia has over 53,000 accessions of 100 crop types; it is working with farming communities to maintain *in situ* traditional genetic-pool holdings that can be propagated free from the genetic alteration imposed by modernization of agricultural practices. Ethiopia also has high faunistic diversity, particularly with regard to endemic birds, mammals and amphibians. Ethiopia is considered the richest in avifauna of all mainland Africa. Although many areas have been designated as national parks, wildlife sanctuaries and reserves or controlled hunting areas, only two areas (national parks) have been gazetted. Designated areas, however, are completely absent from the most productive, thus the most threatened, habitat, i.e., moist evergreen forest and dry evergreen forest.

Ethiopia has a rich cultural heritage, including some of the most important historic and pre-historic archaeological sites in the world; along with its historic structures, these resources are attracting increasing numbers of tourists.

In general, land, water and forests have deteriorated to a low level of productivity. The human and livestock populations are growing with a consequent depletion of the natural resource base. This pressure is most intense in the more productive highlands. Both the National Conservation Strategy and the Forestry Action Program conclude that current levels of exploitation are not sustainable.

3.0 EVALUATION OF PROJECT/PROGRAM ISSUES WITH RESPECT TO ENVIRONMENTAL IMPACT POTENTIAL

PACT's USAID-supported activities could entail support for a variety of interventions, such as: 1) modest infrastructure; 2) small or micro agricultural-related projects, such as improving agricultural production through improved techniques irrigation or drainage of fields, diversification of crops, seed banks, grain storage, promotion of improved plant varieties or credit schemes; 3) agro-processing, such as animal feed or oil pressing; 4) animal husbandry, such as better pasture management or support to improve animal health; 5) aquaculture; 6) agroforestry; 7) watershed or forest management and reforestation, 8) other small or micro-development activities to enhance community development in other sectors; and 9) training, capacity development or other organizational development and educational or training activities, including personnel and commodities.

The physical and topographic conditions, climate, soils, and ecosystems as well as social and economic characteristics that could be encountered are quite variable. Because the specific characteristics and locations of these activities are not definitive, the potential for adverse environmental impacts cannot be excluded, until additional information about project design and location becomes available. Each, therefore, requires environmentally sound-design and review to determine the specific nature and magnitude of potential impacts.Activities do share the common characteristic of being small in scale. Because they could be located in any geographic area, in both rural and urban areas, cumulative, adverse environmental effects of Initiative-assisted activities would be insignificant, although cumulative impacts within the context of other development in a particular setting could not be excluded.

While it is expected that the potential for environmental impacts would occur as a result of the SAG component, in particular the Activity Grants category, provisions of 22 CFR 216.2(c)(2)(i) and (xiv) may apply to education, technical assistance, or training, if these include activities directly affecting the environment or to studies, projects or programs intended to develop capability to engage in development planning, if they could result in activities directly affecting the environment.

4.0 RECOMMENDED MITIGATION ACTIONS (INCLUDING MONITORING AND EVALUATION)

4.1 Recommended Planning Approach

Often, the development activities proposed for support are typically presented and considered as discrete interventions, in isolation from other planned community developments. This linkage argues strongly for the adoption of an integrated approach towards activity planning and implementation. Although an integrated approach towards program planning and management is more complex and time-consuming "up-front," it will reap significant dividends over the longer term in the form of more cost-effective, sound and sustainable community investments and improved natural resources management. For maximum efficiency and effectiveness, these review procedures are intended to be applied within the context of development plans, natural resource management plans or land use plans developed for the areas in which the activities will take place.

4.2 Environmental Screening and Review

These environmental screening and review procedures specify how activities, including grants and subgrants under the Ethiopian NGO Sector Enhancement Initiative, will be examined on an individual basis in order to comply with the determinations (see Section 5) of this IEE in accordance with Reg 16, Section 216.3(a)(2). These procedures are intended to result in environmental accountability and soundness, by requiring that USAID/Ethiopia put in place specific mechanisms to promote environmental review capacity and other environmental capacity for the implementing partners. To ensure that interventions are designed in a sound and sustainable manner (see Section

4.1), the Mission Environmental Officer (MEO) and/or USAID Project Manager will work with the appropriate implementing partners to achieve compliance with these procedures.

PACT is the primary implementing partner of the Initiative. For the SAG component, there is an Advisory Committee, composed of PACT staff and representatives of a variety of Ethiopian NGO implementing partners. IIRR, as noted in Section 1.2, implements the food security/rural development component of the Initiative.

These procedures are based upon utilization of a Screening Form, presented in Attachment 1. This form is consistent with the "Environmental Screening Form for NGO/PVO Activities and Grant Proposals" contained in the Africa Bureau *Environmental Guidelines for Small-Scale Activities in Africa*. USAID/Ethiopia will facilitate the refinement of this form with PACT and the REDSO REO/REA to meet project needs and to incorporate, where appropriate, information that will serve to identify any need for environmental assessment in accordance with Ethiopia's environmental assessment policy and future legislation.

Adherence to the procedures in this IEE, it must be emphasized, cannot be considered in lieu of Ethiopian requirements or vice versa. Efforts will be made, however, in the refinement of the Screening Form to dovetail respective assessment information requirements to the maximum extent allowable.

This IEE does not cover pesticides or other activities involving procurement, use, transport, storage or disposal of toxic materials, and any situation dealing with such will require an amended IEE, except to the extent covered in Category 2 of the Screening Form attached.

Activities, including grants and subgrants, will be individually screened using the Screening Form, which utilizes a four-tier categorization process consistent with Africa Bureau 's *Environmental Guidelines*, as defined below:

Category 1: Activities that would normally qualify for a categorical exclusion under Reg 16 (e.g., community awareness initiatives, training at any level, provision of technical assistance, controlled experimentation exclusively for the purpose of research and field evaluation which is confined to small areas and carefully monitored, etc.). Certain, specifically defined, small-scale activities entailing rehabilitation of water points and construction or rehabilitation of facilities have also been placed in this category.

Category 2: Activities that would normally qualify for a negative determination under Reg. 16, based on an environmentally-sound approach to the activity design and incorporation of appropriate mitigation and monitoring procedures. For example, the design followed, and the manager has access to and will follow, a series of guidelines for the design of small-scale environmentally-sound activities in forestry, natural resource management, infrastructure, etc.

Category 3: Activities that have a clear potential for undesirable environmental impacts and typically under Reg 16 require an Environmental Assessment, such as those involving land development, planned resettlement, penetration road building, substantial piped water supply and sewage construction, large-scale irrigation projects, and projects involving the procurement and/or use of pesticides, or of large-scale or area-wide application of pesticides. All activities listed in Reg. 16 (Sect. 216.2(d)(1)) are automatically included, unless they are small-scale and qualify for a negative determination in accordance with the criteria listed under Category 2.

Category 4: This category groups activities that either USAID cannot fund or for which specific findings must be made in an Environmental Assessment prior to funding. Interventions that are likely to jeopardize a critical habitat for threatened or endangered species or degrade a protected area must be placed in this category. Category 4 lists activities that trigger provisions of Sections 118 or 119 of the Foreign Assistance

Act, which generally relate to degradation of national parks or protected areas, introduction of exotic species, or effects on tropical or undegraded forest lands.

PACT will employ the Screening Form [Attachment 1, to be refined as needed in consultation with the REDSO/REO or REA] and the Environmental Review Reports prepared as a result of the categorization process to evaluate activities and/or proposals. Preferably, the direct or actual implementor of an activity will prepare the forms and the environmental reviews, which will be reviewed by PACT prior to submittal to USAID/Ethiopia. Proposals seeking support from the Initiative must also comply with any Advisory Committee approval criteria and review procedures, which will also include this requirement for environmental screening and review, as well as any other PACT or USAID/Ethiopia requirements designed to ensure developmentally sound and sustainable activities for the Initiative.

An Environmental Review Report shall be prepared for all Category 2 activities. The MEO or Mission Director, or Acting Director, on behalf of USAID/Ethiopia, shall be responsible for clearances on the category determination and Environmental Review Reports. It is assumed that the majority of activities will fall within Categories 1 and 2, and will, therefore, be approvable locally by USAID/Ethiopia without further external review. This delegation of responsibility, without regard to dollar amount of activities, is predicated on the assumption that appropriate and environmentally sound implementation and environmental monitoring and mitigation procedures will be in place. The MEO, should he/she have questions, will pass Category 2 activities and their reviews to the REO and Bureau Environmental Officer (BEO) for consultation. An Environmental Review Report shall also be prepared as the first step for all Category 3 activities to help the REO and BEO determine if an Environmental Assessment is required. While an Environmental Review Report may be prepared for Category 4 activities, it is recommended that developers of activities and proposals consult, through PACT, with the USAID MEO and Project Manager before preparing elaborate documentation. All Category 3 and 4 activities (if there are any) shall be subject to additional environmental evaluation, as deemed appropriate, in consultation with the BEO and REO, and shall be passed on to the Regional and Bureau Environmental and Legal Officers for further review and clearance.

Prior to the approval of an activity, results of the environmental categorization must be available and considered. For Category 2 projects, Environmental Review Reports, including MEO review and, if needed, REO or BEO review, must be performed prior to funding. For any Category 3 or 4 activities, approval cannot be made until the Environmental Review and any additional environmental documentation as determined by the BEO have been prepared and cleared. PACT may, if it desires, categorize or review categorization of activities, based on use of the screening form, prior to approval to a proposer to proceed with final design. This procedure would allow activities that are in Category 1 (no environmental review required) to be carried out and for the proposer to undertake appropriate environmental documentation according to the procedures for Category 2, 3 or 4 activities. Hence, such awards shall contain clauses stating that funding of Category 2, 3 or 4 activities is contingent upon findings, recommendations and clearance of the environmental documentation.

The MEO and/or Project Manager shall on a routine (semi-annual) basis pass to the REO and BEO an updated summary of activities and the results of the environmental categorization and review process, in order to keep them apprised of the type/nature, scale, funding levels and implementation status of the individual activities approved under the process described in this IEE and any corresponding mitigation and monitoring requirements. Reference to this process will also be made in the Mission's R4 submittal to AFR/W.

4.3 Promotion of Environmental Review and Capacity Building Procedures

The procedures described above and incorporated within the Screening Form are intended to ensure environmental accountability and soundness, on the assumption that the Mission has the following additional elements in effect to build environmental capacity with PACT and its NGO partners.

- PACT and its appropriate partners will help design, conduct, participate in, and apply environmental assessment and management training, in conjunction with USAID and Ethiopian resource organizations and agencies, such as the Regional Environmental Assessment Training Course, and pursue follow-up training to assist these partners in properly fulfilling the screening and review requirements in conjunction with concerned Ethiopian organizations and agencies;

- PACT and its appropriate partners will also be encouraged to apply appropriate Ethiopian environmental assessment policies and procedures; and

- A monitoring and evaluation process will be put in place and used by PACT and its appropriate partners, in collaboration with any concerned Ethiopian authorities, and USAID project management.

4.4 Environmental Responsibilities

USAID/Ethiopia assumes responsibility for environmental review and decision-making for all USAID-assisted Ethiopian NGO Sector Enhancement Initiative activities as outlined below:

- Through PACT, and with the assistance of appropriate partners, proposers will submit proposals that take into consideration potential environmental impacts and their mitigation, including avoidance, and will design the activities with an environmental monitoring system in place.

- The proposer and PACT will use the Screening Form to categorize proposals, and the MEO will review and pass on to the REO and BEO any Category 3 or 4 and, as he/she determines, some Category 2 activities.

- The proposer/implementing agent for an activity, with the assistance of appropriate partners, will ensure implementation of agreed-upon mitigating measures and environmental impact monitoring.

- USAID/Ethiopia's MEO and the Project Manager will be ultimately responsible for monitoring environmental impacts of all project-financed activities, as further specified below (Section 4.5).

- Periodic visits of the REO or REA will also be requested for advice, refresher training and validation that environmental processes are in place.

4.5 Monitoring, Evaluation and Mitigation

An **environmental monitoring, evaluation and mitigation process** will be established and used by the implementing partners in collaboration with USAID. USAID-supported activities shall incorporate appropriate mitigation and monitoring procedures as listed below.

- PACT and its partners will utilize the *Environmental Guidelines for Small-Scale Activities in Africa* to assist them in determining what potential impacts should be of concern for different types of development activities in various settings. Using the information from this and other documents cited therein (advice should be solicited from the REO or REA), PACT, with the proposer, will determine which impacts to mitigate and monitor for the particular development activity.

- PACT and its partners must identify in each proposal and in the accompanying environmental review reports all proposed environmental mitigation and monitoring requirements.

- Once the environmental review reports are approved, the mitigative measures and monitoring procedures stated

in the environmental review report shall be considered a requirement.

- The implementing agent/partner, with assistance of other appropriate partners, shall be responsible for implementation of agreed-upon mitigation measures and monitoring of impacts .

- All periodic reports of PACT's implementing partners, under these procedures, to PACT and of PACT to USAID/Ethiopia shall contain a section on environmental impacts, success or failure of mitigative measures being implemented, results of environmental monitoring, and any major modifications/revisions to the project, mitigative measures or monitoring procedures.

USAID/Ethiopia is ultimately responsible for assuring conformity with the procedures spelled out above, including environmental categorization and review procedures. With particular respect to monitoring, evaluation and mitigation, the Mission is responsible for:

- Monitoring and evaluation of activities after implementation with respect to environmental effects that may need to be mitigated, a process which should be integrated into the Mission's pertinent Performance Monitoring and Evaluation Plan;

- Review of PACT and other implementing partners' reports with respect to results of environmental mitigation and monitoring procedures;

- Incorporating into Mission field visits and consultations with implementing partners periodic examination of the environmental impacts of activities and associated mitigation and monitoring (assistance of the REO or REA in preparing guidelines or assisting with the monitoring and evaluation can be solicited); and

- Reporting on implementation of mitigation and monitoring requirements as part of the summary of activities and their status that is passed to the REO and BEO.

5.0 SUMMARY OF FINDINGS

This amended Initial Environmental Examination (IEE) brings the 1995 IEE into conformity with the Africa Bureau environmental procedures for umbrella activities. It also reflects new conditions regarding delegation of environmental review responsibility to Missions for PVO/NGO umbrella type projects (Cable STATE 257896).

Environmental Determinations

Based on environmental review procedures, promotion of environment review, capacity building, and monitoring, evaluation and mitigation procedures specified in this IEE, to which the Mission commits itself, the following environmental determinations are recommended:

1. A **Categorical Exclusion** is recommended for project-financed technical assistance, training and education, institutional strengthening, regional communications and information exchange activities that have no physical interventions and no direct effects on the environment pursuant to 22 CFR 216.2(c)(1)(i) and 216.2(c)(2)(i), (iii) and (v). **The screening form will be used to confirm this determination for each activity.** This categorical exclusion does **not** apply to education, technical assistance or training if such include activities directly affecting the environment, such as construction of facilities, per 216.2(c)(2)(i), **nor** to studies, projects or programs intended to develop the capability of recipient countries to engage in development planning when designed to result in activities directly affecting the environment, per 216.2(c)(2)(xiv).

2. A **Negative Determination with Conditions** is recommended for all other activities entailing community development. This IEE specifies a set of steps, in accordance with the Africa Bureau's *Environmental Guidelines for Small-Scale Activities in Africa*, to ensure adequate environmental review of USAID-supported activities, including capacity-building elements. This negative determination is also conditioned on the provision of supplemental project technical assistance and training support to augment existing efforts. These capacities will be developed and implemented in close collaboration with USAID/Ethiopia and the Initiative's partners.

Conditions

USAID's support for the Ethiopian NGO Sector Enhancement Initiative will follow a formalized environmental review process for its activities. A key component of this review process is the use of a Screening Form (Attachment 1) to categorize activities, and review and screen them for potential environmental impacts. Use of this screening form and the categorization process are recommended in accordance with the AFR *Environmental Guidelines for Small-Scale Activities in Africa*.

USAID/Ethiopia assumes responsibility for environmental review, with clearance by the Mission Environmental Officer (MEO) or USAID Director or Acting Director in accordance with the environmental review procedures outlined herein for Category 1 and Category 2 activities. All activities classified as Category 3 or 4, based on the procedures for categorization and review (in the unlikely event there are any), and possibly some in Category 2, at the discretion of the MEO, will be subjected to additional environmental assessment, as deemed appropriate, in consultation with the Regional Environmental Officer (REO) and Bureau Environmental Officer (BEO), and will be passed to the Bureau and Regional Environmental and Legal Officers for further review and clearance.

PACT may, if it desires, categorize or review categorization of activities, based on use of the screening form, prior to approval to a proposer to proceed with final design. This procedure would allow activities that are in Category 1 (no environmental review required) to be carried out and for the proposer to undertake an appropriate environmental review in accordance with the procedures for Category 2, 3 or 4 activities. No activities classified in Category 2, 3 or 4 will be funded until the environmental documentation required by this IEE has been prepared, reviewed and cleared. Hence, such awards shall contain clauses stating that funding for such activities is contingent upon adherence to the findings and clearance of the environmental documentation.

Partners implementing the Initiative's USAID-supported activities will help design, conduct, participate in and apply appropriate environmental assessment/design and implementation/mitigation procedures for each activity. The Project will support appropriate environmental training and will do follow-up training to assist these partners in properly fulfilling this review requirement, in conjunction with concerned Ethiopian organizations and agencies.

An environmental monitoring, evaluation and mitigation process shall be established and used by the implementing partners, including grantees, in collaboration with USAID. Up-dated summaries of activities and their status, based on the procedures described in this IEE, will be periodically submitted to the REO and BEO to keep them apprised of the type, scope and implementation status of the activities and their corresponding mitigation and monitoring requirements. Reference to this process will be made in the Mission's annual R4 submittal to AFR/W.

This IEE does not cover pesticides or other activities involving procurement, use, transport, storage or disposal of toxic materials, and any situation dealing with such will require an amended IEE.

Adherence to the procedures in this IEE are not in lieu of any environmental assessment procedures required under Ethiopian law, nor can adherence to Ethiopia's environmental procedures be substituted for compliance with the procedures in this IEE. Efforts will be made, however, in the development or revisions of the Screening Form to dovetail respective assessment information requirements to the maximum extent allowable.

ENVIRONMENTAL SCREENING/REPORT FORM FOR NGO/PVO ACTIVITIES & GRANT PROPOSALS

BACKGROUND

USAID, as a "re-engineered, learning institution," has introduced major changes in its new operations systems, with a strengthened focus on results (not activities), greater accountability and empowerment, teamwork, participation and customer orientation. For example, projects are replaced with "results packages" provide USAID operating units and collaborators the flexibility they need to adapt to changes during implementation. The underlying rationale is to focus on results, while still managing inputs and monitoring outputs properly, and to give those responsible (including the host country partners) for achieving results the flexibility to change approaches and tactics as situations change or lessons are learned.

USAID's Africa Bureau Environmental Office, in conjunction with the Regional Environmental Offices, has been developing an initiative for environmental management capacity building. This initiative is intended to support USAID/AFR Missions, their implementing agents and collaborators. An important rationale for this initiative is that Africa Bureau environmental and legal staff anticipate providing significantly enhanced responsibility to carry out environmental reviews to those USAID Mission programs whose designers and/or implementors have successfully completed an Environmental Assessment course and/or participated in related capacity-building activities. Relevant agency experience has shown that such enhanced Mission authority can greatly facilitate field-level program activity design and implementation. These NGO Environmental Guidelines are consistent with USAID's new precepts of flexibility.

The present Environmental Screening and Reporting Form (ESF) is designed to be consistent with the Initial Environmental Examination process, and to assist USAID Missions and their implementing partners design and implement activities in an environmentally sound manner in accordance with all salient agency policies and procedures. Use of the ESF will greatly reduce the need for review and approval of NGO grant activities at the regional or Washington levels.

INTRODUCTION TO USE OF THIS FORM

This form is to be utilized to screen activities to be performed by all applicants for grants under USAID funding, including grantees of the PVO umbrella projects, and proposals submitted for consideration for funding under other USAID programs including grants management units. This is a *generic* form , illustrative only, and its final contents are to be refined and jointly determined among the affected partners -- NGO, USAID, host country agencies, etc. To the extent possible, the form should reflect host government environmental policies and procedures, e.g., accounting for existing designated protected areas.

Typically, two broad categories of projects will be funded: (a) those designed to strengthen local institutional capacities to manage the natural resource base and (b) those designed to support the development of appropriate infrastructure needed for sustainable natural resource management. Activities could include training, technical assistance and other institutional support, income-generating activities through the exploitation of natural resources in a self-sustaining and environmentally sound manner or development of physical infrastructure to further natural resource management at the district level. Under other components of USAID-funded programs, training, technical assistance, research, studies, and information-related activities and other types of activities can be funded.

This form is intended to be adaptable to unique circumstances. In using it, adjustments can be made in consultation with the Regional and Bureau Environmental Offices. It is strongly advised that the Mission Environmental Officer make on-site visits prior to finalization of the ESF, and that the ESF be rational and fully defensible and without ambiguity as to how the conclusion was reached that the activity(ies) will have no significant impact.

< **Example of detailed Environmental Review from Tanzania** -- USAID Regional EA Course 9/97>

KUFACAMPA Environmental Review for Kufatembo Community Campground & Lodge

(Prepared for NAKPAT & USAID/Nakabanda - October 1997)

1. Background, Rationale, and Outputs/Results Expected

This planned activity, in the amount of U.S. $100,000 in USAID assistance, is proposed to the Nakabanda Protected Area Trust (NAKPAT) to provide for site preparation, construction and purchase of equipment and materials for a community campground/lodge in the vicinity of Kufatembo National Park. The proposed campground/lodge has been planned in consultation with Nakabanda Parks and Protect Areas (NAKAPAPA) to attract a class of tourist willing to pay a Park fee of $200/day to view the Kufatembo National Parks endangered *Fortrani* chimpanzees and the rare endemic snake, the Blue-eyed Boomslang. The campground/lodge is meant to provide direct benefits to the communities neighboring the Park through employment and revenue generation (See 2. below) together with other multiple use strategies for use of resources in peripheral areas of the Park. One intent of this activity is to help reduce lingering hostility of communities, which has resulted from the Park Authority's eviction of farmers from the Park in 1952 and the adoption of a policy that has ignored the interests of community members from 1952 to 1990.

2. Activity Description

The proposed site is on 10 hectares of public land bordering the National Park. The entrance to the proposed campground is about 200 meters from the North Gate (See map).

The Community-Based Organization (CBO) proposing to Nakabanda Protected Area Trust (NAKPAT) is known as the Kufatembo Community Campground Association (KUFACAMPA). KUFACAMPA has been reconstituted from its original form (one representing related family members only) and now consists of an elected Board of Directors from the Kufatembo Community. This new association was created after several open community forums and stakeholder meetings, initiated after the first Kufatembo stakeholder consultation organized by NAKPAT.

The campground/lodge activity has also been altered based on additional information the results of the stakeholder consultations and now will consist of:

- Twenty-four (24) 5m x 6m tents on concrete slab, together with attached toilet and shower area also on slab. Total slab area: 5m x 11m.
- Dining room/meeting room/bar area on concrete slab. Area: 7m x 13m'.
- Outdoor dining area on dirt with reed fenced enclosure. Circular area with radius of 5m.
- Kitchen on concrete slab. Area: 7m x 10m.
- Reception/Office on concrete slab with attached men and women's toilets also on slab. Area: 5m x 12m.
- Manager's house, 2 bedrooms, sitting room, dining room kitchen, toilet and bath/showers. All on concrete slab. Area: 10m x 23m.
- Maintenance building/garage on concrete slab, including outdoor slab area for fueling vehicles from fuel drums. Area: 10m x 13m.
- Single lane gravel road to site and office reception area. Gravel parking lot 50 meters from office/reception area. Proposed lot is designed to hold up to 30 cars. Gravel road also passes around site to garage/maintenance building.
- Interpretative trail development in consultation with University of Nakabanda ecologist.
- Fuelwood to be purchased from small farmers practicing agroforestry, or private woodlot owners, for outdoor eating/meeting area and kitchen.
- Solid waste pit. Area: 5m x 10m.
- Tents, manager's house, and dining area will have wooden floors over concrete slab.
- Tent showers are open air with reed enclosures for privacy.
- Paths and trails are to be gravel only. Slate path from reception/office to dining/meeting area.

applying natural materials in construction. Many of the features of the current KUFACAMPA proposal described herein, incorporate TIHI concepts. However, the TIHI proposal was rejected by the community and Nakabanda National Parks, because Texas International could not justify going forward with the project unless they could build a facility large enough to accommodate 100 persons per day (50 beds) with a 60 percent accommodation rate. For ecological reasons Park/University of Nakabanda planners recommended against a lodge of this size. The decision to maintain the $200 per day entry fee and the subsequent permit system restricting the number of tourists visiting Kufatembo Park to a maximum 48 persons/day resulted in a decision by Texas International to withdraw their proposal.

(3) World Environmental Alliance of Trophy Hunters (WEALTH) proposed turning the site into a trophy hunting concession, arguing that fees from controlled trophy hunting in Kufatembo National Park and associated buffer zones would bring far more revenue to the Kufatembo National Park and Kufatembo communities. Nakabanda Parks and Protected Areas planners and the Economics Department at the University of Nakabanda agree with this assessment. While trophy hunting might be encouraged in other Nakabanda Parks, it has been rejected by NAKAPAPA because of Kufatembo National Park's status as a world heritage site and its primary and growing attraction to non-consumptive ecotourists who would be distressed to encounter professional and legalized hunting within Kufatembo Park or surrounding buffer zones.

3. Environmental Situation

The site lies at approximately 1350 meters, and consists of rolling terrain below high volcanic hills. The primary vegetation type is disturbed Afro-montane rainforest; approximately 40 per cent of the site and the surrounding area outside the Park has been cleared for timber and planted to maize and sweet potato. About 2 hectares of forest on the site serves as a burial ground for the local community and contains several sacred tombs of potential archeological significance. The region receives 800 - 1000 millimeters of rain per year, with a dry season typically from June through August. Population density in the vicinity of Kufatembo National Park averages 250 per km^2 and the population growth rate is about 3.2% per year. Soil fertility and agricultural productivity have declined steadily over the last two decades. Per capita income averages approximately US $ 110/year and appears to be stagnant or falling. The deforestation rate in the region is about 3% per year. The nearest town, Ukungu, has a population of approximately 30,000 and is 40 kilometers from Kufatembo. The road providing access to the Park from Ukungu was once paved, but the pavement has deteriorated to such an extent that little pavement remains; because of large potholes and the bad condition of the road overall the average traveling speed is approximately 25km per hour. Drainage structures have not been maintained and in the rainy season the road is slippery and prone to landslides.

The Park Agency has no legal control of lands outside the boundaries of the park. Lands within and surrounding the communities in the buffer or peripheral zone of the Park are in some cases state land and in other cases held through traditional tenure, controlled by the head of each village. In a few cases, those with customary or traditional rights to land have "sold" their interests to persons or groups from outside the communities. Neither the regional nor local governments have exercised any control on land use, such as zoning, in the area adjacent to the Park. The World Bank has urged the development of a Master Plan for the Park that would include zoning and land use controls for the area adjacent to the park, including towns in the vicinity such as Ukungu.

The proposed campground site lies in a rain forest strip along the banks of Mvua Baridi River. Mvua Baridi is perennial and is the main source for Samawi Lake, a volcanic crater lake, important commercially for fish and crayfish. Kufatembo National Park has been designated a world heritage site because of its population of the endangered "*Fortrani*" chimpanzees, renowned for their basic binary computational skills and the endemic, Red Book listed snake, the Blue-eyed Boomslang. Professional opinion on the Park's maximum tourism carrying capacity varies, but is considered to be no more than 48 persons per day in the dry season and 24 in the wet season. The Park Authority has determined that the entrance fee to the park is $200 per day for the right to visit the area where one can view the chimpanzees, with lesser fees yet to be determined for other types of use.

Baseline information includes a pre-construction site survey by a University of Nakabanda ecologist in consultation with a site architect selected by KUFACAMPA and Nakabanda Parks and Protected Area (NAKAPAPA) Authorities. The ecologist conducted species counts of flora and fauna and took baseline transects. Five endemic plant species were

identified that merited special consideration for on-site preservation. An archeologist from the Nakabanda Preservation Society surveyed the tombs and sacred forest and developed a plan for preservation of the tombs and sacred forest on the site, and for community management of tourist visits to these sites.

Water quality was tested in the Mvua Baridi River and found to be free of coliform or other significant pollutants under dry season conditions. The river has a high silt content during much of the year making it unsuitable for drinking without filtration. Hydrological data indicate that groundwater recharge rates are adequate to support a year round pumped extraction rate of 4500 gallons/day (maximum campground/lodge demand - See Section 4.3). Soil and hydrological tests conducted by the University of Nakabanda reveal permeable alluvial sands, requiring special attention to prevent contamination of the Mvua and groundwater from septic tanks and leach fields, and the proposed solid waste pit. Site plans and a description of the rationale for selection of sites for tents and facilities is provided as Annex A. A socio-economic baseline survey and a Knowledge, Attitudes and Practices (KAP) survey was conducted in order to track campground benefits/costs on affected communities and to determine if the campground will have a beneficial effect on community/Park relations.

4. Evaluation of Activities and Issues with Respect to Environmental Impact Potential

The concept of a campground/lodge for no more than 48 tourists/day is consistent with the Kufatembo Regional Tourism plan and the Kufatembo National Park Management Plan. It has also been approved by Nakabanda Parks and Protected Area (NAKAPAPA) authorities. Siting of the campground/lodge was done in consultation with a qualified ecologist/planner and an architect familiar with minimizing impacts on land and environmental resources (See ECODESIGN, Inc. *Site Plan* and maps). Data available from the Ecotourism Society, such as *The Ecolodge Sourcebook for Planners and Developers* (Hawkins *et al.*, 1995) and contained in *Environmental Guidelines for Small-Scale Activities in Africa* (Knausenberger *et al.*, 1996) have been utilized in order to provide a sustainable design that avoids significant, adverse impacts.

Siting of the campground/lodge facilities, as a consequence of the sensitivity and ecological consideration with which site plans were developed (see Annex A) is not expected to have adverse impacts on rare fauna and flora resident in the site area nor on other environmental resources. Inadequate site planning could have led to unacceptable pollution of the Mvua Baridi River and camp drinking and cooking water; however, campground facilities are located at a sufficient distance from the river and with proper design to avoid such effects. Appropriate siting of the solid waste dump will result in no adverse impacts on groundwater and runoff.

4.1 Planning and Design Phase

No adverse environmental impacts are anticipated during the actual planning and design for the campground/lodge. Investigations and studies of ecological resources, water quantity and quality, soils and archeology carried out during site reconnaissance were not invasive and did not require disturbance of vegetation, clearing or the like. All test pits dug for soils and archeological investigations have been backfilled.

Land speculation, to the extent that information is available, has not occurred, but the possibility that local residents may be contemplating "sale" or transfer of land to enterprises cannot be ruled out.

4.2 Construction-Related Impacts

Potential adverse on-site impacts during construction include site clearing of indigenous tree and plant species, noise, dust and potential siltation of the Mvua Baridi. The total area to be cleared is approximately 0.8 hectares. As specified in Section 5 below, mitigative measures will be undertaken to reduce these short-term impacts and provide for long-term landscape maintenance.

Increased truck traffic, carrying equipment, fuel, other supplies, and construction materials will travel the principal access route from Ukungu. Estimated additional traffic is three lorries per day for a period of two months during peak construction and an average of one additional lorry per day for an additional two months.

Hydrological information indicates that a sufficient volume of water will be available from the river to prepare the needed quantities of concrete. Sand, present on site along the banks of the river, will be excavated for construction., in locations where bank erosion is not present. Gravel for use in concrete making and for the site roads and paths will be trucked in from an off-site quarry, approximately 5 km from the campground/lodge site.

Short-term employment will be generated as a result of the construction operations. The contractor and supervisory staff will number approximately three, who will reside in tents during the construction period. Temporary pit latrines will be dug to provide sanitary facilities during the construction period. Approximately 5 to 10 unskilled and semi-skilled laborers per day will be employed from the population in the surrounding communities for a period of four months. Thus, no construction camp will be needed and no adverse impacts typically associated with construction camps, such as disease transmission, sanitation problems, poaching, wood consumption or social effects are anticipated.

The source of fuel during the construction period will be purchased fuelwood for cooking and diesel fuel for operation of a concrete mixer.

4.3 Impacts of Campground/Lodge Operation

During operation, key concerns are the (1) quantity of water supply and potential for pollution of Mvua Baridi from sewage, shower and kitchen water, and clothes washing; (2) potential contamination of well water from the above; (3) downstream alteration in water quality, affecting communities on the river as well as juvenile fish and crayfish populations in Lake Samawi and the livelihood of Lake Samawi fishermen and Lake Samawi communities; (4) potential water pollution and disease vector transmission from solid waste disposal; (5) noise from camp operation; (6) threats to indigenous flora and fauna on site; (7) non-renewable energy sources versus use of wood, the extraction of which could become unsustainable; (8) avoidance of site contamination with fuel and fuel byproducts; (9) potential for degradation of archeologically and historically important tombs and the community's burial ground/sacred forest; and (10) need to maintain architectural and landscape aesthetics to retain site appeal for tourists.

The volume of water utilized on a daily basis, assuming maximum occupancy of the camp and use of water by resident manager and staff, is estimated to be 70 gallons/person/day including laundry, cleaning and food preparation or a maximum campground/lodge demand of 4500 gallons/day. Washing will be done in concrete basins/tubs off the kitchen area, using pumped well-water. Runoff will be directed into the kitchen leach field. Water used in connection with laundry and catering will be re-utilized to the maximum extent practicable to maintain landscaping. The well for pumped water will be have a concrete cap to prevent contamination.

Tent sites, flush toilets and showers are more than 50 meters from the river. Human waste will be disposed of in septic tanks and leach fields are designed to drain away from the Mvua Baridi River, thereby minimizing downstream pollution effects. Septic tanks will also be checked every six months and emptied annually by Ukunga Gardens, Inc. or sealed as required. As indicated in Section 5, a water quality monitoring program to ensure that juvenile fish and crayfish population can be maintained downstream will be instituted.

The solid waste pit will be 100 meters from the river and from the campground. Solid waste will be disposed of and covered daily to sufficient depth to prevent rodents and wild animals from feeding on rubbish. The pit will have an estimated life of five years, after which it will be permanently covered and a new adjacent site opened. As indicated in Section 5, a waste management plan incorporating recycling and limitation on used of packaged materials as well as investigation into composting of garbage will be undertaken. No burning of refuse or garbage will be permitted.

Noise from camp operation will be minimized through (1) application of photovoltaics (in lieu of a generator) to provide electricity for radio communication, lighting and water pumping, and (2) use of bottled gas for refrigeration combined with purchase of ice blocks in the nearby town of Ukungu.

Indigenous, endemic flora and fauna will be protected under the University of Nakabanda's ecological component of the site management plan. The campground/lodge operator will provide to visitors information on both on-site and off-site flora and fauna with instructions regarding identification and need for respect and protection.

In order to minimize both the use of non-renewable energy sources and dependency on fuelwood, a combined strategy for energy supply has been adopted -- use of solar water heaters with bottled gas back-up to eliminate dependency on wood for water heating, solar -powered lighting, solar-powered pump, fuel efficient iron woodstoves in the lodge kitchen and a bottled gas stove for the manager's house kitchen. As noted in Section 5, sustainable wood production will be encouraged.

Fueling and maintenance of vehicles will be done over aluminum catch pans resting on a concrete slab. Oil and petrol wastes will be stored with appropriate labeling and then transported in sealed drums where they will be disposed of at Ukungu Hazardous Waste, Inc. , the only Government approved site in the region (established and sponsored under a grant from the Netherlands).

An archeological management plan developed by the Nakabanda Preservation Society will be followed to protect the on-site tombs and sacred forest resources, while also allowing community-controlled access to these sites for tourists.

The use of indigenous materials in the construction of facilities, particularly thatch, bamboo and reed, will need to be maintained and replenished in order to maintain the structures and their appeal to visitors. As indicated in Section 5, sustainable production will be fostered. The operator will maintain landscaping, following the precepts laid out in the ecological component of the site plan. In utilizing indigenous plants for landscaping, emphasis will be placed on maintaining or creating plant communities rather than use of specimens or formal plantings.

Positive economic benefits will result from operation of the community campground/lodge. In addition to the manager and his family (accounting for three-full time jobs), fifteen additional full-time jobs will be created for a maintenance personnel, security guards, gardener and groundskeeper, maids and cleaning services, cooks, waiters and kitchen help. Employees will be sought from the local community. Additional laborers will be engaged on a period basis to maintain buildings, tent sites, gravel paths and roads.

4.4 Induced and Indirect Impacts

Key positive impacts are anticipated from increased community/Park authority cooperation, reduced stress on the agricultural resource base through increased off-farm income, and enhanced co-management of the environment/natural resource base in the buffer zone surrounding the Park.

As a result of the campground/lodge (assuming it is successful) and the future rehabilitation of the access road from Ukungu, park planners and managers should anticipate induced tourism demand at Kufatembo National Park. Although plans for the community campground/lodge limit accommodation to no more than 48 tourists at one time, and thus limit indirect negative effects on Kufatembo National Park (with its permit quota system of 48 persons per day), pressure to build additional lodging is probable. Indeed, given that tourists might spend a first day arriving within the campground before visiting the park and a third day visiting in the area before departing, the argument could be made that three times as many tourists could be accommodated in tourist facilities outside the park. Induced demand for additional tourist lodging can be attributed only in part to the development of the community campground/lodge itself. This demand will largely be a result of the improved access to the Park and the increased demand for eco-tourism in general. Nevertheless, the presence of the campground/lodge will attract other entrepreneurs to develop snack-bars, craft shops and other types of development.

Over the longer term, community benefits from the campground/lodge and the future of Kufatembo National Park are threatened by a demographic growth rate that will result in a doubling of the population in Kufatembo region within 20 years. Cumulative effects on an already stressed regional natural resource base will occur, unless measures to reduce population growth, provide for sustainable resource use and control development are implemented.

4.5 Impacts of Decommissioning or Abandonment

While there is no reason to presume that the facility would need to be de-commissioned or abandoned in the future, assuming proper maintenance, the result of needing to abandon to remove the facility are considered to be minor. The

facility remnants would not create any long term threat to the environment; concrete slabs could be broken up and disposed of and the septic tanks and leachate fields could be filled, if warranted.

5. Environmental Mitigation Actions (including monitoring and evaluation)

5.1 Construction

Prior to site development, trees that must be cleared will be tagged; all others will be designated for preservation. Construction impacts will be minimized by accomplishing site grading, excavation and building during the dry season; careful siting of the construction road to avoid cutting of old growth rainforest; and transport of materials by wheelbarrow or cart wherever feasible. Interior site roads will have drainage channels. They will also be watered and surfaced with gravel to minimize dust Use of gravel road surfacing will also reduce soil erosion and potential downstream siltation. Upon completion of construction, stumps will be removed, all exotic plant species will be removed and disturbed areas replanted with indigenous vegetation. The bids and specifications (tender) for the contractor will include these requirements as well as the requirement to develop a plan to control soil erosion and siltation and to utilize, as appropriate, siltation fences, straw or hay bales and the like to minimize effects of construction activities on water quality of the Mvua Baridi River.

Although construction-related noise will be generated, no noise control mitigation plan will be needed, because of the distance of the site from sensitive receptors (schools, churches and houses). Consultant ecologists have determined that the anticipated noise levels will not disturb indigenous wildlife, which are either not likely to be disturbed by the noise, not likely to be found resident or breeding near the site or will retreat further into the forest. When heavy machinery is utilized, workers will be provided with sound-attenuating protective gear.

The quarry site from which gravel will be extracted for the site access roads and paths will be limited in extent and depth so as not to disturb the water table and no drilling or blasting will be required. The contractor will be required to fill the excavation, restore site topography to the extent feasible and replant indigenous vegetation. Although the community indicated some interest in utilizing the quarry as a livestock watering point, this use was determined to be inappropriate and likely to engender adverse impacts on ecological resources in the vicinity of the quarry.

Temporary measures to fill holes and limited regrading of the principal access road from Ukungu will be needed in order to permit lorries to bring in materials and equipment. This work shall be coordinated in conjunction with the planned USAID/World Bank rehabilitation of the road; full-scale rehabilitation will occur after the principal haul activities for the campground/lodge are completed.

An independent inspector will monitor the contractor's construction activities, completed construction and restorations. The contract will include penalties for failure to perform mitigative measures as specified.

5. 2 Operations

Sustainable operations of the campground/lodge will need to rely on the implementation of on-going mitigative measures in the form of plans to manage extraction and use of material sources (such as wood and other materials) and the disposal, recycling or recovery of wastes. The following mitigative measures will be implemented and evaluated. Additional measures will be considered based on the results of these evaluations.

- Management and staff will be trained in water conservation practices and guests will be asked to participate in conserving water by using towels and sheets for several uses.

- A solid waste management plan will be developed to limit use of packaged materials for consumables, recycle containers, and reduce litter in order to minimize the volume of waste that will be disposed of in the solid waste pit. The campground/lodge management will work with DANCED volunteers who are performing ongoing investigations into composting of biodegradable waste in connection with agro-forestry and farming activities.

- Although impacts of runoff, particularly during the rainy season, are controlled largely because of the site design and layout have taken into account ways to minimize these effects, a soil erosion and sediment control plan with instructions and recommendations for dealing with heavy precipitation events will be implemented.

- Impacts on forests and other vegetation, such as reeds, bamboo and sources of thatch, will be mitigated through (1) creation of an agroforestry fund from campground/lodge revenues to establish a local agroforestry/seed nursery and seed distribution center, and to provide small subsidies for tree seed and seedlings; (2) purchase of fuelwood and building materials from farmers practicing agroforestry or operating private woodlots in the vicinity of the camp; and (3) increased support for community co-management of Park forest resources including employment of community forest guards.

Monitoring and evaluation activities have been designed to identify selected, but potentially significant impacts that design and operational controls may not have avoided or minimized and the effectiveness of mitigative measures -- both those incorporated within the design and those that are ongoing management practices. Environmental monitoring will consist of re-checking transects and carrying out species counts every two years under the direction of the University of Nakabanda's Environmental Resource Centre to determine changes in plant and wildlife composition. River water and well-water quality will be tested by the camp manager every six months at selected sampling locations upstream, at the campground and downstream. The volume of waste generated and volumes placed in the disposal pit will be measured one day per month (coinciding with a peak capacity day over the period of operation). Kufatembo National Park Authority shall participate in an annual review of the campground/lodges impact on the Park and Kufatembo communities, with the minutes of this meeting available to NAKAPAPA and the general public.

5.3 Indirect and Induced Impacts

Indirect and induced impacts as a result of the lodge and associated other tourist development will be difficult to control., unless a new approach to land use planning and development is adopted for the environs of the park. Cumulative effects of increased tourism and related development combined with the current rate of population growth in the area pose the most significant threats not only to the environment but to the quality of life of current and future generations.

The World Bank-financed Park Masterplan, which includes a strategy for land use controls on tourist and non-traditional development outside the park, will examine the potential for growth in tourism at the Park as well as the appropriate zoning or other controls that can be used to limit development of facilities for tourists within acceptable limits. NAKPAT will work at the policy level to facilitate and encourage the implementation of strategies for controlled development.

Three percent of lodge revenues will be applied to the Kufatembo Family Planning Initiative, a separate donor supported activity in the Kufatembo region in recognition of the need to control population growth and increased pressure on fragile ecological resources.

Socio-economic and KAP surveys will be repeated every two years to determine the degree of community benefit from the campground/lodge and changes in community/Park authority relationships. These surveys will also help measure the effectiveness of agroforestry and family planning initiatives.

6. Other Information

Topographic Maps of Kufatembo National Park and environs. Department of Maps and Surveys
KUFACAMPA Architectural Site Plan, ECODESIGN, Inc, October 1996.
Ecological Survey of Proposed Kufatembo Community Campground/Lodge (including species counts and transects), University of Nakabanda Environmental Resource Center, August 1997.
Socio-economic Baseline Survey of Kufatembo National Park Buffer Zone Communities, University of Nakabanda Centre for Social Science Research (NCSSR), August 1997.
Kufatembo Buffer Zone Knowledge, Attitudes and Practices Survey, SECONSULT, July 1997.

Archeological/Cultural Site Plan for Kufatembo Community Campground/Lodge, Nakabanda Cultural Society, June 1997.
Kufatembo Regional Tourism and Development Plan, October 1996.
Kufatembo National Park Management Plan (October, 1996)

12. Discussion and Break-Out Groups: Food Aid and Natural Resources Management

Doing Better at Doing Good

Description/Objectives

The purpose of this exercise is to consider and discuss if and how current food aid programs in the natural resources sector could be improved to increase their effectiveness and impact. Workshop participants are encouraged to review the background documents provided with this module as well as the document *Environmental Review and Public Law 480*. Many food aided rehabilitation and development programs, in Ethiopia and around the world, have adopted natural resources management (NRM) as useful activities for engaging rural people in food-for-work with the intention of creating productive assets. These NRM activities have included tree-planting, soil and water conservation, water impoundment and small-scale irrigation and a variety of other agriculture related activities (including some efforts at building or refurbishing rural infrastructure).

Natural resources management activities, which directly address the productivity, durability, resilience and sustainability of agricultural ecosystems, are logical choices for such food aided-NRM actions. The basic premise is essentially simple: food aided- natural resources activities will help to address short-term food needs through food-for-work while enabling the participant/beneficiaries to produce more food in the medium-term and thus be less vulnerable to household food insecurity.

The renewed stress on the need to carry out environmental review of food aid programs provides a logical opportunity for enhancing the natural resources management activities being undertaken. Any sound environmental review entails a degree of data collection, analysis and planning which allows those preparing and designing these programs to consider the place and impacts of natural resources management in the context of supporting agricultural productivity.

The exercise will begin by assigning participants to five breakout groups, focusing on the following themes:

- tree-planting
- soil and water conservation
- water impoundment and small-scale irrigation
- sustainable intensification of agriculture
- livestock husbandry and fodder resources management

Each group should identify a rapporteur and a spokesperson. These groups will meet over lunch to discuss their themes. Immediately after lunch, there will be a discussion of some of the emerging issues related to food aid and natural resources management with individuals who have been involved in the evaluation and programming of these types of activities. The spokesperson of each group will be expected to contribute the group's findings to this discussion.

Background Readings

Catterson, T.M. and Knausenberger, W.I. 1997. *Environmental Review and Public Law 480- Food Aid Programming*.

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Environmental Review and Public Law 480 Food Aid Programming

by

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EXECUTIVE SUMMARY

There are six main sections to this paper: **I- an introduction** to food aid programs and the environment; **II- an overview of the present practices** related to environmental oversight of food aid programs; **III-** a discussion of the **changing policy and programming framework** in which these programs will operate in years to come; **IV-** an examination of the **issue of food aid and environmental impact**, including information on current environmental review procedures; **V-** a discussion of the **opportunities** for using food aid for achieving positive impacts in terms of meeting food security goals through natural resources and environmental management; and **VI-** an outline of a **strategy for programming** vis-a-vis food aid and environment.

I- Introduction:

The first section briefly reviews the policy, regulatory and budgetary background of food aid programming for development. It also outlines the purpose of this paper, namely, to examine the issues related to food aid and the environmental review process, and in that light, the potential for achieving more sustainable development results with food aid resources.

The intention here is to put food aid into context for those less familiar with these programs and the current magnitude of these important development resources, the future directions and parameters under which they operate. Similarly, for those food aid program specialists who may not have had a great deal of experience in the natural resources arena, the discussion of hunger, poverty and the environment highlights **the linkages between food insecurity and environmental degradation** and the inherent potential and occasional conflicts for addressing both.

. Food aid currently provides **an enormous resource fund for development**; P.L. Title II resources amount to the equivalent of over U.S. $1 billion annually. The paper notes that while **the availability of food aid resources is declining overall**, as the result of the gradual elimination of large surpluses and greater reliance on market forces for international trade and commerce in cereals, the demand is likely to continue to expand. This situation will compel food aid programmers to **find ways to use these resources more effectively and efficiently**. In that specific regard, the section puts forward the **key premise** of this paper: namely, that **food aid used for carefully planned and executed environmental and natural resources management will support the development of more productive and sustainable agriculture and reduce smallholder vulnerability to food insecurity.**

II- Background-- Food Aid from the Environmental Review Perspective:

The second section gives an overview of present practices related to food aid programs and environmental review. Although food aid programs have been exempted in large measure from such scrutiny in the past, USAID has now taken **a policy decision to scrutinize these**

programs under its environmental review procedures (22 CFR 216). It is noted that a number of USAID's traditional food aid program partners-- the international PVO community-- have already implemented environmental review procedures for some of their own programs.

The paper notes that **given the nature of most food-aided development activities**, typically involving manual labor (as compared to mechanized activities), **the potential for serious negative environmental impacts is low**. The author's **experience**, however, with field based evaluations of food aid and natural resources management projects in Sub-Saharan Africa **suggests that there is ample opportunity for improving their effectiveness**. They typically involve the use of food-for-work for a public works style approach to natural resources management (through tree-planting and/or soil and water conservation) on common or open access lands. While projects of this type may have some positive impact on reversing localized environmental degradation problems, they more typically do not affect the overall agricultural productivity in the areas in which they work, and thus do not yield longer-term gains in food security for participants.

Environmental review and sound planning of environmental management activities could, it is pointed out, **lead to a better understanding of how to use food aid for supporting agricultural productivity gains through natural resources management** activities thereby **achieving incremental gains in effectiveness**, in terms of both environmental stability and food security.

The section also reports on **a recent internal environmental review of the entire P.L. 480 portfolio** of the Agency. This review (albeit still on-going) had, at the time of the preparation of this paper, considered the potential impacts of some 373 projects and activities of all the Offices of the Bureau for Humanitarian Response. Although the review identified only a relatively **modest percentage (4%) of food aid projects classified as having potential negative environmental impacts**, it has solidified the conviction of the need to submit these activities to environmental review. The **issue** which remains is that of **building the institutional capabilities**, within the Agency and among the PVO partners, **to routinely scrutinize these projects** under the procedures of 22 CFR 216. The World Food Programme which uses a good deal of U.S. food aid resources for its programs, is also singled out for enhanced capacity building for environmental oversight.

III- Changing Framework for Food Aid Programs:

The third section of the paper discusses the implications for food aid programming within the context of the evolving policy and programming framework for U.S. development assistance in general. It is intended to provide a backdrop against which the incorporation of environmental review and planning as part of food aid program design, approval and implementation should be considered.

The recognition of the scarcer resource base for food aid has already prompted the

Agency to **redefine its policy framework for food aid and food security**. The 1995 Policy Statement which serves as the basis for BHR action programs, embodies a number of very pragmatic **directives that**, in the view of this author, amply and even explicitly support the contention that **natural resources management activities can make a difference by helping to enhance agricultural productivity and** with it, household **food security**. Similarly, the present concern for ensuring that U.S. assistance meets the challenges and opportunities for working along the Relief to Development Continuum, amply reinforces the premise of using food aid for achieving specific strategic development objectives in many countries "in transition".

Finally, in this context, the paper points out that applying the precepts of a "Re-Engineered USAID" and the "Managing for Results" modality it promotes, will place new and special demands on the institutional capabilities of USAID's traditional food aid partners-- the international PVO community, the World Food Programme, and local non-governmental organizations (NGOs).

IV- Food Aid and Environmental Impact:

Section Four marks the turning point in this document in that it begins to provide guidance, both general and increasingly specific, as to **how to respond to the issues** raised in the preceding three sections.

Although the paper is not considering the environmental impact of emergency feeding programs, because of the primacy of the humanitarian needs involved, it does offer some insights for these situations. For example, **adding environmental planning to emergency food aid programs**, particularly as part of disaster prevention and mitigation projects, may help to forestall some of the degradation that often accompanies large influxes of refugees. Doing so would be a *prima facie* case of actions on the "relief to development continuum" which "promote rather than undermine long-term development".

Non-emergency (development oriented) food aid programs are, as might be expected, **as likely to have negative environmental impacts as similar dollar funded development activities.** These impacts, albeit much less extreme than those possible with dollar funded, large-scale capital development or rural infrastructure projects, are, nevertheless, worth noting. The paper provides a **table listing the activities** of this type (typically food-for-work activities carried out in a public works mode), their potential **impacts** and suggested **mitigation measures**.

This section also notes that part of the problems may arise as a result of the **limitations of food aid as a resource** itself. An inability to purchase needed materials or to contract for technical assistance may open the door for negative impacts. Furthermore, the sometimes **transitory nature of food-aided development efforts** which function for a limited period can lead to incomplete works or inadequate post-construction maintenance that lower real effectiveness and occasionally cause environmental harm.

V- Opportunities for Food Aid-Funded Environmental Management:

Because of the significance attached to food-aided development activities in the natural resource management sector in the USAID Policy Statement, Section Five provides **a fulsome discussion of both past experience with programs of this nature and the very real opportunities for the future**. Drawing upon the findings of a series of program level evaluations carried out by the author and others in Sub-Saharan Africa (in Niger, Ethiopia and Ertirea), this section provides **a retrospective view of the findings with food-aided NRM**. A key issue raised is that of the mixed nature of these types of programs and their frequent inability to satisfactorily meet either food security or environmental management objectives.

Ample attention is given to **the themes of participation and governance**, watchwords of the day among the development community, with considerable applicability in the realm of food-aided development projects as well. Building on the findings of the evaluations of food-aided NRM projects and the lessons learned in dollar-funded NRM projects, the paper underscores the need for a genuine shift in approach which fully embraces **the real paradigm of participation**. A new approach must aim at achieving genuinely participatory rural development by **putting more of the analytical capabilities and decision-making responsibilities and authority in the hands of those most directly affected-- the rural people themselves**. Programs must endeavor to incorporate community level institution building itself as a well-defined development objective, creating and motivating community self-reliance for problem solving.

The paper points out that **food aid projects are particularly susceptible to the "top-down" approach** because the participants often do not know or do not expect to be the future recipients of food aid until it is almost too late. **Building community institutions** is essential so as to enhance local level capability **to "draw down" the support and services** of the government and its development partners for a fairer share of the national and natural wealth, including when it is necessary-- food aid. The paper echoes the USAID Policy Statement which emphasizes the need to **incorporate participation as an important part of making the transition from "relief to development"**.

The section goes on to highlight what has been **a number of recurring conceptual and operational errors of a technology-dominated ("techno-fix") approach to natural resources management**, whether funded with dollars or food aid. The availability of food aid resources for food-for-work tends to promote an "intervention-oriented" approach to the challenges of natural resources degradation, often overlooking **the need to manage the land-use and not just treat the land affected** (treating symptoms and not the causes). Similarly, food-aided NRM programs must be wary of a tendency to attempt to "institutionalize subsistence farming". Food-aided NRM and agricultural improvement programs must look ahead in time and space and perceive how food aid can assist in **the undeniable transformation of rural life styles and land-use patterns** that in many cases are already underway.

Sound environmental review of these programs involves a level of environmental planning that, properly carried out in a participatory manner with the affected local people, cannot fail to add realism and the potential for impact with food-aided NRM. Harnessing local knowledge and promoting local problem solving capabilities will lead to a better understanding of the magnitude of the problems and a more comprehensive understanding of the response that will be needed to overcome them. **Too many food-aided NRM projects define *a priori* what it is they will do**-- typically, a labor intensive land rehabilitation effort, involving tree-planting or soil and water conservation on commons or open-access lands. Because of the intensity of the solution, **their efforts are perforce limited by the availability of the resources**, leading to ineffective or incomplete solutions to the natural resource problems that are undermining local food security on private farm lands.

This section points out as well the importance of developing a sense of the economic and financial considerations of food-aided natural resources management. Real time realization of tangible benefits, in the context of returns on an investment, must be part of these programs. **Conservation, no matter how compelling, cannot be achieved on the backs of those least likely to be able to afford it.**

One of the biggest difficulties with food-aided NRM projects is that they often set **unfortunate precedents or lead to inefficiencies, by using a public works approach and generous incentives** to address natural resources degradation problems. An emphasis on the quantitative, e.g., planting trees and moving food aid, tends to foster investments of large amounts of labor and equivalent **high costs per unit area treated which cannot be sustained.** Similarly, they create a type of **program dependency** within rural society and/or send the wrong message, reinforcing the notion that the State will intervene to counter natural resources degradation. Treating people as laborers limits real participation and fosters uncertainty about the future, thereby **perpetuating a short-term, crisis view of the problems.**

Finally, among the pitfalls of the past, the tendency towards **compulsive interventionism often distorts the ability to achieve real impact and lasting results**. Programs which gage their success on physical accomplishment or on food aid deliveries alone, may overlook the need for palpable impact on either the ecological conditions of the area or on the food security and economic well-being of the local people.

This section then goes on to discuss **the very real opportunities implicit in using food-aided NRM activities to address food security**. The premise is basic; moving beyond the public works approach whose benefits are too diffuse to make meaningful changes of a timely nature in improving agricultural productivity which is the root cause of hunger among the populations "at risk". It provides a series of examples whereby food-aided NRM activities can meet both near-term needs (feeding hungry people) while helping to ensure that they are less vulnerable to food insecurity. It points out that much of **this achievement may result from the increasing agility of program development**, under the new precepts of Agency policy, which promotes **an integration of resources** to address strategic objectives in a given country.

Specific guidance is also offered on **building drought resilience in arid lands farming strategies** by moving food-aided NRM efforts on to the farmlands of local smallholders rather than working exclusively on degraded common lands. It signals **the opportunities**, largely overlooked in the past, for food-aided interventions **in support of livestock husbandry** and improved use, conservation and management of grazing land. The section also discusses, albeit briefly, some of **the basic premises for achieving greater impact with the four principal types of NRM interventions** which are often featured in food-aided programs: agroforestry, soil and water conservation, tree-planting, and sustainable agriculture.

This section concludes with a discussion of **some other environment related options for food aid programs**. It points to the opportunities, for example, with using food aid to enhance participant acceptance of **environmental planning in refugee resettlement programs**. Achieving real impact on biodiversity goals may be attained if programs do more to provide options to **diversify rural lifeways and income opportunities so as to take the pressure off of protected areas**. The section underscores the importance of **supplying sufficient water of good quality and it potential profound effects on nutrition and health**, and thus links NRM activities in watershed management and protection to food security. It underscores the very real opportunities for **using food aid to employ people in programs of urban cleanup and environmental management**.

VI- A Strategy for Environment and Development Food Aid Programming:

The last section of the paper, Section VI, provides **an overview of the parameters of a strategy for environment and development food aid programming**. It begins by reiterating the compelling case for environmental review and planning as a result of the major policy and program changes currently emerging in the food aid sector. The most important point of this section focuses on **the need to look at environmental review and planning as sound investments and something beyond the predominantly regulatory mandate**. This paper is based on the firm conviction that environmental review and planning will be essential to an increase in the effectiveness and efficiency of food aid programs.

Effectiveness will be achieved because of **the dual result: feeding hungry people** over the short-term while assisting them to develop sustainable and productive farming systems that **reduce their vulnerability to food insecurity. Efficiency can be enhanced by better integration of food aid with other development resources**. Doing so will make it possible to offer a more broadly-based strategic approach involving policy change, technological development, the provision of other vital inputs, and enhanced institutional capabilities, all of which can be linked, backwards and forward, to the rationale and modalities for the use of food aid. **Efficiency will also be improved by enhanced engagement** of the participants and the staff which administer these programs, who learn to use food aid resources to overcome the emergency mindset that created dependence and to apply them where they are most needed and most likely to yield results in food security and the environmental stability on which it must be based.

Because of the relative newness of the environmental review in food aid circles, this section provides some summary guidance on these procedures for the interested reader. In particular, it **draws attention to the recent publication of the new Technical Paper** (No. 18) of the Bureau for Africa's Office of Sustainable Development: *Environmental Guidelines for Small-Scale Activities in Africa-- Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities.* It highlights as well **the potential utility of "programmatic environmental assessments"** as a tool for considering the environmental implications of a wide variety of small-scale activities often difficult to predict at the outset of a multi-year food aid program. It draws attention as well to the needs for both mitigation measures and monitoring and evaluation components to these programs in order to complete the skills needed to address the potential of environmental impact from food aid programs.

This section, and the paper, concludes by **highlighting the real challenge of building the requisite sensitivities, skills and experience for sound environmental review and planning** of these programs among the staff of the Agency, its partner PVOs and cooperating country institutions. In order to meet the demand for these services within USAID and among the principal international partner PVOs, **the paper recommends** that full consideration be given to the design and financing of **an umbrella support project** which could provide training and technical assistance services over the next five years as these internal skills build up. It also suggests that given the predominance of the World Food Programme in utilizing U.S. food aid resources, a dialogue be tabled with that organization as to how to meet these challenges.

At the cooperating country level, the paper recommends that USAID Missions consider supporting **the development of an "apex type body" within the local PVO/NGO community** which could take charge of providing training and services related to environmental review and planning for its constituent organizations. No process to implement environmental review of food aid programs or build the skills required for the same can ignor the capabilities and mandates of **the agencies of the line ministries within the cooperating country**. It underscores the reality that building these kinds of skills will make it easier to add a sense of the relationship between food security and environmental stability to the policy agenda for national development planning.

13. Introduction to Environmental Mitigation and Monitoring

Description/Objectives

This session introduces you to mitigation and monitoring concepts needed in preparation for the field trip, including (i) basic terminology and the value of environmental mitigation and monitoring; (ii) the importance of developing mitigation and monitoring plans in the design process; and (iii) the kinds of information you will need in order to develop field trip case study mitigation and monitoring plans.

A more detailed treatment of environmental mitigation, monitoring and evaluation (M&E) is found in Module 16.

Readings

Annex 1 - "Indicative List of Environmental Factors to be Monitored," Excerpts from Volume II Sectoral Guidelines, *World Bank Environmental Assessment SourceBook*, Electronic Version. 1991.

Form

Annex 2 - Mitigation Strategy by Activity Phase

Annex 1

INDICATIVE LIST OF ENVIRONMENTAL FACTORS TO BE MONITORED
Excerpts from Volume II Sectoral Guidelines World Bank Environmental Assessment SourceBook Electronic Version[1]

Monitoring Related To Dams and Water Retention Facilities

Factors to be monitored for dams and water retention facilities should include:

- rainfall
- stored water volume in the reservoir
- annual volume of sediment transported into reservoir
- water quality at dam discharge and at various points along the river (such as, salinity, pH, temperature, electrical conductivity, turbidity, dissolved oxygen, suspended solids, phosphates, nitrates)
- hydrogen sulfide and methane generation behind dam
- limnological sampling of microflora, microfauna, aquatic weeds and benthic organisms
- fisheries assessment surveys (species, populations. etc.) in the river and reservoir
- wildlife (species, distribution, numbers)
- vegetation changes (cover, species composition, growth rates, biomass) in the upper watershed, reservoir drawdown zone, and downstream areas
- increases in erosion in the watershed
- impacts on wildlands, species or plant communities of special ecological significance
- public health and disease vectors
- in and out-migration of people to area
- changes in economic and social status of resettlement populations and people remaining in the river basin

Monitoring Related to Fisheries Activities

Factors to be monitored for fisheries activities include:

-The more data you collect the more data you analyze
-Keep it simple
Monitoring is expensive

The following excerpts were derived from a search on the *keyword*: 'monitoring' under the electronic version of the *World Bank Environmental Sourcebook: Volume II Sectoral Guidelines*. 1991.

SRCBOOK.* August 21, 1996

Capture Fisheries

- water quality (including pollution and oil spills)
- fish stocks (population size and structure)
- fish landings
- conformance by fishermen to regulations on equipment use, fishing areas, catch, fishing seasons
- presence of any discarded materials causing "ghost-fishing"
- effects of land use or water management on water quality and fishery resources
- condition of non-fish species, especially indicator species (those most susceptible to changes in water quality)
- contamination of fish or shellfish or presence of conditions which could lead to contamination (e.g., red tide, oil spills)
- condition of coastal zone habitats (mangroves, sea grass beds, coral reefs)

Culture Fisheries

- water quality in fish ponds or water bodies containing traps, nets or attachment substrates for nonmotile organisms
- water quality of fish pond effluent
- water quality and quantity of fish pond receiving waters
- hydrologic effects of fish ponds
- effect of aquaculture on local capture fisheries (population size and structure, health condition)
- presence of fish diseases or parasites
- contamination of fish or shellfish
- increase in water-borne or water-related disease vectors or human disease attributable to fish pond establishment

Fish processing

- water quality of influent to and effluent from fish processing plants
- changes in commercial and non-commercial (especially indicator) species down-stream of processing plants

Monitoring for Planning for Floodplain Management

Factors which influence the quantity of water entering and being withdrawn from the river, the land's capacity to absorb floodwater, and the potential damage from floods must be monitored in order to carry out proper planning for floodplain management. Direct and indirect impacts of flood control works should also be closely followed. Data to be collected in routine monitoring should include:

- quantity, intensity, timing and geographical distribution of rainfall

- storm patterns
- soil moisture conditions at various times of the year
- stream discharge (including records of annual peak discharge)
- storage, diversion and regulation of stream flows
- changes in drainage and other factors that affect stormwater runoff
- sediment content of the river water
- sedimentation problems in downstream areas
- changes in the river course and riverbed
- demographic changes in the floodplain and watershed areas
- rural and urban land uses (controlled and uncontrolled land use change on the floodplain and watersheds of the river)
- socioeconomic impacts resulting from the project (including changes to pre-project agricultural, pastoral, fishing practices)
- effects of flood control measures on riverine, estuaries or near-shore marine fisheries
- effects of flood control measures on floodplain vegetation
- effects of flood control measures on wildlands, wildlife habitats and wildlife populations

Monitoring Forestry Projects

Monitoring in forestry projects is extremely important to determine that management plans are being followed and that the forest stand treatments are achieving the desired results.

The following factors should be monitored for logging:

- loggers, harvesters and road builders adhere to conditions set forth in their contracts designed to minimize environmental impacts
- harvesting and transportation do not create unanticipated environmental problems (monitoring of soil erosion, soil fertility, stream water quality, groundwater level, vegetation and wildlife changes)
- changes in species and site conditions are identified and stand treatment prescriptions are altered as appropriate
- only designated areas are accessed and only the specified species and volumes are harvested
- natural regeneration after harvesting occurs as predicted (rate of cover restoration, rate of regeneration of various species)
- objectives of the overall development project are being met and infrastructure to regulate and manage the project is adequate
- no unpredicted socioeconomic impacts occur and if so adequate steps are taken to mitigate them, and that a mechanism exists for community organizations to monitor and evaluate the project and voice their concerns on a regular basis
- financial distributions are legal and according to contracts and these are adjusted in the event that social services are over-burdened or costs exceed predicted values

The following factors should be monitored under reforestation and plantation:

- environmental impacts of site preparation and replanting quality of planting stock
- growth rates of the plantation
- weed problems
- presence of pests and disease
- management treatments: if being done properly and according to schedule
- protection of the stands
- market trends
- distribution of revenues and benefits from the plantations
- changes in costs and benefits as conditions change
- recalculation of costs and benefits as conditions change
- pressure on agriculture, land tenure, natural forests
- environmental impacts of harvesting
- long-term viability of the plantation from ecological, economic and managerial standpoints

Monitoring Irrigation Projects

Factors to be monitored for an irrigation system should include:

- climate (wind, temperature, rainfall, etc.)
- stream discharge above the irrigation project and below at various points
- nutrient content of discharge water
- flow and water levels at critical points in the irrigation system
- water table elevations in project area and downstream
- water quality of project inflows and return flows
- quality of groundwater in project area
- water salinity levels in coastal wells
- physical and chemical properties of soil in irrigation area
- agricultural acreage in production
- cropping intensity
- crop yield per unit of land and water
- erosion/sedimentation rates in project area
- relation between water demand and supply of users (equitability of distribution)
- condition of distribution and drainage canals (siltation, presence of weeds, condition of linings)
- upstream watershed management (agricultural extent and practices, industrial activity)
- incidence of disease and presence of disease vectors
- health condition of project populations
- changes in natural vegetation in the project area and on the floodplain downstream
- changes in wildlife populations in the project area and on the floodplain downstream
- fish population and species

Monitoring Livestock Projects

Factors to be monitored in a livestock project should include:

- range condition (assessment of present state of health of the range in relation to its potential)
- range trend (direction of change of range condition)
- availability of and access to natural fodder and forage, cultivated fodder, and imported feedstuffs (in stallfed animals)
- numbers and types of animals
- seasonal distribution and movement of animals
- condition of the livestock (weight, presence of disease, other health indices)
- condition of the soil (i.e., signs of increased erosion, compaction, decreased fertility, etc.)
- water points (location, condition, and intensity of use, and condition of vegetation around the water points)
- market conditions (changes in price, development of alternative markets, etc.)
- changes in economic indices of livestock producers (e.g., income levels and health)
- changes in social organization
- external land use changes and demographic changes which have impacts on the range resource and livestock producers
- changes in wildlife populations and habitat due to livestock production

Monitoring Road Construction

Monitoring of the impacts of road construction will consist of looking at the following:

- the "performance" of the installation after construction
- erosion during and after construction
- the installation of erosion control and drainage works to ensure that it is adequately done
- verification that proper waste disposal at the construction is carried out (cut and fill material, used oil, human waste, trash, debris, etc.).

Monitoring Tourism Development[1]

Monitoring plans should include baseline data and periodic review of objectives to determine if plans are being realized. Typical profiles can be developed for protected and ecologically sensitive areas such as beaches, wetlands, reefs; water quality and sediment loading in all water bodies; erosion and sedimentation impacts associated with infrastructure development such as roads, ports, harbors, marinas, hotels, shopping centers and the like; impacts associated with recreational

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World Bank Environmental Assessment Sourcebook: Volume II - Sectoral Guidelines. 1991 , p..227, para. 21.

activities such as reef diving, spear fishing, use of all-terrain vehicles, and access to areas previously denied; degree of staging/phasing of development and any observed impacts; demands on transportation and other infrastructure such as water supply, wastewater treatment and solid waste disposal capacity, and the observed system responses; effects on local and regional society and economy.

Annex 2

Mitigation Strategy by Activity Phase

Phase Mitigation Strategy	*Planning/Design*	*Construction*	*Operation*	*Decommissioning*
Avoid Impact				
Minimize or Diminish Effect				
Rectify by Repair or Rehabilitation				
Reduce or Eliminate over Time				
Provide Compensation				
Other				

14. Field Trip Presentation and Working Group Preparations

Description/Objectives

The field trip will provide you with hands-on experience with preliminary environmental assessment skills. The purpose of the field trip presentation is:

- to provide you with some background on the field sites and proposed activities that will be reviewed;
- to explain how the field trip will be organized, and
- to brief you on what you should seek to accomplish. The day following the field trip, you will prepare draft Environmental Reviews in working groups and present these in a general session. After discussion and review, you will then have the opportunity to suggest alternatives for mitigation, monitoring and evaluation.

Working Group Preparations: Subsequent to the field trip presentations, you will break into working groups. Instructions for this preparatory working group are provided separately in the attached instructions.

Background Documents for Field Trip

Available background documents for the overall project and proposed activities at the field trip site

Sectoral Sections from *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities,* USAID, AFR/SD/PSGE, 1996.

Checklists provided in earlier module (10).

Instructions to Working Groups for Field Trip/Case Studies

The final products of the working groups will be draft "preliminary" findings and IEEs or environmental reviews for presentation in general session.

Preparatory Working Group Session (Day Prior to Field Trip)

- Review all documents in the field trip instruction package;
- Brainstorm on the most important issues to review during the field trip. Use a flip chart to list likely "hot topics".
- Decide on the assessment tools to use during the field trip. Review available checklists, lists of indicators, matrices, and other aids to determine which are most useful and appropriate for the field site under consideration. Develop, as a group, a matrix of issues and activities tailored to the field site, to ensure all important issues are covered.
- List resource persons and institutions that would ideally be contacted based on their technical and scientific capabilities, and experience. Be inclusive at this stage. You will obviously only have the opportunity to meet with those individuals at the course or field site, but a fuller list will help in brainstorming, and the list of contacts to made will be included in the final presentation.
- Develop an outline for the draft Environmental Review.
- Divide up responsibilities among members of the group in terms of who will be responsible for investigating which issues, contacting which individuals, presenting findings, etc. Appoint a team leader responsible for overall coordination.
- Seek out resource persons, facilitators, and other participants who have expertise in areas relevant to the field site for ideas on what to look for at the field site or suggestions on other sources of expertise.

Field Trip Reminders

Bring:

- Checklists
- Maps
- Environmental Screening Form
- *Environmental Guidelines for Small-Scale Activities in Africa*
- Site Descriptions from the Sourcebook

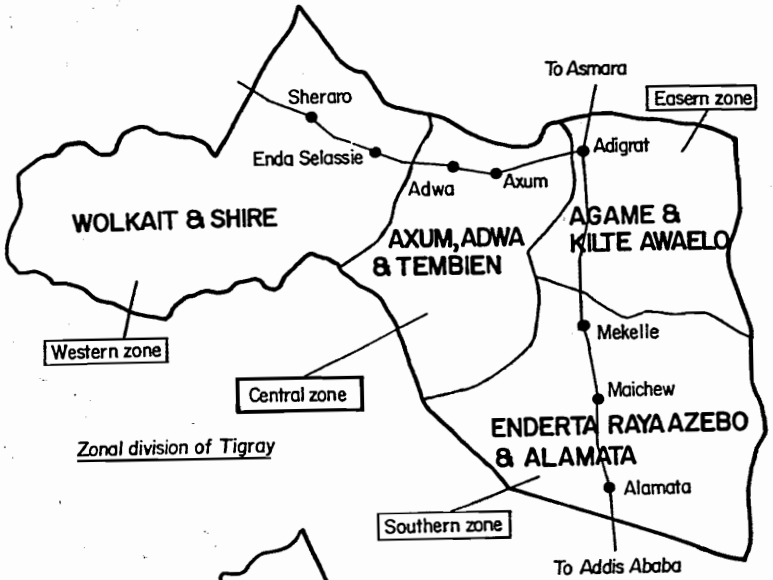
Use Your Eyes and Ears at Site to Acquire Data for:

- The Environmental Screening Form
- Environmental Review
- Development of Mitigation and Monitoring Plans

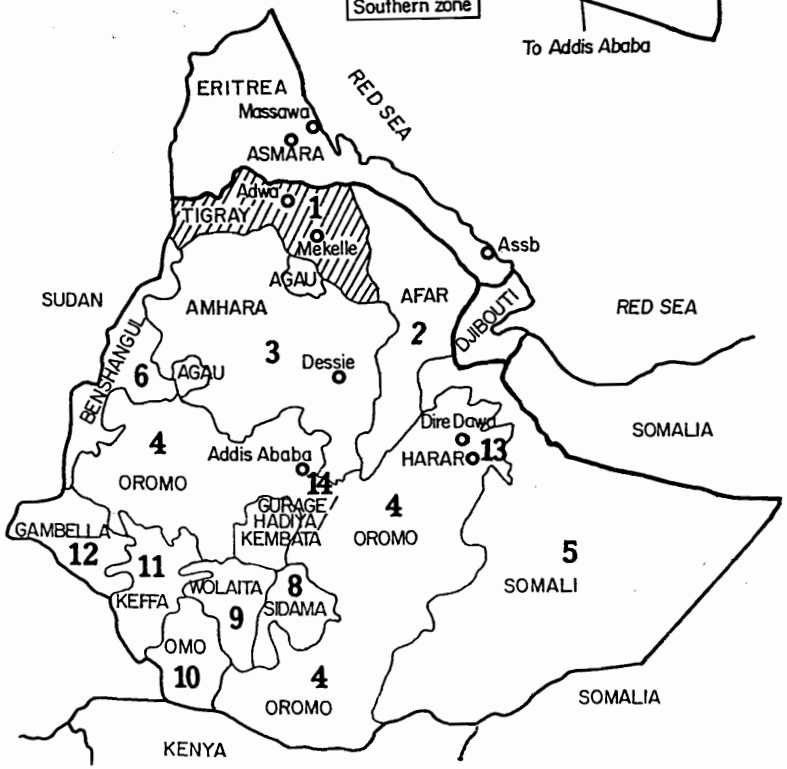
Site visit duties:

- Make sure you have read Module 14: Field Trip Presentation and Working Group Preparations
- Select a Team Leader/Chairperson
- Select Rapporteur (Rapporteur read Module 1)
- Assign experts as desired (i.e., continue with activities and roles as defined during the preparatory woring groups described on the previous page)
- Distribute Lists and Duties
- See out opinions and concerns from as many individuals at the field site as possible
- Solicit ideas for environmental mitigation efforts from local residents

Map of Ethiopia with focus on Tigray



Zonal division of Tigray



Ethiopian regions

FARMING SYSTEMS, RESOURCE MANAGEMENT AND HOUSEHOLD COPING STRATEGIES IN NORTHERN ETHIOPIA

Report of a Social and Agro-Ecological Baseline Study in Central Tigray

1995

Prepared by the Relief Society of Tigray (REST) in collaboration with NORAGRIC at the Agricultural University of Norway

4.1 Climate

The climate of Tigray is highly unpredictable characterised especially with unreliable rainfall. Severe droughts causing famine have affected the region approximately every tenth year through this century.[7]

With regard to measuring rainfall there is unfortunately no detailed time series data that allow us to chart changes in rainfall pattern over time. However, some information on average annual rainfall in Tigray is available from the National Meteorology Authority for the years 1961 - 1987. These data indicate that the region's average rainfall is 578 mm as compared to the national average of 921 mm. This means that in most years Tigray received 37% less precipitation than the national average. Moreover, the variability of rainfall from year to year was very high.

Table 1. National and regional rainfall averages and variabilities for the period 1961-1987

	Mean annual rainfall	% of Eth. average	Standard deviation	Coeff. of variation	1984 rain
Tigray	578	63	162	28	44%
Ethiopia	921	100	71	8	78%

Note: The 1984 annual average is presented as a percentage of the 27-year average.

Source: National Meteorological Authority (re. in IFPRI 1992).

4.2 Land resources

Detailed information on land form, land-use mapping, and soil series classification is best obtained through aerial photograph interpretation, supported with professional field surveys. This study provides only general and physically observable topographical features of the programme area (for details, see Chapter 6: *Agriculture*).

[7]Rural elders express surprise at the current climatic situation. During informal discussion, most elder inhabitants of the survey sites noted that, in the past, the climate of central Tigray was characterised by a rainy season of at least three months length, followed by nine months during which little rain falls. But, these elders note, nowadays the duration and intensity of rains has declined, and in most years, a rainy season of 40 to 50 days only is observed. Hence, many areas that were green 20 years ago are now bare.

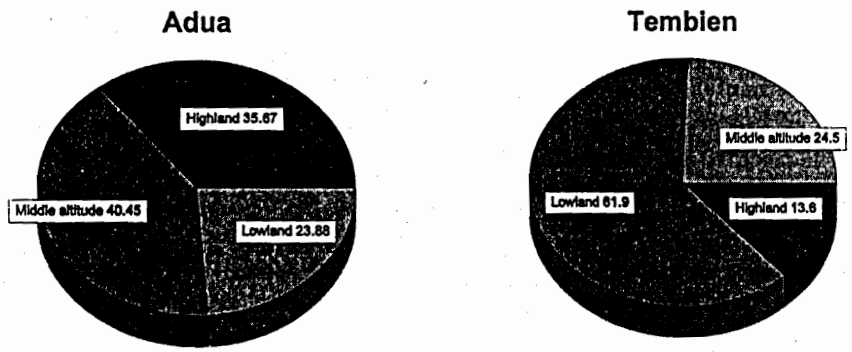


Figure 1. Distribution of sample households by altitude zones

4.3 Vegetation

When we in Tigray talk about "forests", we mean localised patches of woodland around churches and in remote places. This is because the natural forest area has been largely destroyed, mainly through encroachment of subsistence cultivation. Only the Abergelle, Adi Ahferom, Endabatsahma and Keyih Tekli *weredas* have some remains of natural forest. Natural forest cover of Adi Ahferom and Endabatsahma is 0.15%, and 1.15%, respectively. Deforestation is greater in Degua Tembien, Hahaile and Embaseneyti. In Degua Tembien and Hahaile, it is due to the shortage of fuelwood. Cutting of trees to expand agricultural area is a factor in the deforestation in Embaseneyti. The vegetation of Abergelle is decreasing rapidly, due to cutting trees for house construction and agricultural implements.

In order to preserve and regenerate natural forest, area closure is being practiced, and promising results. In the surveyed *weredas*, a total of 14,709.55 ha. of land is kept under area closure. Of the different tree species, eucalyptus is widespread, since it is fast maturing and has a relatively high cash value. Farmers grow eucalyptus near their homestends and in their fields. *Acacia etbaica* (*Seraw*), *Acacia amythethophylla/seyal* (*Chea*) and *Euclea schimperi* (*Kliaw*) are also seen, as they are drought-resistant trees. On the other hand, *Olea Africana* (*Awlie*), *Juniperus procera* (*Tsihdi*) and *Ficus vasta* (*Daero*) are becoming extinct.

Table 2. Tree species commonly used as a source of fuelwood

Wereda	Tree species
Adua district	
Adi Ahferom	*Eucalyptus* spp, *Euclea schimperi*
Embaseneyti	*Acacia etbacia, Olea africana, Rhus glutinosa*
Endabatsahma	*Acacia etbacia, Dodonaea angustifolia,* Ankeba[x], *Euclea schimperi*
Hahaile	*Rhus glutinosa, Acacia etbacia, Carisa edulis, Euclea schimperi*
Tembien district	
Abergelle	*Acacia etbacia, Acacia amythethophyla/seyal,* Tsalwa[x]
Degua Tembien	*Eucalyptus, Acacia etbacia, Acacia amythethophyla/seyal, Olea africana, Rhus retinorrhoea/natalensis*
Keyih Tekli	*Acacia etbacia, Dodonaea angustifolia, Acacia amythethophyla/seyal, Albizia malacophylla*

Note: The superscript x is used to signify the vernacular names as the scientific names have not been obtainable.

Table 3. Tree species commonly used for construction

Wereda	Tree species
Adua district	
Adi Ahferom	*Eucalyptus, Olea africana, Cordia africana*
Embaseneyti	*Eucalyptus, Croton macrostachys, Ziziphus spina-christi, Olea africana, Ficus sycomorus/vasta*
Endabatsahma	*Cordia africana, Eucalyptus, Acacia etbacia, Ziziphus spina-christi,* Weyba[x], *Olia africana, Croton macrostachys, Acacia albida*
Hahaile	*Eucalyptus, Olea africana, Cordia africana, Acacia albida, Croton macrostachys, Rhus glutinosa*
Tembien district	
Abergelle	Sibkana[x], Weyba[x], *Commiphora africana*
DeguaTembien	*Eucalyptus, Ficus sycomorus/vasta, Sagla[x], Cordia africana, Euphorbia abyssinica*
Keyih Tekli	*Eucalyptus*, Sagla[x], *Olea africana, Cordia africana*

* Vernacular name; scientific name not available at present.

Table 4. Tree species commonly used for making farm implements

Wereda	Tree species
Adua district	
Adi Ahferom	*Eucalyptus, Olea africana, Croton macrostachys, Acacia lahay*
Embaseneyti	*Eucalyptus, Ziziphus spina-christi, Olea africana*
Endabatsahma	*Cordia africana, Acacia etbacia, Ziziphus spina-christi,* Weyba[x], *Acacia amythethophyla/seyal, Dodonaea angustifolia, Euclea schimperi*
Hahaile	*Eucalyptus, Olea africana, Cordia africana, Croton macrostachys, Rhus glutinosa, Acacia amythethophyla/seyal*
Tembien district	
Abergelle	Shisha[x], Sibkana[x], Weyba[x], Tsalwa[x]
Degua Tembien	*Eucalyptus, Olea africana*
Keyih Tekli	*Acacia albida, Olea africana, Cordia africana, Ziziphus spina-christi*

* Vernacular name; scientific name not available at present.

Table 5. Tree species commonly used as fodder

Wereda	Tree species
Aduadistrict	
Adi Ahferom	Shibaka*, *Cordia africana, Dodonaea angustifolia*
Embaseneyti	*Ficus sycomorus/vasta, Aloe* spp., *Ficus palmata/capraefolia*
Endabatsahma	*Ziziphus spina-christi, Cordia africana, Acacia amythethophyla/seyal, Acacia albida,* Sagla*
Hahaile	Lusinya, Susbaniya, *Cordia africana*, Shibaka*, *Acacia amythethophyla/seyal*
Tembien district	
Abergelle	Malkuza, *Acacia amythethophyla/seyal, Acacia etbacia, Ziziphus spina-christi*
Degua Tembien	*Olea africana, Acacia etbacia, Dodonaea angustifolia*
Keyih Tekli	*Albizia malacophylla, Acacia albida*

* Vernacular name. Scientific name not available at present.

Table 6. Tree species with edible fruits

Wereda	Tree species
Adua district	
Adi Ahferom	*Cordia africana,* Kumel*, *Carissa edulis*
Embaseneyti	*Ficus palmata/capraefolia, Cordia africana*
Endabatsahma	*Cordia africana, Ziziphus spina-christi, Carisa edulis,* Liham*, *Boswellia papyrifera*
Hahaile	*Ziziphus spina-christi, Cordia africana, Ficus palmata/capraefolia, Ficus sycomorus/vasta,* Sagla*
Tembien district	
Abergelle	*Ziziphus spina-christi, Mimusops laurifolia, Boswellia papyrifera*
Degua Tembien	*Cordia africana, Ziziphus spina-christi, Ficus sycomorus/vasta*
Keyih Tekli	*Cordia africana, Ziziphus spina-christi,* Liham*, Kumel*

* Vernacular name. Scientific name not available at present.

Table 7. Tree species which have other uses

Wereda	Tree species	Purpose
Adua district		
Adi Ahferom	*Cordia africana*, Kumel*, *Carissa edulis*	
Embaseneyti	*Euphorbia abyssinica, Ficus sycomorus F.vasta*	For fencing
Endabatsahma	*Ziziphus spina-christi, Eucalyptus, Melia azedarch, Cordia africana*	Have medical value
Hahaile	*Eucalyptus, Croton macrostachys, Cordia africana, Ziziphus spina-christi, Carisa edulis*, Eka*	Have medical value, for fencing and for making rope
Tembien district		
Abergelle	*Boswellia papyrifera*	Medical value and for washing clothes
Degua Tembien	*Eucalyptus, Olea africana*	Local medical value
Keyih Tekli		

* Vernacular name. Scientific name not available at present.

4.4. Wildlife

Recurrent droughts and prolonged war activities are the main factors behind the disappearance of wildlife in the area. Moreover, as there were no effective wildlife protection measures, there was a great depletion of wildlife resources by local communities. However, as a result of area closure, an improvement in the variety and number of wildlife has been observed. The majority of large wild animals are found in the Tekeze border areas of Abergelle, in the Werie valley, and in the lowland areas of Embaseneyti.

4.5. Water resources

Scarcity of water is affecting millions of humans and animals. The problem is more acute than the loss of soil and natural vegetation. Almost all drought and famine events in Tigray are linked to inadequate rainfall. This report does not provide details of water resources, but instead notes topics of study that should

be followed during specialist survey work. In particular, emphasis should be given to critically analyse the status of ground water resources, including depth, seasonal variations, recharge rates, and quality.

Large rivers like the Giba, Werie, Mereb and Tekeze are the major perennial rivers that pass through central Tigray. However, these rivers are presently not utilised for agriculture. At the same time, it is difficult to conceive sustainable development in agriculture that depends on rainfall alone. Hence, an intensive assessment of potentially irrigable land is crucial.

4.6. Soil erosion

The aridification process, combined with a relatively large and steadily increasing population performing rather intensive agricultural activities in a steep and hilly environment, has led to severe soil erosion in the survey area. Survey results show that 65.2% of the total area surveyed is used for agriculture. With population increasing at 2.9% per annum (CSO report of the 1984 census), and with no other viable alternative for livelihood than agriculture, rural people have few options except over-exploitation of land, implying that the land degradation process will be difficult to reverse.

Table 8. Cultivable land (in ha) exposed to severe erosion

Wereda	Total area (ha)	Size of arable land	Arable land exposed to severe erosion	Per cent of exposed land
Adua district				
Adi Ahferom	4349.10	2470.80	1000.90	40.5
Embaseneyti	9315.75	6134.80	2888.25	47.1
Endabatsahma	16623.60	7023.70	3526.60	50.2
Hahaile	6784.40	4312.00	2940.00	68.2
Tembien district				
Abergelle	n.a.	n.a.	n.a.	n.a.
Degua Tembien	17843.20	9945.60	6088.70	61.2
Keyih Tekli	16570.50	10497.50	2468.25	23.5
Average	**11916.10**	**6730.70**	**3152.10**	**48.5**

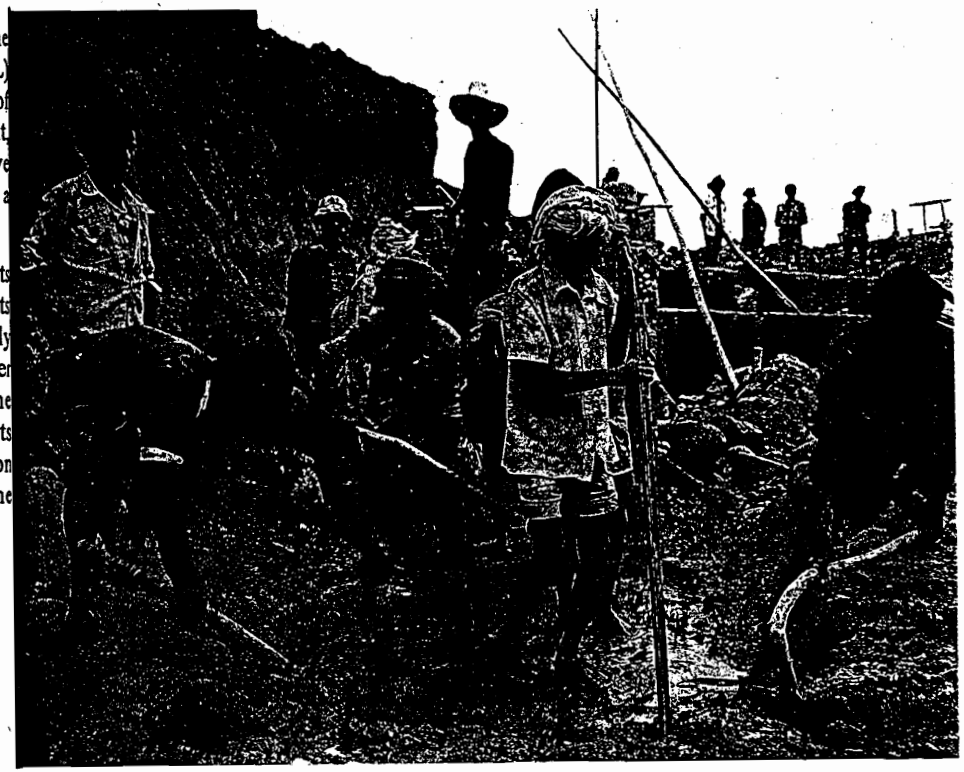
n.a. = data not available.

From the above data it can be estimated that approximately half of the cultivable land is exposed to severe erosion. Moreover, previously cultivable lands have been, or are being, turned into waste lands due to the formation of wide and close-spaced gullies, and loss of top soil. Large deposits of stones in many places may be a good indicator of the degree of severity in erosion. Furthermore, denuding of browse and other vegetation on non-arable land is causing erosion problems on arable land.

There are no recent studies that examine the erosion level in the programme area. However, according to the Hunting Technical Services Limited (HTSL) study carried out twenty years ago, the amount of soil eroded from a hectare of land in a year in Tigray was estimated to be 17 tonnes (HTSL 1976). At present, given increased exposure of the area to high population pressure and intensive agricultural practices, unmatched by environmental protection programmes, a higher erosion rate is expected.

Today, farmers of the programme area are conscious of erosion, including its long and short-term impact, and they are also aware of means of decreasing its severity. They repeatedly note, for example, that the erosion rate has greatly accelerated over the last two decades. Current measures of soil and water conservation are encouraging, and tangible results are being seen. At the same time, the rate of erosion still outstrips protective measures. Hence, further efforts are needed to narrow the gap, especially considering that agricultural production and the effect of erosion on productivity is a central issue in the lives of some 90% of the people of the region.

CHAPTER 5: HUMAN RESOURCES



Men at road work
Photograph: Håkon Ødegård, NORAD

5.1 Population and labour force

One of the crucial variables in designing development programmes is the population and its distribution. As noted earlier, reliable population figures for Tigray are lacking. The Relief Society of Tigray (REST) claims a population of 4.8 million. This was based on a 1988 report which compiled population sizes of *tabias* as reported by *tabia baitos*. An extrapolation was then made taking into account a 2.9% national growth rate. Some adjustments were also made to accommodate new, post-war regional boundaries. The Central Statistical Office (CSO), on the other hand, claims a population for Tigray of three million, based on the 1984 national population census and extrapolating to the present (CSO 1986). Recent reports from the Regional Government estimate a population of 3.4 – 4 million.

With regard to this survey, we do not intend to make any estimate of the population of Tigray based on our findings for a specific part of the region. The National Population Census, which was launched in October/December of 1994, will serve as the reliable source regarding the population of the region. It has, however, been possible to do some calculations on population density using the survey findings for each *wereda*.

Table 9. Population size and population density per hectare of cultivable area

Wereda	No. of *tabias*	No. of *kushets*	Population	Total cult. area (ha.)	Persons per cult. ha.
Adua district					
Adi Ahferom	10	34	22067	2470.8	8.90
Embaseneyti	17	44	44277	6134.8	7.22
Endabatsahma	17	54	50337	7023.7	7.17
Hahaile	14	76	37083	4312.0	8.60
Tembien district					
Abergelle	14	58	42393	17759.3	2.39
Degua Tembien	15	57	61824	9945.6	6.22
Keyih Tekli	17	58	54366	10497.5	5.18
***Wereda* average**	15	54	44621	8306.2	5.37

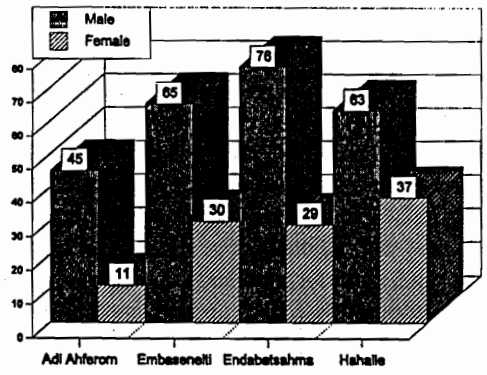


Figure 2a. Distribution of household heads by sex in the sample *weredas* of Adua

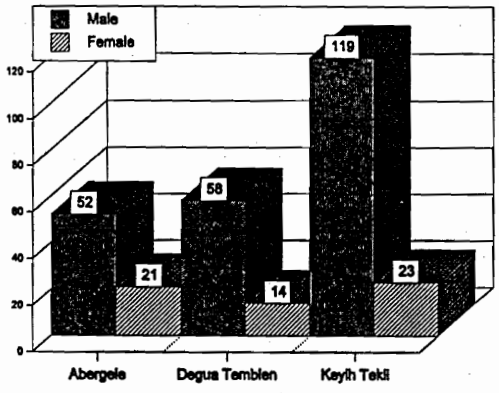


Figure 2b. Distribution of household heads by sex in the sample *weredas* of Tembien

Table 10. Number of households and household sizes at *tabia* and *wereda* levels

Wereda	Households per *tabia*	Households per *wereda*	Persons per household
Adua district			
Adi Ahferom	426	4260	5.18
Embaseneyti	523	8891	4.98
Endabatsahma	626	10642	4.73
Hahaile	616	8624	4.30
Adua average	**547.75**	**8104.25**	**4.80**
Tembien district			
Abergelle	682	9548	4.44
Degua Tembien	896	13440	4.60
Keyih Tekli	650	11050	4.92
Tembien average	**742.67**	**11346**	**4.65**
***Wereda* average**	**631.2**	**9493.6**	**4.73**

Table 11. Distribution of household heads by sex and marital status of household members

Wereda	Sex of family head		Marital status					Absent household members %
	Male	Female	Single[8]	Married	Divorced	Widowed	Children	
Adua district								
Adi Ahferom	80.36	19.64	10.7	33.7	2.4	3.1	50.00	0.3
Embaseneyti	68.42	31.58	15.3	30.2	1.9	5.5	47.00	4.0
Endabatsahma	72.38	27.62	7.7	33.9	3.6	4.2	50.6	4.6
Hahaile	63.00	37.00	13.3	32.8	2.8	7.2	44.0	2.8
Adua average	**71.04**	**28.96**	**11.75**	**32.66**	**2.68**	**5.00**	**47.91**	**2.93**
Tembien dist.								
Abergelle	71.23	28.77	10.5	40.9	2.5	5.0	41.2	0.3
Degua Tembien	80.56	19.44	5.5	37.0	3.0	3.3	51.2	5.5
Keyih Tekli	83.80	16.20	7.3	35.3	2.1	4.3	50.9	0.4
Tembien average	**78.53**	21.47	7.77	37.73	2.53	4.20	47.77	1.00
Central Zone average	74.25	25.75	9.76	35.20	2.61	4.60	47.83	1.97

Survey results show that approximately 25% of households are headed by women. When asked why this is the case, most *baito* members suggested that many men were killed

[8] A single person is an unmarried man/woman beyond the recognised age of marriage.

Survey results show that approximately 25% of households are headed by women. When asked why this is the case, most *baito* members suggested that many men were killed during the civil war. However, the American anthropologist Bauer, after his 1969 fieldwork, notes the prevalence of women-headed households in his village of study to be 20% (Bauer 1973). Hence, we can guess that women-headed households are a feature of Tigray social organisaion, although losses during the war may have exacerbated this phenomenon.

The great majority of households are engaged in farming. Only 1.1% of surveyed households were engaged in non-agricultural activities. On the basis of survey results it can be estimated that there are on average 176 households per *kushet*.

At present, there are a number of landless adults who have reached the legal age for allocation of land, but who have not yet received their share due to the fact that they reached adulthood after the last land re-distribution. In addition, there are also landless households comprising households headed by ex-soldiers; returnees from settlement areas of the ex-regime and repatriates mainly from Sudan and Eritrea. These groups of households depend primarily on relief food assistance, and selling their labour. Some own oxen and are hence able to hire land from other households to farm. Petty trading of consumer goods is also a means for survival for such households.

To have a closer view of the human component Tables 12–14 provide detailed information on the age and sex distribution among the members of the surveyed households.

As can be seen from the table, approximately half of the population is less than 15 years of age, and only 13 per cent is 50 years or older. We must, however, be aware of the fact that rural people, especially the elders, have a very inaccurate appreciation of their particular age as it is rarely recorded, and as it bears little importance. For the youngsters, their age is much more precise as it is most often remembered when they were born, and as most of them today attend schools. Even when taking the statistical uncertainties into concern, we believe that the findings in this table do present a rather correct picture of the actual situation.

Table 12. Sex distribution of household members surveyed

Wereda	Sex		Percentage		Sex ratio (MF) x 100
	Male	Female	Male	Female	
Adua district					
Adi Ahferom	143	147	49.3	50.7	97
Embaseneyti	230	242	48.7	51.3	95
Endabatsahma	242	254	48.8	51.2	95
Hahaile	196	234	45.6	54.4	84
Adua average			**48.00**	**52.00**	**92**
Tembien district					
Abergelle	169	154	52.3	47.7	110
Degua Tembien	165	165	50	50	100
Keyih Tekli	358	341	51.20	48.8	105
Tembien average			**51.18**	**48.82**	**105**
Central Zone average	**1503**	**1537**	**49.44**	**50.56**	**98**

The proportion of males to females of the surveyed area is estimated to be close to 49:50, and the sex ratio (total male/total female) x 100 is found to be 98.
Note: Sex ratio: The number of males to 100 females

Table 13. Age distribution of members of surveyed households

Age group	*Wereda*								%
	Adi Ahferom	Embaseneyti	Endabat-sahma	Hahaile	Abergelle	Degua Tembien	Keyih Tekli		
0 -4	51	69	82	69	51	58	119		16.41
5 -9	52	72	74	63	37	56	107		15.16
10 - 14	36	66	64	55	45	37	104		13.39
15- 19	32	69	62	52	45	36	82		12.43
20 - 24	18	34	45	41	34	20	47		7.86
25 - 29	16	23	29	28	21	15	37		5.56
30 - 34	9	14	22	14	14	19	29		3.98
35 - 39	11	22	15	18	17	22	29		4.41
40 - 44	13	16	12	13	10	10	33		3.52
45 - 49	13	18	22	19	12	15	33		4.34
50 - 54	8	15	18	15	12	8	27		3.39
55 - 59	11	26	17	8	10	11	17		3.29
60 - 64	7	10	16	15	7	9	16		2.63
65 & above	13	18	18	20	8	14	19		3.62
Total	**290**	**472**	**496**	**430**	**323**	**330**	**699**		**100**

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	Male	Female	Male	Female	
Adua district					
Adi Ahferom	143	147	49.3	50.7	97
Embaseneyti	230	242	48.7	51.3	95
Endabatsahma	242	254	48.8	51.2	95
Hahaile	196	234	45.6	54.4	84
Adua average			**48.00**	**52.00**	**92**
Tembien district					
Abergelle	169	154	52.3	47.7	110
Degua Tembien	165	165	50	50	100
Keyih Tekli	358	341	51.20	48.8	105
Tembien average			**51.18**	**48.82**	**105**
Central Zone average	**1503**	**1537**	**49.44**	**50.56**	**98**

The proportion of males to females of the surveyed area is estimated to be close to 49:50, and the sex ratio (total male/total female) x 100 is found to be 98.
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Age group	*Wereda*							%
	Adi Ahferom	Embaseneyti	Endabat-sahma	Hahaile	Abergelle	Degua Tembien	Keyih Tekli	
0 -4	51	69	82	69	51	58	119	16.41
5 -9	52	72	74	63	37	56	107	15.16
10 - 14	36	66	64	55	45	37	104	13.39
15- 19	32	69	62	52	45	36	82	12.43
20 - 24	18	34	45	41	34	20	47	7.86
25 - 29	16	23	29	28	21	15	37	5.56
30 - 34	9	14	22	14	14	19	29	3.98
35 - 39	11	22	15	18	17	22	29	4.41
40 - 44	13	16	12	13	10	10	33	3.52
45 - 49	13	18	22	19	12	15	33	4.34
50 - 54	8	15	18	15	12	8	27	3.39
55 - 59	11	26	17	8	10	11	17	3.29
60 - 64	7	10	16	15	7	9	16	2.63
65 & above	13	18	18	20	8	14	19	3.62
Total	**290**	**472**	**496**	**430**	**323**	**330**	**699**	**100**

Table 14. Percentage age-sex distribution of sample households from seven *weredas* of central Tigray (M=MALE, F=FE

	AGE (YEARS) 0-4	5-9	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65+	TOTAL	TO
ADI AHFEROM																
M	26	25	21	11	10	7	2	2	7	11	3	7	3	7	142	
F	25	27	15	21	8	9	7	9	6	2	5	4	4	6	148	2
M (%)	8.97	8.62	7.24	3.79	3.45	2.41	0.69	0.69	2.41	3.79	1.03	2.41	1.03	2.41	48.97	
F (%)	8.62	9.31	5.17	7.24	2.76	3.10	2.41	3.10	2.07	0.69	1.72	1.38	1.38	2.07	51.03	1
EMBASENEYTI																
M	33	41	29	34	19	10	4	3	7	14	9	12	3	12	230	
F	36	31	37	35	15	13	10	19	9	4	6	14	7	6	242	4
M (%)	6.99	8.69	6.14	7.20	4.03	2.12	0.85	0.64	1.48	2.97	1.91	2.54	0.64	2.54	48.73	
F (%)	7.63	6.57	7.84	7.42	3.18	2.75	2.12	4.03	1.91	0.85	1.27	2.97	1.48	1.27	51.27	1
ENDABATSAHMA																
M	39	39	39	27	20	17	9	2	6	12	8	9	5	10	242	
F	43	35	25	35	25	12	13	13	6	10	10	8	11	8	254	4
M (%)	7.86	7.86	7.86	5.44	4.03	3.43	1.81	0.40	1.21	2.42	1.61	1.81	1.01	2.02	48.79	
F (%)	8.67	7.06	5.04	7.06	5.04	2.42	2.62	2.62	1.21	2.02	2.02	1.61	2.22	1.61	51.21	1
HAHAILE																
M	30	32	22	30	16	14	5	4	6	8	12	4	2	11	196	
F	39	31	33	22	25	14	9	14	7	11	3	4	13	9	234	4
M (%)	6.69	7.44	5.12	6.98	3.72	3.26	1.16	0.93	1.40	1.86	2.79	0.93	0.47	2.56	45.58	
F (%)	9.07	7.21	7.67	5.12	5.81	3.26	2.09	3.26	1.63	2.56	0.70	0.93	3.02	2.09	54.42	1
ABERGELLE																
M	25	23	25	21	15	13	8	6	7	7	6	5	3	5	169	
F	26	14	20	24	19	8	6	11	3	5	6	5	4	3	154	3
M (%)	7.74	7.12	7.74	6.50	4.64	4.02	2.48	1.86	2.17	2.17	1.86	1.55	0.93	47.68	52.32	
F (%)	8.05	4.33	6.19	7.43	5.88	2.48	1.86	3.41	0.93	1.55	1.86	1.55	1.24	0.93	47.68	1
DEGUA TEMBIEN																
M	35	23	20	17	11	7	4	11	4	8	6	8	4	7	165	
F	23	33	17	19	9	8	15	11	6	7	2	3	5	7	165	3
M (%)	10.61	6.97	6.06	5.15	3.33	2.12	1.21	3.33	1.21	2.42	1.82	2.42	1.21	2.12	50.00	
F (%)	6.97	10.00	5.15	5.76	2.73	2.42	4.55	3.33	1.82	2.12	0.61	0.91	1.52	2.12	50.00	1
KEYIH TEKLI																
M	60	60	55	38	22	20	11	8	12	23	15	11	9	13	357	
F	59	47	49	44	25	17	18	21	21	10	12	6	7	6	342	6
M (%)	8.58	8.58	7.87	5.44	3.15	2.86	1.57	1.14	1.72	3.29	2.15	1.57	1.29	1.86	51.07	
F (%)	8.44	6.72	7.01	6.29	3.58	2.43	2.58	3.00	3.00	1.43	1.72	0.86	1.00	0.86	48.93	1
TOTAL (%)																
M	8.25	7.90	6.86	5.79	3.76	2.89	1.40	1.28	1.66	2.70	1.88	1.89	0.94	2.15	49.35	
F	8.21	7.31	6.30	6.62	4.14	2.70	2.60	3.25	1.79	1.60	1.41	1.46	1.69	1.56	50.65	
M + F	16.45	15.21	13.16	12.40	7.90	5.58	4.00	4.53	3.45	4.30	3.29	3.35	2.63	3.72	100	1

Table 15. Special skills available among the inhabitants of the surveyed *weredas*

Wereda	Type of skill						Other
	Masonry[9]	Carpentery	Black smith	Weaving	Pottery	Basket prod.	
Adua district							
Adi Ahferom	989	-	76	-	-	609	609
Embaseneyti	1313	-	-	-	188	1126	375
Endabatsahma	1218	-	101	-	-	2131	304
Hahaile	690	-	-	-	259	259	345
Tembien district							
Abergelle	787	262	-	-	262	1312	262
Degua Tembien	937	-	-	187	560	1105	1686
Keyih Tekli	1633	78	78	-	-	4667	389

5.2 Social organisations and institutions

5.2.1 Characteristics of the rural community

In rural Tigray, the *sidra bet* (literally, "people of the house") has essentially the same meaning as a "household". It is the most fundamental social unit of rural society.[10] In central Tigray, household size is usually grouped into three categories: big, medium and small. Big households have at least eight members, a medium household ranges between four and seven members, and a small household has three members or less.

[9]The reason for the high number of masons is that most houses in central Tigray are made of stones, implying that in any community you will find many men with house-building skills.

[10]In this survey a household is defined as a group of persons (in rare cases it may be one person) living together in one house or in some cases in nearby houses, having the closest social and economic links. Quite regularly they work, store, and consume their food/produce together. The household most commonly has a family unit as its nucleus.

The traditional rural household usually consisted of a compound containing a dwelling for sleeping, and a dwelling for cooking. Nowadays, most newly established households have only one dwelling which serves both functions. Four types of dwellings are typical of central Tigray:

Adarash, a house with walls constructed from stones, and a wooden roof covered with sand. Mainly owned by rich households, it is used mostly for receiving guests, sleeping, etc.

Hidmo, a house with walls constructed from stones and a roof made from wood covered with sand; it usually has a rectangular shape, although in some cases it may be circular. The same function as the former, but smaller. A house common to most families.

Sekella, the upper story of an *adarash*.

Guji, a house with the structure of a hut, i.e. it is round. Walls and roof are made mostly from wood. The roof is thatched. For poor people this is the common house used for living; for rich people this is an additional house.

Most houses are used both for living, sleeping and cooking.

These houses require much wood for pillars, ceilings, roofing and thatching. Thus, deforestation can in part be linked to the cutting of trees for house construction.

5.2.2 Wealth status in the rural community

In most parts of rural Tigray, the number of livestock, and especially cattle, is used as a major indicator of the household's wealth status. However, in *wereda* Adi Ahferom, ownership of the tree *Rhamus prinoides* (*gesho* in Tigrigna), used for brewing local beer, is commonly used as a measure of wealth. In the lowland areas, such as for instance *wereda* Abergelle, goats tend to be more important than other livestock as a measure of wealth.

Although there are other indicators of wealth besides livestock (for example, the amount of field crops, cash savings, capital assets such as gold), for the purpose of a baseline survey we have taken livestock as the appropriate point of departure to classify households into three categories: rich, middle and poor. Although wealth is a relative term which will vary both in time and space (from *wereda* to *wereda)*, such broad categories enable us to obtain a first general picture of households in the survey area. Table 16 provides details in this regard.

Table 16. Wealth classification by *wereda*

Wereda	Rich (minimum possession)	Poor (maximum possession)
Keyih Tekli	2 oxen, 3-4 cows and 20-30 sheep/goat	0 ox; other cattle adding at most up to the value of 1 ox
Degua Tembien	3 oxen, or at least the equal value of 3 oxen in other cattle	1 ox, and other cattle adding at most up to the value of 1ox
Abergelle	3 oxen, 100 goats, and 5 cows	5 goats, 1 ox (and the equal value of 1 ox in other cattle)
Hahaile	2 oxen, 2 cows and 20 goats	0 ox; the value of other cattle less than the value of 1 ox
Adi Ahferom	25 *gesho* trees	10 *gesho* trees
Embaseneyti	2 oxen, or at least the equal value of 2 oxen in other cattle	0 ox; the value of other cattle less than the value of 1 ox
Endabatsahma	2 oxen, or at least the equal value of 2 oxen in other cattle	0 ox; the value of other cattle less than the value of 1 ox

5.2.3 Community organisations

The rural community is internally divided into smaller units, beginning with the household, *sidra bet*. Above this unit, there are other social groups or associations that function to provide social and mutual assistance to the membership units. These include the *gorebet* or neighborhood; *mahber*, which is a religious association of neighbors, relatives, or friends who gather monthly to feast in honour of a particular saint; *lifinti*, which is the name given to a reciprocal exchange between two people. The exchange items may be either an oxen for ploughing or labour for farming. Other non-formal organisaions which are more common in the *wereda* towns are *ekub*, a local cash savings association, and *edir*, an association for assistance in the case of death of a household member.

In terms of formal social organisation, the *baito* is the most important structure. *Baitos* are organised at each administrative level, including *tabia*, *wereda* and region, with the regional *baito* functioning as the supreme council or legislature of Tigray. The *tabia baito* is the basic level of government, and is accountable to the people of the *tabia*. It is also responsible for organising people for community development programmes, and for reflecting the needs of the community during programme planning.

Other formal organisations of the rural community include: the Farmers' Association, Youth Association, the Democratic Association of Tigrayan Women, TPLF Fighters Family Association, and different cooperatives such as peasant service cooperatives and small-scale co-operatives. Associations for merchants, day-labourers, handicrafters, and teachers are also common in the *wereda* towns.

5.2.4 Activity calendar of the rural community

The survey recorded approximately 20 types of major domestic and agricultural activities conducted by the household; the majority of these are accomplished by women. They include:

Grinding, the hardest task for rural women. A considerable proportion of the rural women are estimated to grind by hand using a large stone, since motor-powered grinding mills are mainly located in *wereda* towns. To save time, women also grind at night or early morning.

Water-fetching, which is a woman's routine daily activity, especially for younger women who are mainly responsible for carrying out this task. However, in some households, young unmarried men also bring water. In most areas surveyed, water-fetching takes more than one-third of available time during a day.

Child care, which is considered essentially the same as food preparation. Young, unmarried women and mothers-in-law may also assist a housewife in feeding, bathing, carrying and other tasks.

Collection of firewood is the responsibility of both male and female children. Where there are no children, however, women of the household will typically be responsible for this task.

Food preparation, is culturally considered to be completely the responsibility of women, meaning that men do not assist in food preparation at all. The fact that women are responsible for food preparation also means that they have primary responsibility for managing and stretching grains and other food resources from harvest to harvest, a task of critical importance to the household.

Other routine domestic activities which consume women's remaining time each day include spinning cotton, basket-making, washing clothes and cleaning of the compound.

Agricultural activities are seen as mainly the responsibility of men. However, with the exception of ploughing, most agricultural work is undertaken by both

men and women, although variations are seen between *weredas* in the extent of women's participation, and even between households.

Ploughing (*mihras*) is carried out by men in almost every month of the year. With regard to ploughing, only one woman (head of a household) in the entire survey was found to plough by herself. Periods of ploughing vary mainly depending on the type of crop to be planted.

Collection of plant debris (*migulgual*) is mostly undertaken at the time of ploughing; typically, while men plough, women collect the plant debris. Sometimes, young men assist women in this.

Hoeing (*mikuskuas*) is mainly done on vegetables, and sometimes on maize. This is the duty of both women and men.

Weeding (*tsahyay*) is carried out by both men and women, as well as children. Aside from ploughing, it is one of the most labour-intensive of farming activities. Weeding is done in the months of June, July and August.

Harvesting/cutting (*atsid*) is performed by both men and women, and is also very labour- intensive. Often the entire household will be in the field for most of the day during harvesting, taking food with them, and returning after dark. The women then have to prepare an evening meal, with grinding to be done for next day's ration before daylight. Harvesting usually commences in September, but for some types of crops it may start in August. Harvesting ends in January.

Preparation of threshing ground (*awdee midilaw*). The digging of the ground is done by men, while the smearing with mud and smoothing is mostly done by women.

Threshing (*mizbat*) is performed when the days are sunny and rainless, so that crops would not get wet. It usually starts in October, but sometimes in September for some types of crops such as barley. It continues usually up to January (in rare cases up to March). Both women and men participate in threshing, although typically women will throw stalks onto the threshing floor and winnow, while men will drive oxen around the threshing circle.

The remaining agricultural activities are conducted by both men and women, with children especially responsible for livestock herding.

Although the domestic and agricultural work burden of rural people is very great, work is not done every day throughout the year. A rather substantial number of religious holidays are observed when work should not be indertaken (see Table 51).

CARE -

RESOURCE MANAGEMENT PROJECT

TRANSECTS

How to do a transect

1. Find local people who are knowledgeable and able and willing to walk and help.
2. Discuss with them aspects to be noted (soils, trees, crops, etc.) and approximate route (participatory mapping can help).
3. Assign tasks in the team.
4. Walk the transect, including diverse conditions
5. Observe, ask and listen (don't lecture).
6. Ask about and discuss problems and opportunities
7. Note contrasts and changes, and identify zones.
8. Make a transect diagram

Tips: Invent your own ways of doing it. Let people invent theirs.

Don't rush

Don't lecture

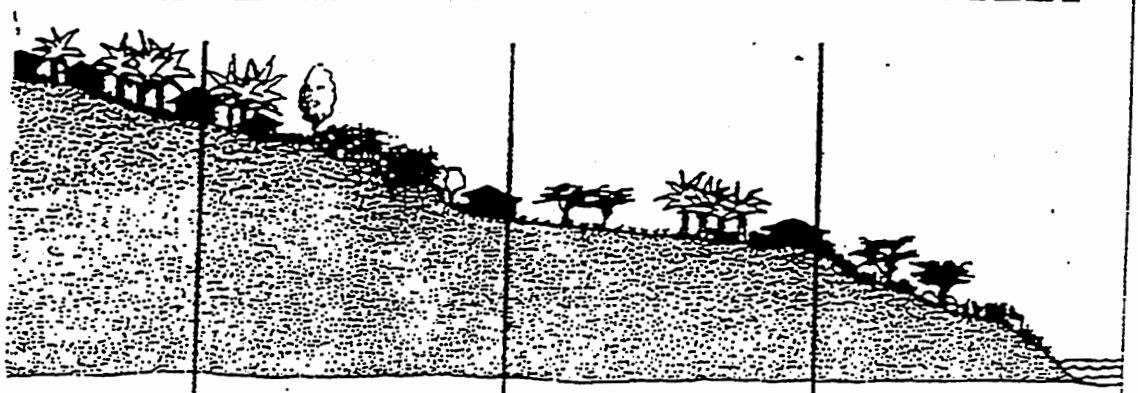
Do be inquisitive

Do show your interest

EXAMPLE

☐ FIGURE 3. Transect of Mbusyani

Figure 3. Transect Through Mbusyani



SOIL	LOOSE, DEEP RED SOIL	SANDY SOILS AND SMALL PATCHES OF RED SOILS	SHALLOW SANDY SOILS. ROCKY IN MOST PARTS.
WATER	ABOUT 3/4 OF HOUSEHOLDS HAVE SHALLOW WELLS. AREA ALSO HAS 3 DAMS & ONE SPRING.	A RIVER INFESTED WITH BILHARZIA, 2 POORLY MAINTAINED DAMS.	WATER IN KILINGONI RIVER SALTY. RIVER KATHANA HAS BILHARZIA. ROOF CATCHMENT IN PROGRESS.
VEGETATION	ALL NATURAL VEGETATION CLEARED TO GIVE WAY TO SETTLEMENT.	HIGH PROPORTION OF NATURAL VEGETATION, MAINLY ACACIA LANTANA, CANOLA GRASSES.	NATURAL VEGETATION CONSISTING OF ACACIA, SHRUBS AND GRASS.
SOCIAL-ECONOMIC INDICATORS	1/2 OF HOUSEHOLD HEADS IN WAGE EMPLOYMENT, MAJORITY HAVE MABATI ROOFS BRICK OR STONE WALLS.	1/2 OF HOUSEHOLD CORRUGATED IRON ROOFS. 1/2 GRASS THATCHED, BRICK WALLS.	MAINLY GRASS THATCHED HOUSES.
FOOD CROPS	MAIZE, BEANS, PIGEON PEAS, BANANAS.	MAIZE, BEANS, A LOT SORE PIGEON MILLETS, FRUITS, BANANAS.	MAIZE, BEANS, PEAS, BANANAS, FRUITS.
CASH CROPS	COFFEE	COFFEE	COFFEE
ACHIEVEMENTS (LAST 5 YEARS)	SOIL CONSERVATION, TREE PLANTING, WATER DEVELOPMENT - WELLS, ROOF CATCHMENT.	SOIL CONSERVATION, WATER DEVELOPMENT - DAMS	SOME SOIL AND WATER CONSERVATION
FORESTRY / AGROFORESTRY	WIDESPREAD AGROFORESTRY WITH GREVILLEA, EUCALYPTUS, MANGOES AND PAWPAWS.	MINIMAL TREE PLANTING, BUT MANGOES AND PAWPAWS PLANTED	VERY LITTLE TREE PLANTING
RESOURCES MANAGEMENT	A LOT TERRACING. EMBANKMENTS REINFORCED WITH MULTI-PURPOSE GRASSES	A LOT OF BENCH TERRACING	LIMITED SOIL CONSERVATION
PROBLEMS	INADEQUATE WATER, EDUCATION AND HEALTH FACILITIES, FAMINES AND LACK OF THE FACILITIES	WATER, FAMINE, INADEQUATE EDUCATION AND HEALTH FACILITIES	WATER, TRANSPORT AND FOOD
OPPORTUNITIES	REHABILITATION 3 DAMS, 1 SPRING, EXTERNAL ASSISTANCE - TOOLS, MARKET	WATER DEVELOPMENT - DAM, WELL, ROOF CATCHMENT. GOVERNMENT ASSISTANCE	WATER DEVELOPMENT - DAMS, ROOF CATCHMENT. EXTERNAL ASSISTANCE.

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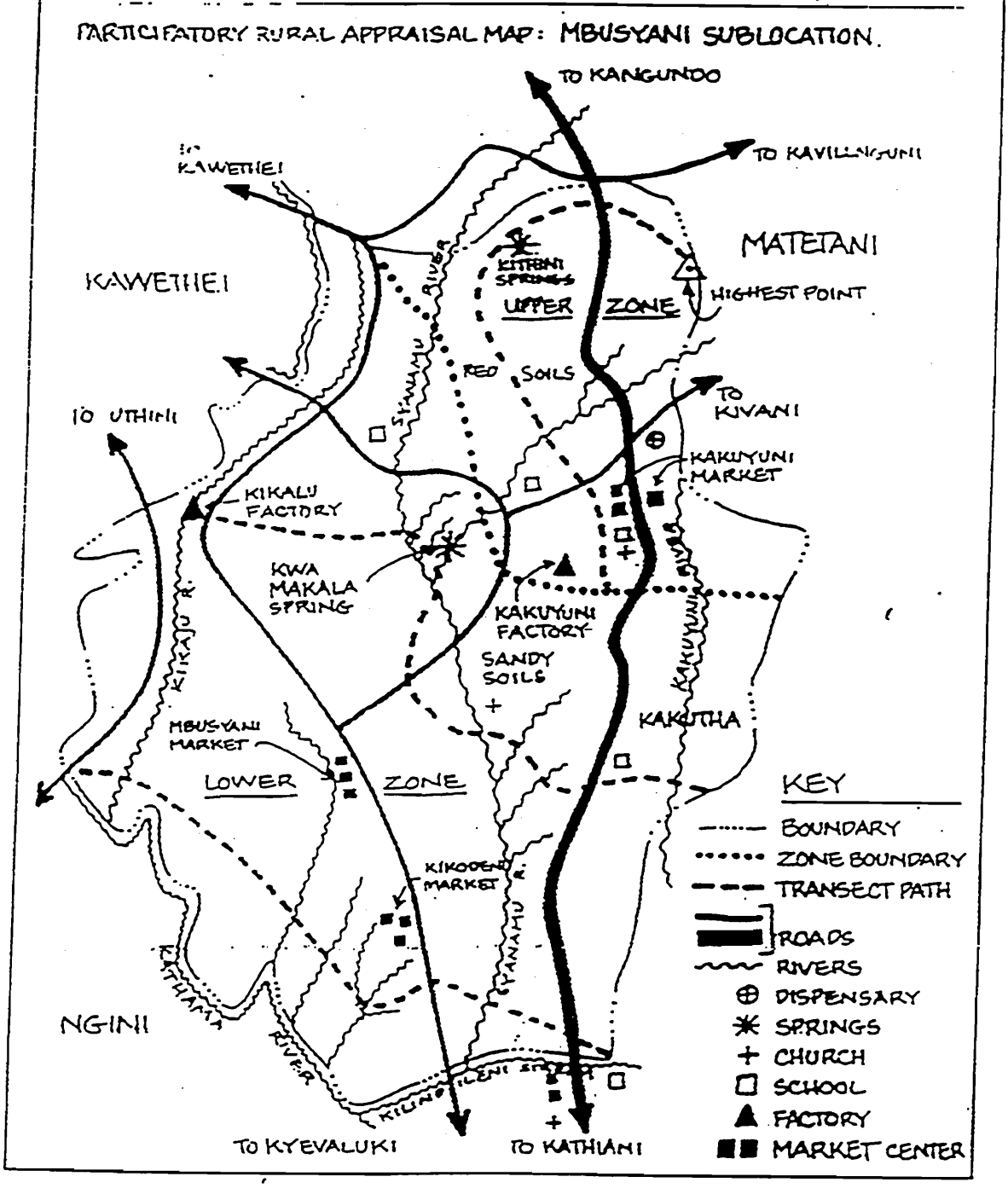
Figure 1. Sketch Map of Mbusyani



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MAPPING

How to do participatory mapping

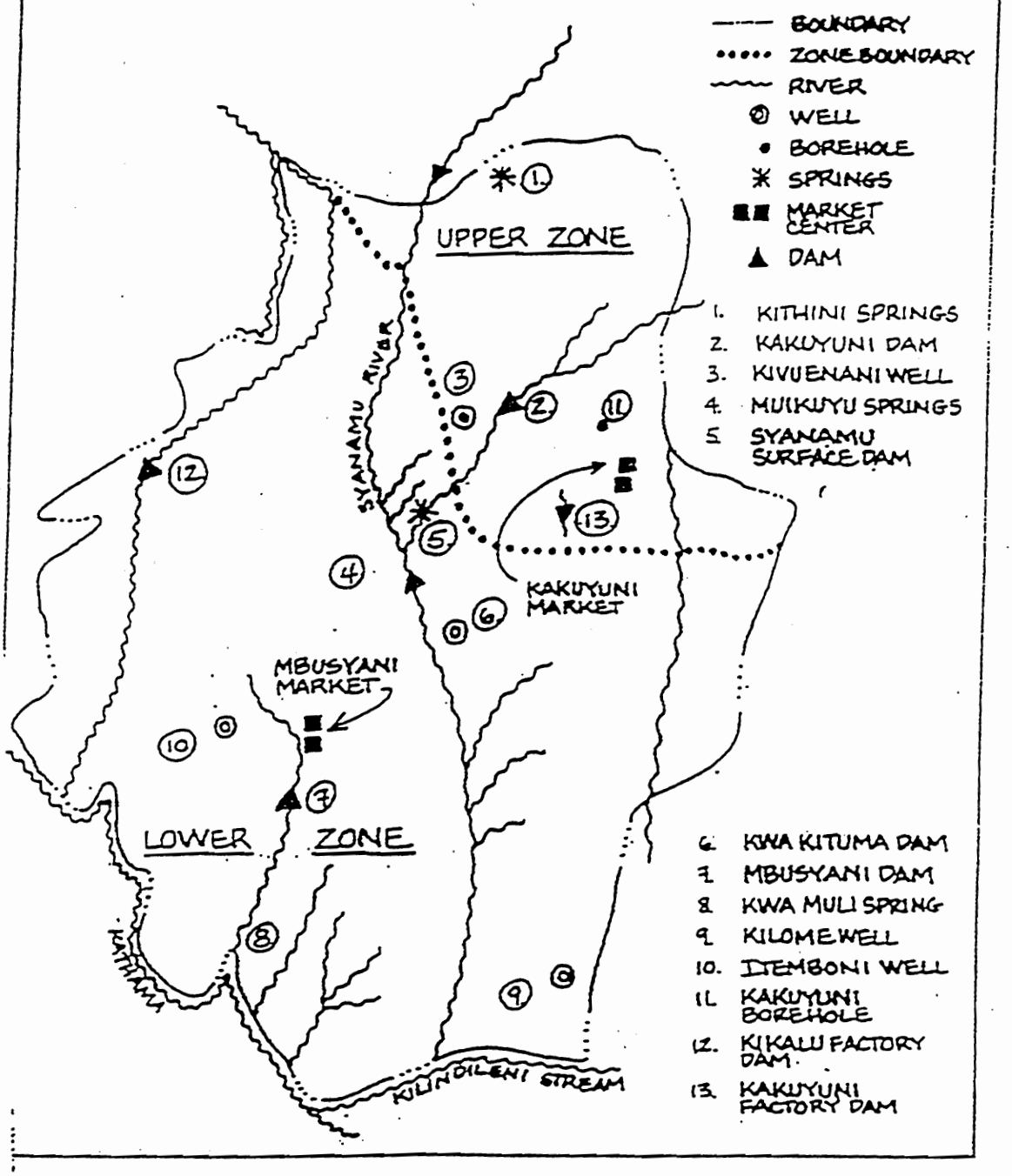
1. Decide what sort of map.
   - social (village residential area)
   - natural resources (village land area)
   - watershed - forest - farm etc.
2. Find people who know and who are willing to share their knowledge.
3. Choose a suitable place and medium.
   - the ground....sticks, stones, rangoli
   - the floor or flat surface...chalks, stones, rangoli
   - paper.....pencils, pens...
4. Help people get started by letting them do it. Be patient. It's their map.
5. Sit back and watch. Or go away!
6. Keep a permanent (paper) record including mapper's names to give them credit.

Tips: Sometimes a succession of maps works well.

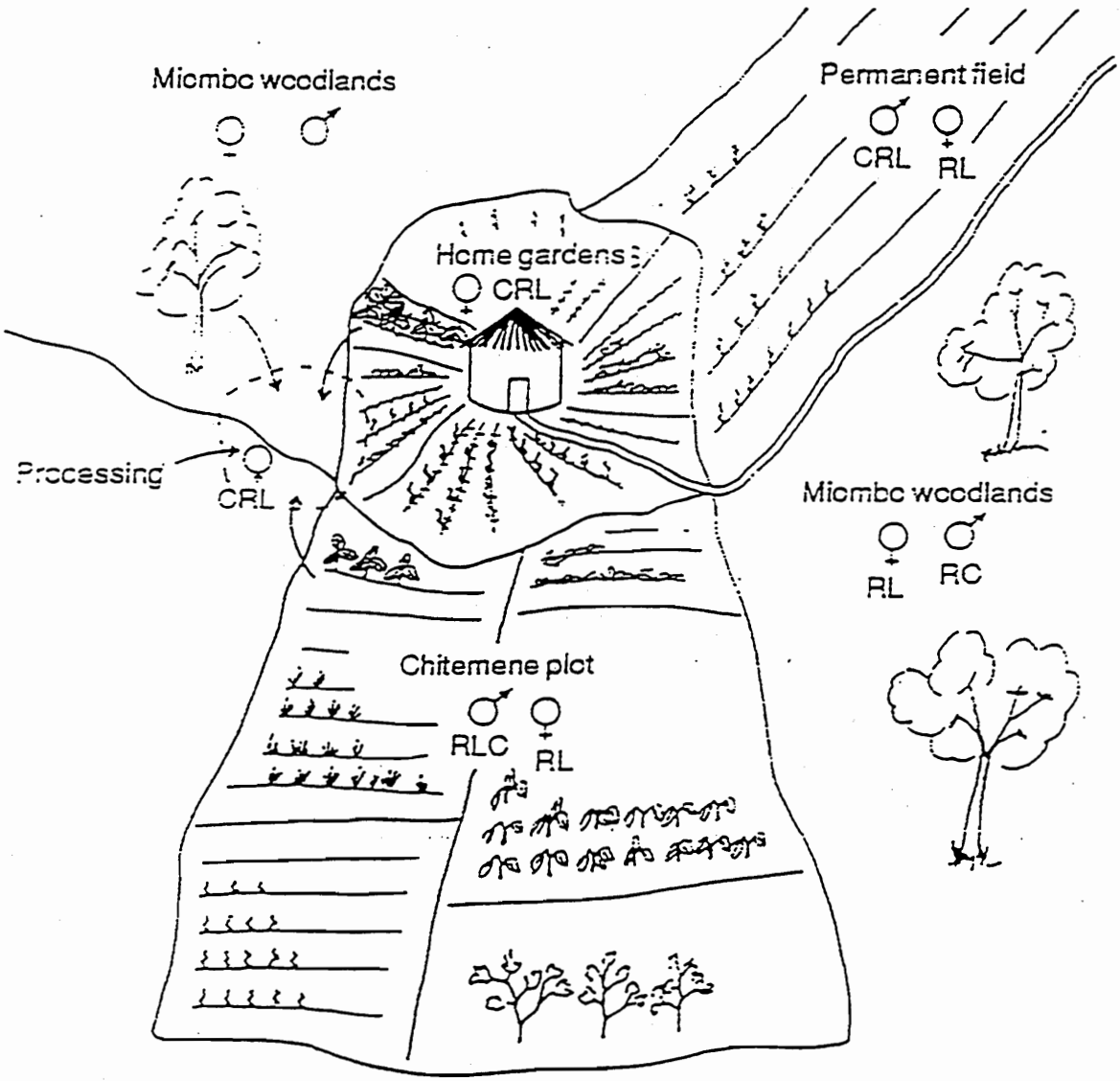
Don't: interfere or interrupt, except very occasionally

Do: Choose a place and materials people feel free with
Encourage corrections/additions
Lead on from the map to eg. transects, wealth ranking, topical PRAs etc.

Figure 2. Mbusyani Water Sources



The Chitemene System in Northeast Zambia



FIELD TRIP SITE RECONNAISSANCE REPORT FORM

Date: 1996 Distance: ___km from _____ (venue)

Time: ___hours___min. from_____ (venue)

Location:

Landscape:

Proposed Activities

Purpose/Rationale

SiteCharacter

Stakeholders:

Regional Area Land Use Issues

Sensitive Areas

SITE VALUABLE FOR THESE LESSONS:

Construction Impacts: _____

Operational Impacts: _____

Induced/Indirect: _____

Cumulative: _____

Mitigation: _____

Opportunities for Strategic Planning/Enhanced Benefits:

Other Comments:

AGBE RIVER DIVERSION

Location

The Agbe River diversion project is located in Central Tigray, at Abergelle Woreda, near Abi Adi, around 80 km from Mekelle on an all-weather gravel road. The main markets of the villagers are Agbe, Abi Adi and Mekelle. Travel time by automobile is between 2.0 and 2.5 hours.

Purpose

In addition to providing short-term relief for the local population in the form of food-for-work employment generation, the Agbe River project diversion purpose is to increase the income and diet of beneficiaries. The project aims to achieve this by:

1. Providing a reliable source of water for small-scale irrigation;
2. Increasing the area available for irrigation; and
3. Increasing the diversity of crops cultivated in the area.

These objectives are intended to shield the local population from the vagaries of climate, one of the main generators of food insecurity in the region.

Site Characteristics

The Agbe river diversion is set at the foot of a steep escarpment. The site is situated between 1000 and 2000 m amsl. The diversion structure is built across a small perennial stream that originates from springs on the escarpment wall. The stream is flanked by high (2-5 meters) and steep channel walls. During the dry season, estimated minimum stream flow is about 30 l/s. As evidenced by the size of the channel, wet season peak flow may exceed dry season flow by several orders of magnitude. When left to its own devise, the stream flows for about 10 kilometers to join the Tekeze River.

The Agbe stream diversion is in an area that is estimated to receive in the range of 410 to 820 mm of rainfall per year (other sources indicate a range between 500 and 700 mm). Rainfall is distributed in two rainfall seasons, *belg* (February-May) and *Kiremp* (June-September) with the later far outstripping the former in terms of total rainfall. Annual precipitation, as in most arid and semi-arid locations, is unpredictable. Estimated coefficient of variation for mean annual rainfall is between 30% and 40%. Mean annual temperature is estimated to be over 20 °. Annual moisture deficit is over 900 mm per year.

The soils are mostly shallow and very stony, with the exception of strips of deep alluvial soils along ephemeral and perennial streams. Even these, however, are very stony.

The vegetation is predominantly composed of tall- and medium-height shrubs of various species of *Acacia spp., Ziziphus spp., Salvadora spp., and Commiphora.*

Land Use

The predominant land use appears to be primarily small-ruminant husbandry. Wheat barley and teff are cultivated. The straw produced by these crops is used to supplement livestock diets in the dry season.

A considerable proportion of the landscape is under natural vegetation because climatic and edaphic limitations severely curtail the opportunities for rainfed agriculture.

Currently four individuals irrigate about 10 has by extracting water from the stream with traditional means. The main crop produced in this irrigated area is maize. Abandoned terraces along the stream channel suggests that this strip, now under a cover of *Acacias spp.*, was at one time cultivated.

Activity Characteristics

The Agbe diversion will consist of a weir that measures about 4 meters in width and 2 meters in height, and associated water conveyance system. A 2000 m lined canal will deliver the water that is diverted at the weir through a side gate. This canal will entail the construction of several drop structures as it descends a 5%-10% slope to reach the irrigable area. The weir is equipped with two or three metal gates that may be opened to allow dry season flow water to proceed downstream. When closed, 100% of the dry season flow (30 l/s) may be diverted to the irrigation canal. The wet season flow will easily over top the weir wall and will be little affected by its presence. There will be a main canal, secondary canal and tertiary drainage canals, farm access roads, beneficiary training, soil and water conservation measures and construction of a store.

Apart from providing short-term employment for 150 individuals per day for an entire year through the food for work program, the Agbe diversion is intended to benefit 200 households. It will provide water for irrigating a total of 30 hectares, based on 24-hour irrigation, during the dry season. During the wet season, the system will be used to provide supplementary irrigation to 50 hectares of rainfed cultivation. Potential crops include cotton, maize, and peppers. Participants will need to clarify how the benefits flow to 200 households. (Typical criteria are 0.25 to 0.5 ha of irrigated land per household.) It is envisioned that land within the irrigated perimeter will be allocated to all beneficiaries. The project will be managed, operated, and maintained by organized WUA assisted by the BOANR. REST will follow the performance, impact and maintenance of major structures of the project.

Expected Results

It is expected that the increase in irrigated area will allow for crop diversification, increased yields and income. The local diet should also improve from the increase in income and crop variety. It is also expected that farmers capacity to manage irrigated agriculture will improve through on the job training.

Contacts

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Woharebi Abdulaziz, Design Engineer, REST
Asfaw Hailu, Construction Engineer, REST

MALLEBA EARTH DAM

Location

Malleba dam is being built in the Central Tigray Region, in Degua Tembien Woreda, approximately 30 km to the northwest of Mekelle. Access is via an all-weather gravel road. The journey by automobile takes a little over 1 hour.

Purpose

The dam is being constructed under the food-for-work program. Additional to the short-term benefits brought about by employment generation (approximately 2,500 persons/day), the project purpose is to increase income of local farmers by:

1. Providing water for small-scale irrigation of 50 hectares; and
2. Increasing crop production

Ancillary benefits include the increased availability of stored water for local use and runoff and flood control.

Site Characteristics

Malleba Dam is being constructed across an intermittent river between 2000 and 3000 meters amsl. The local topography is steep with slopes in the watershed exceeding 30%.

The dam is in an area where mean annual rainfall is estimated to fall within the 410 to 820 mm range (other estimates suggest between 500 and 700 mm) with rainfall split into two wet seasons: the *belg* (short-rains) from February to May, and the *kiremt* (long rains) from June to September. Typical of semi-arid climates, local rainfall is highly variable and unpredictable. Mean annual temperature in this hot and semi-arid area is estimated to fall within the 18C ^{o} and 27 ^{o} range (other estimates suggest 15C ^{o} to 20 ^{o}).

The soils on the uplands are stony, medium-textured and shallow to moderately (50 cm) deep. Organic matter content is low and pH's tend to be above 7.0. Dark and deep clay soils occur along drainage ways, usually in concave position. These have low infiltration rate and are poorly drained.

Land Use

The predominant land use system is small-scale agropastoralism. Land pressure is intense with the bulk of the landscape tilled annually for the cultivation of wheat, barley, and teff. The livestock sector of the production systems appear to be seriously depleted and there appears to be a shortage of draft animals.

Activity Characteristics

The Malleba Dam will be a small-scale earth dam with a storage capacity of 0.958 million cubic meters. The dam will be built of heterogeneous material with a core of clay. Dam construction will take 149,000 m^3 of fill material. A spillway will be built to allow for water in excess of storage capacity to be

discharged. One main irrigation canal will convey water for about 1.5 km to the area where the plots will be irrigated. This main canal will be lined whereas secondary canals will not. The project will be operated and maintained by organized WUA assisted by the BOANR. REST will be involved in the follow-up of the performance, impact and maintenance of major structures of the project.

Beneficiary training and soils and water conservation measures will be undertaken.

Expected results

The dam was specifically designed to hold enough water to provide for surface irrigation of 50 hectares. An estimated 300 households will participate in the irrigation scheme. Participants will need to determine how these number relate to the criteria of 0.25 to 0.5 ha of irrigated land per household. There are an estimated 500 households in the local community. The stored water will provide for supplementary irrigation during the wet season and full irrigation during the dry season. It is expected that the farmers will cultivate maize, onions, pepper, tomatoes, and potatoes. Cropping patterns will be diversified and hence, diets of the beneficiaries will improve.

Contacts

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REST/EU MICRO-PROJECTS PROGRAM

The projects in Bellet and Semha, which form one case study, are described separately below.

1. BELLET CATCHMENT SOIL AND WATER CONSERVATION PROGRAM

Location

Bellet Village is located about 30 km from Mekelle, 3 kilometers East of Quiha, the capital of the ex-Dedeba Derg Ajen Worden (now Enderta Woreda). Access is via an all-weather gravel road; travel time is between 30 and 45 minutes by automobile.

Purpose

The long-term overall purpose of this activity is to improve the ecological condition of the Bellet Catchment area. In the short-term, the local population is benefitting from short-term employment. The specific objectives are:

1. To reduce soil loss and crop damage in upper slopes and arable lands by controlling runoff, limiting gully formation, and increasing soil-water retention;
2. To alleviate the severe shortage of wood for fuel and construction; and
3. To re-vegetate selected slopes.

Site Characteristics

Bellet village sits on a hill top above 2000 meters above msl. The village, which dates back more then 300 years, hosts a population of about 300 people. The village is devoid of social facilities and children wishing to attend school must walk thirteen miles.

The climate is typical of that found in Central Tigray. Mean annual rainfall in this zone is estimated to fall within the 500 and 700 mm range with rainfall split into two wet seasons: the *belg* (short-rains) from February to May, and the *kiremt* (long rains) from June to September. July and August are the peak rainfall months, when over 70% of annual precipitation falls. Typical of semi-arid climates, local rainfall is highly variable and unpredictable. The estimated coefficient of variation for rainfall is around 30%. Mean annual temperature is estimated to fall within the range of 15C ^{o} to 20 ^{o}. The hottest month is May and the coldest month is December. Frosts and hail are occasional climatic occurrences.

The Bellet catchment is characterized by steep (>45%) rocky slopes separating strongly undulating "valleys' with slopes that range from 5% to 15%. Most soils are stony, appear to have lost their surface horizon, and are low in organic matter. Gullies are common throughout the area, especially in concave drainage ways. Along major drainages, broad terraces formed behind rock walls attest to the age of soil conservation practices in the area. Some of these have now fallen into disrepair.

The woody vegetation around Bellet is non-existent. Some steep slopes are covered by *Cynodon dactylon* a vigorous stoloniferous grass extremely resistant to grazing and of moderate palatability. The few fallow fields support a thin mantle of annual plants.

Land Use

Bellet's principal form of land-use is rainfed agriculture with teff, wheat, and barley the primary crops. Some households keep cattle primarily for draught power and small-ruminants. Wheat, teff and barley straw are stored as dry season forage. Catchments surrounding farm lands are considered highly degraded.

Over 70% of the land surface is cultivated in any given year. The absence of firewood forces the local inhabitants to use cattle dung as a source of fuel.

Activity Characteristics

The activities to be conducted by the Bellet Soil and Water Conservation Project will entail the construction of 475.2 km of soil and stone bunds, 124.5 km of hillside terraces, 8,400 meters of check dams and the plantation of 160,000 seedlings of indigenous and exotic trees. These interventions will take place in 1096 hectares of the catchment. During the seedling establishment period, the area will closed to livestock grazing.

The approach adopted is participatory and the catchment project was proposed and initiated by the local community.

Expected Results

The Bellet Soil and Water Conservation project is expected to reverse the downward ecological trend currently affecting the catchment. It is expected that approximately 1918 inhabitants (5 per household) of Egri Hariba, where Bellet is situated, will benefit form reduced runoff and soil conservation.

Contacts

Ato Tewolde Berhan Woldegerima , Program Manager
Ato Girmay

2. SEMHA IRRIGATION SCHEME

Location

The Semha project lies about 13 km northwest of Quiha, located in Enderta Woreda and is about 25 km from Mekelle. The site is two to three kilometers from the main road and reachable by 4X4 high clearance vehicles. The site sits at around 2000 meters above msl.

Purpose

The overall purpose of the Semha project is to increase food production through the provision of a reliable source of water by means of improved irrigation structures. Ancillary works, such as improved roads, should facilitate access and marketing of excess production. The scheme will also entail the improvement of the current access road. Specific objectives include:

1. To improved capture and conveyance of water from small perennial stream to irrigated fields;
2. To re-allocate land within irrigated perimeter to ensure more equal distribution of benefits; and
3. To organize the community to manage and maintain the improved irrigation system.

Site Characteristics

The climate is typical of that found in Central Tigray. Mean annual rainfall in this zone is estimated to fall within the 500 to 700 mm range with rainfall split into two wet seasons: the *belg* (short-rains) from February to May, and the *kiremt* (long rains) from June to September. July and August are the peak rainfall months, when over 70% of annual precipitation falls. Typical of semi-arid climates, local rainfall is highly variable and unpredictable. The estimated coefficient of variation for rainfall is around 30%. Mean annual temperature is estimated to fall within the range of 15C ^{o} to 20 ^{o}. The hottest month is May and the coldest month is December. Frosts and hail are occasional climatic occurrences.

The site of the Semha Irrigation project sits in a small valley flanked by steep hills. The valley narrows from a width of nearly 1 km at the far end of the irrigation perimeter to less than 100 meters at the diversion point. The hillsides around the irrigated perimeter show clear signs of erosion. The vegetation cover is visibly depleted.

The source of water is a small perennial stream that originates in the hills behind the irrigated perimeter. This stream has incised itself into a 3-4 meter deep gully. According to long-time inhabitants of the village, the gully has increased in length by over one kilometer in the past 30 years. This has resulted in the lowering of the local base-level (stream-level) and in the need for the expansion of the principal conveyance canal towards the head of the stream higher in than the original diversion point. This is necessary because an altitude difference needs to be maintained between the irrigated fields and source of water as this is a gravity-fed system.

The soils within the irrigated perimeter are dark cracking clay with low infiltration rate. Deep gullies dissect the lower reaches of the irrigated perimeter.

Land Use

The area is intensively cultivated. The predominant production system is agropastoralism, with the crop sector apparently more important than the livestock sector. The principal crops are teff, wheat and barley. Land preparation is done with oxen.

Surface (flood) irrigation has been practiced on the site for over 70 years. Currently there are an estimated 40 hectares of irrigated land. This existing traditional irrigated area is shared by farmers from nearby Kushets and is water from a diversion and canals, constructed by the farmers themselves. Limiting water availability results in less than ideal yields. The principal irrigated crops are maize and tomatoes.

Activity Characteristics

The Semha Irrigation Scheme micro-project will entail the modification of the existing traditional irrigation scheme. Specific works will include an improvement of the stream- diversion structure and

lining of the primary canals. Like other projects under the EU Micro-Project Progamme, local farmers are expected to operate and manage it.

Currently, water diversion is accomplished by a rock and mud wall erected annually around 2 kilometers up stream from the lower reaches of the irrigated perimeter. This rock and mud wall is washed away every wet season. Considerable seepage occurs under the wall, which keeps a small amount of water flowing in the stream. The Semha project proposes to erect a permanent concrete wall *in-lieu* of the traditionally built mud and rock diversion wall.

The primary water conveyance canals are unlined. Their walls are well-vegetated and these water courses appear to be relatively stable. The amount of irrigation-water lost through seepage is unknown. The Semha project proposes to line the primary conveyance canals with concrete. Other activities will include land reclamation and drainage, diversion weirs, farm layout, pump sites, and road improvement. Details of these activities were not available at the time of this write-up.

Improvement of the traditional system will also entail the re-assignment of plots within the irrigation scheme to households that now have no access to irrigated land. It is unclear how this process of land re-assignment will take place. It is expected that the increased efficiency of the upgraded irrigation network will allow for the irrigation of 60 (some sources indicate 50) hectares of land.

Expected Results

The improved irrigation infrastructure will lead to more efficient use of water for irrigation. All in all it is expected that 6 groups of 50 farmers each will benefit directly from the irrigation scheme. Benefits will include more reliable yields, higher income, and improved diet. Other sources estimate the number of beneficiaries at 1800 households. Participants will need to determine how these numbers relate to the criteria of 0.25 ha to 0.5 ha of irrigated land per household. Furthermore, the erection of a permanent diversion wall signifies that less labor will have to be invested to rebuild it annually.

RUBAFELEG AND FLAGA SMALL EARTH DAMS

Introduction

In this case study you will visit two dam construction sites. Rubafeleg and Flaga dams are two small earth dams built for the same purposes and addressing the same needs. They differ somewhat in terms of size and environmental setting. As you examine the two dam sites, keep in mind the following questions:

1) Given the similarity of purposes, construction approaches, and engineering design, would one environmental examination -- as per the screening form -- suffice to establish the level of environmental assessment needed for both dams? Can they be handled in one environmental review?
2) How do the two dams differ, if at all, in terms of environmental and social impact?
3) Do the impacts of one dam relate to the impacts of the other (e.g., same watershed?). Do they have independent purposes, i.e., could rehabilitation of one dam be done without doing the other?

Location

Both dams are in Atsbi-Womberta woreda, in the Eastern zone of Tigray region. Rubafeleg/Debreselam dam is located 82 km northeast of Mekelle and 36 km northeast of Wukro. Flaga/Haresaw dam is located 91 km northeast of Mekelle, 16 km northeast of Atsbi and 35 km east of Wukro. They are approximately 2 to 2.5 hours drive from Mekelle.

Purpose

The overall purpose for both dams is to enhance the quality of life of the local inhabitants by increasing household income through crop production and diversification. The specific objectives are:

1. To provide small scale irrigation for vegetable and other crop production;
2. Increase the amount of water available by storing water,
3. Recharging the ground water table to increase the spring flow; and
4. Provide runoff and flood control to protect the land.

Site Characteristics

The landscape around the Rubafeleg dam site is hilly with steep gorges and hills alternating with undulating valley bottoms. The Flaga dam site sits below a rim of cliff forming sandstone, which overlies a variety of metamorphosed rocks. Below Flaga dam there is a wide and open flat valley which looks very suitable for irrigated agriculture.

Both dam sites are in a hot semi-arid area in a zone where mean annual temperature is estimated to fall within the 18^0 - 27^0 C range. The dams lie in a zone where mean annual rainfall is estimated to fall within the 410 - 820 mm. range. Rainfall is considered erratic. The altitude is 2690 meters amsl.

The soils at both dam sites are similar. Generally speaking, the dominant soil texture is silty clay (75%) or sandy clay-loam (25%). Soil depth is generally around 50 cm.

Land Use

Seventy-five percent of the land area around Rubafeleg dam is cultivated, with the remainder being bare land or used for grazing or forest plantation. The main crops are wheat, barley and teff, with small plots of lentils and sesame. While the same suite of crops is cultivated around the Flaga site, the proportion of cultivated land (30%) is much smaller than that at Rubafeleg. Around Flaga, about 40% is considered bare land, 20% of the land is forested and 10% used for grazing.

Activity Characteristics

Construction of the dam and associated structures of the Rubafeleg dam is near completion. Ninety-six thousand cubic meters of earth fill will be used in the construction of the dam wall. The dam, with a height of 17 m, will have a storage volume of 964,000 m^3 of water. The command area is estimated to be about 70 ha with 15-20 ha for irrigation and 5 ha for grazing. This water will be produced by 28.1 km^2 of steep watershed.

The Flaga dam is being modified to increase its water storage capacity. The dam wall is being raised by 0.5 m to increase its current storage capacity of around 900,000 m^3 to around 1,000,000 m^3. The catchment area is approximately 8.2 km^2. The command area is approximately 80 ha, with irrigated area of 30 to 40 ha.

In both Rubafeleg and Flaga, the primary canal networks need to be excavated and lined.

Construction/finalization of both dams will entail or has entailed clearing the construction site from unwanted gravel and soil material, excavation of trenches, extraction of material (clay, sand, rocks) for dam wall construction, excavation of spillways, collection and transportation of gravel and stone for spillway, earth placement on the dam, sand transportation for filter and masonry; excavation of canal network, and lining of canals. Ancillary activities will include the organization of community level groups to manage and maintain the structures.

Expected Results

The expected results for both dams include an increase in the area available for irrigated agriculture, increased water availability for local use, and an increase of household income for the local communities. Rubafeleg dam will benefit between 40 and 80 households, whereas Flaga dam will benefit between 60 and 120 households. It is unclear how/if land will be re-assigned between households. It is also not known what proportion of the total population is represented by the beneficiaries.

Contacts

Ato Kassahun Michael , Forester, REST
Ato Belay Haddis, World Vision
Ato Yossef Gitmao, Team leader, World Vision
Ato Woldeciros Getachew, Agriculturist, World Vision
Community leaders

RURAL CREDIT SCHEME

Location

REST has implemented a Rural Credit Scheme in target communities located in food deficit areas within the Tigray Region. A main branch and a sub-branch are located in Adigudom, an area to the south of Mekelle, about 45kms (an 1 hour drive) from the city. A sub-branch is also located in Agula village to the north of the city, about 30 kms from Adigudom. Participants will visit branches in both locations and will visit farmers involved in the rural credit program.

Purpose and Need

1. To enhance agricultural production through increasing access to credit for the purchase of agricultural inputs;
2. To promote savings and credit;
3. To promote sale of agricultural output;
4. To encourage income diversification and generation; and
5. Reduce the exploitation of the rural community by local money lenders.

About the Rural Credit Scheme

Farmers in these areas have suffered under inappropriate government policies, dependence on subsistence farming for survival, poor farming systems, poor marketing network, and inaccessible formal financial institutions. The Scheme follows a community participatory approach in which selection of beneficiaries, group formation, and programme implementation of the local community, the Baitos (local councils) and the direct beneficiaries are involved. Group and centre leadership is made by a democratic election by the members and such positions are held by rotation so that every member can develop leadership and managerial skills. Participants are urged to understand the mechanisms of who applies for and whose permission/approval is required to get it.

The program not only provides credit to target farmers to engage in activities of their choice, but also gives special emphasis to training farmers on accounting and managerial skills to manage the use of their credit and savings. The scheme also gives emphasis on encouraging the participation of women, who account for 50% of the beneficiaries in most target communities. The scheme has so far recorded only a 5% deliquency rate, and 1-2% default in each community, an illustration that nearly 94% of beneficiaries pay back their loan at the appointed time. The Credit Scheme supports approximately a total of 132,000 clients who are supported by main and sub-branches staffed by REST representatives in each target village. Credit given to farmers is up to 2,500 birr/person depending on the proposed activity and financial situation of each farmer.

Results Expected

- Marketing efficiency will improve with an increase in access to credit;
- The living standard of households will improve due to an increase in income;
- Improved entrepreneurial skills of beneficiary farmers will result in increased job diversification and income redistribution; and
- The competitiveness of rural financial services will be increased..

Contacts

Ato Gebremariam, Manager of the Rural Credit Program
Ato Tsehaye, Branch Manager of Adigudom

REST's EXPERIENCE IN RURAL CREDIT: A SUMMARY

Gebremariam Tessema
Relief Society of Tigray (REST)

1 Progress report of 1995 as of September 30, 1995

Particulars	Male	Female	Total
Number of members	7522	6337	13859
Number of	7506	6442	13948
Amount of loan disbursed	11683348	7322899	19006247
Savings mobilised	666638	569878	1236517
- group tax	505120	341205	846326
- group contribution	41245	64140	105386
- centre savings	56020	79142	135163
- individual savings	64252	85389	149641

2 Programme impact

- Marketing efficiency has increased
  Indicators Marketing days
  Price of commodities
  Availability of commodities

- Services have increased
  Indicators Bakery
  Butchery
  Local restaurants
  Tailoring
  Shoe-making and repairing
  Cycle renting

- Increased access to credit
  Indicators Operation on 20 sites
  Reduction of interest rates charged by money lenders due to competitive market

- Increased household income
  Indicators Ninety per cent of the clients have claimed that their income has increased basically and some have declared themselves non-relief recipients

- Improved entrepreneur skill
  Indicators Weaving machine device
  Gravel production
  Using oxen for farming and selling

- Increased women's participation in economic activities
- Integration of various activities

  Indicators Illiteracy campaign
  Centre used as a forum for extension workers
  Members are easily mobilised for urgent community development activity, e.g. afforestation, veterinary vaccination

3 Justification

Generally due to:
- inappropriate government policies
- land degradation
- backward farming conditions
- lack of financial intermediaries
- the regional economy has remained dependent on external assistance.

More specifically though, the subsistence agriculture contributes substantially in terms of gross regional production and employment which is characterised by:
- scattered settlement
- poor economic and social infrastructure
- low capital formation
- imported inflation and seasonal price variation of agricultural produce
- poor marketing network
- lack of diversification
- Inaccessible formal financial institutions and poor informal financial services, i.e. local money lenders.

4 Objectives

To tackle these problems, the rural credit scheme was envisaged with the following specific objectives:
1. To enhance agricultural production through providing credit or agricultural inputs
2. To promote sale of agricultural output
3. To promote savings and credit
4. To stimulate the local economy
5. To reduce exploitation of the rural community by local money lenders
6. To promote income diversification and generation of the poor.

5 Strategy

To achieve the above stated objectives the following strategies are considered most appropriate:

5.1 Participation

REST follows a community participatory approach in which selection of beneficiaries, group formation, and programme implantation of the local community, the Baitos (local councils) and the direct beneficiaries are involved. Group and centre leadership is made by a democratic election by the members and such positions are held by rotation so that every member can develop leadership, managerial skills and quality.

5.2 Gender focus

REST gives special emphasis to women by giving priority to them and by making the loan delivery system based on gender basis so as to encourage women to be engaged in some economic activities and earn income without being discouraged by their male counterparts.

5.3 Sustainability

Long-term sustainability is a key objective of the scheme which is made possible by making some profit to cover its costs.

5.4 Increased thriftiness

Massive mobilisation of savings to be undertaken by the scheme to meet increased loan demands in rural Tigray.

5.5 Integration

REST facilitates production increase of the agricultural sector so as to maintain food security by integrating its operation with other development programmes of the region.

5.6 Factors for success

5.6.1 Savings mobilisation

- convenience in terms of accessibility, simplicity, and stability/sustainability
- security or dependability i.e. building the confidence of the public on the particular institution
- liquidity i.e. right of repeated withdrawal of deposits as soon as possible whenever required
- return on capital i.e. comparative advantage of saving money with the given interest rate and what it can earn if invested in other alternative areas like livestock, *Ekub* etc.

5.6.2 Efficient and effective credit management

- high recovery rate or less loss from loan
- controlled overhead costs
- vertically and horizontally co-ordinated credit delivery, and
- simple and easily accessible structure.

15. Working Group: Drafting Environmental Reviews for Case Studies, Presentations, and Discussion

Description/Objectives

The morning after the field trip, group leaders and rapporteurs with convene their respective working group teams (5-6 persons) to work on the preparation of a draft Environmental Review for each field case study visited. This exercise should begin with a discussion from each participant of their site observations, based on their assigned responsibilities from the original working group session held on Day 2 prior to the field trip. After individual observations have been presented, group leaders should encourage open discussion of the proposed activity or project, overall impressions of soundness, environmental constraints and opportunities for mitigation, and possible design alternatives, if appropriate. The working group should then proceed to preparing the draft Environmental Review, employing all the tools from the field visit. The draft Environmental Reviews are to be summarized in a general session by the workgroup rapporteurs in 5-10 minute presentations.

This session should help you gain experience in actual field environmental review and in the use of the various tools (checklists, matrices, expertise, test equipment, etc.) applied in the Environmental Review process. A workgroup flip chart summary is expected from this session including: (i) a brief description of the proposed intervention; (ii) an outline draft Environmental Review; (iii) a description of the USAID approval process for the intervention under review; (iv) suggestions for further analysis; and (v) additional expertise which may be required for fuller environmental review (including institutions or individuals who might be utilized).

Guides for an Environmental Review

Getting Started with Case Study Environmental Review Preparation

Think of your working group as a multi-disciplinary team, with each of you contributing different kinds of expertise. Consider members of other working groups and the facilitators as potential expert consultants from whom you can draw information and advice.

Remember also that this is an exercise. You won't know all the answers to the questions you generate. In some cases, you may have to take an educated guess or make an assumption. Or you may note the kind of additional research that would be needed.

On the day of the field trip, you will have appointed a *field trip* leader. Now that you are preparing the environmental review, re-elect or choose a new *report* team leader for your group. You may want to consider choosing a different person to make the presentation or have two people share making the presentation to the whole group.

Review what you learned and share your observations in discussion.

Budget your time so that you limit and allocate time (you may want to appoint a timekeeper) to each of the **first four** items of the environmental review described here. In your time budget, include time to prepare the flip charts or acetates for presentation. You should be preparing flip charts as you discuss each component of the environmental review, but they may get messy and need to be redone or simplified.

The preparation of mitigative measures and monitoring (Item 5) is another exercise for which you will have additional time and another presentation. You will likely consider mitigation and monitoring while you are thinking about Items 1 through 4 of the Environmental Review, so ask someone to keep notes that you will use later. It is possible, however, that concerns about mitigation or costs thereof might mean you want to redesign the activity. If that is the case, do so as part of Item 1 and 2, described on the following pages. The same instructions about timekeeping will apply to the mitigation and monitoring exercise. We urge you in that exercise also to consider choosing a different team leader and different presenter(s), so that several individuals have the opportunity to be team leaders and presenters.

1. Background, Rationale and Output/Results Expected

- State why the proposed activity is desired.

- List the results: Distinguish between the physical reality (a school or a well is constructed) and the ultimate result (potable water or education).

- Is there some important history to the activity (fish farming was tried before, but it failed, because... or the community being assisted was relocated because of another project, etc.)?

- Is the activity a rehabilitation of a previous investment (e.g,., terraces)? It may be important to know why the rehabilitation is proposed. Was this rehabilitation expected and planned for in the original plan or design? Was the prior design incorrect or inappropriate? Was maintenance neglected or improperly carried out? If faulty design or lack of maintenance is provoking the rehabilitation, how will these problems be avoided in the rehabilitation activity?

- Why is activity "x" the best or the most feasible way to accomplish the goal? For example, if increased income is the ultimate goal, why is small-scale irrigation (or aquaculture or micro-enterprise) the chosen activity? What other planned or potentially necessary activities are linked to the activity under consideration? The planned intervention may be necessary to accomplish the goal, but is it sufficient? For example, if vegetable production were to increase, is the road adequate to handle transport to market?

- What would happen if the no action alternative were chosen? The answer is not that things remain the same.

2. Activity Description

Make a sketch map (schematic) of the site's relationship to the region or setting and a map showing important features of the site, which can be used as part of your presentation.

Find the appropriate section in *Environmental Guidelines for Small-Scale Activities in Africa* or other reference material and read about the kind of project you have. Several sector descriptions may apply.

Fill out the chart on the next page, if it is convenient, using the questions listed below as a way to generate discussion. Or, discuss the questions and note locations for activities.

- What actions will be taken during the *planning and design* phase? For example, do samples need to be taken to do siting, does there need to be an engineering survey? Is the proposed activity one that would prompt people to move to or away from the site in anticipation of the activity happening? While planning and design work does not usually affect the environment or human behavior, sometimes it does. Or, sometimes a decision made in this phase is in effect not reversible. If your activity has such characteristics, note how and why.

- What actions will be taken during *construction*? Is a construction camp needed? Where does the labor come from? Does an access or haul road need to be constructed? Is quarrying needed to obtain construction materials or is a borrow pit for earth fill needed? What other construction materials are needed (wood, bricks, etc.) and where do they come from? If earth or vegetation is removed during construction, what will be done with the material removed? Do utility pipes need to be laid? What social impacts may result during this phase?

- What actions occur during *operation*? What inputs are needed? What raw materials, water or energy sources? Where do they come from? What products are created and where do they go (export, autoconsumption)? Are waste products created and how are they disposed of ? Is traffic generated? What routine maintenance and repair activities need to be done and what inputs, material, labor, transport and the like are needed? What social impacts may result during this phase?

- Is *decommissioning* pertinent? If the activity were to cease (no longer needed or no longer funded) or has completed its useful life (reservoirs silt up, mines are exhausted, etc.), does it just disappear? What is left behind and what characteristics do the "leftovers" have?

Are there **alternatives** to the activity proposed and have they been evaluated? If so indicate why the particular activity was chosen. If no alternatives have been considered, are there any and what are they?

List Activities	Locations (list where activities occur -- from site or component to the region, nation or larger, as appropriate)				
Planning/Design					
Construction					
Operation					
Decommissioning					

3. Environmental Situation

- Describe location:
  Political/administrative unit (taxing or lack thereof or other social and political characteristics may be relevant);
  Physical and ecological setting (mountains, floodplain, coastal zone, desert; arid, humid, seasonal variations, drought cycles or the like);
  Features of the specific site (steep, flat, vegetated how, and so on).)

Remember you need to know something about all the locations you listed for each activity for Section 2 above. Thus, if a project requires an access road or a utility line to a site or a borrow pit, relocation of families to another place, off-site disposal of waste, etc., there may be more than one location involved.

- Go to Table 7A-1 *Major Categories in a Baseline Study* (in your sourcebook) and determine what features might be important to describe or about which to acquire data. Or go to the listing on page 9A-22 and note those categories. Determine key characteristics and key data needs.

- What else is happening in the locations or area where your project is? Are roads being built or rehabilitated? Are there other projects operating or about to start-up? Has this area been identified as a growth area? Are there plans for power development or extension of electricity that does not now exist? Are there resources, such as minerals or biological resources, that will likely be exploited in the foreseeable future?

- What is the future no action alternative (the baseline situation in the future, as it will be shaped by trends, growth, further degradation, improvement in water quality or air quality as regulations are developed and enforced, normal environmental change or the like)? If no clear trends exist, you may have to consider the existing situation to be the best approximation you have of the future. For example, if one is building a road through a forested area that has already been targeted for cutting and for development in the next four years, how much does it matter that the road building will result in loss of vegetation?

Remember: You are not writing an environmental encyclopedia! Be guided by your national environmental policy or Environmental Action Plan and by the special or unusual characteristics of the locations affected. For example, in one country, genetic diversity and maintenance thereof in indigenous crop varieties is considered important; in another, preventing land degradation or soil erosion may have special value. Consider what is ecologically or culturally unique, unusual or sensitive. Consider what regulations or laws might apply. For example, are there special prohibitions on building in or filling of wetlands?

4. Activities and Issues With Respect to Environmental Impacts

- Consider using the "project impact matrix" contained toward the end of Module 10 in your sourcebook as a means of organizing the team's thoughts or draw up your own matrix with key activities by project phase and key environmental components. Look again at the *Environmental Guidelines for Small-Scale Activities in Africa* or other references. Consult some of the checklists in your sourcebook to trigger ideas about impacts.

- Go back to the chart or the list that you made for Section 2 of the Environmental Review and bear in mind the characteristics of the environment you noted in Section 3.

- For each activity or action you listed for Section 2, determine how this activity would or could affect some environmental component, e.g., aquatic ecology, soils, topography, water quality, flora and fauna, etc. You probably won't have time to consider all the direct, indirect/induced, and cumulative impacts of every possible action as it affects every component of the environment. Thus, you should choose the top four or five of those that seem most critical or important and focus on these. If you have additional time remaining, you can tackle the other, less critical issues.

  Determine direct impacts first, e.g., clearing land means loss of vegetation. A new or improved road means there will be traffic or additional traffic that did not exist previously.

  Consider the implications of each direct impact to arrive at indirect or induced development impacts. Use the literature available; for example, look at the network charts in Module 10 to see how one can link direct impacts, to secondary, tertiary, etc. impacts. For example, does development of a site mean that more people will be attracted to an area, resulting in population growth or will the clearing be so extensive or in such a sensitive zone that a habitat will be destroyed?

  Go to the list in Module 7 Section 3, subsection Predict Potential Impacts (page 7A-8) and use some of these impact descriptors, e.g. magnitude, direction, extent, etc.

  Consider what you said about the **future no action alternative**. **Compare** the expected impacts to that, not just the current baseline situation.

  Use your previous determination of other activities taking place in your project area to identify what types of cumulative impacts might occur.

- Judge the significance of the impacts. You may utilize the list in Module 7, Section 3, subsection *Determine Significance of Impacts* (page 7A-9) to assist you. Remember, however, that unless there are specific laws, regulations or policies that say "x" is significant or standards exist that are not to be contravened, significance is a matter of judgment.

5. Environmental Mitigation Actions (including monitoring and evaluation)

This is a separate exercise. You likely will have considered these while you were preparing previous parts of the Environmental Review; now you have additional time to consider these.

Mitigation

- Select the three to five most critical impacts that need to be mitigated. (You can go back and choose more, if you have time.)

- Use the attached chart, if you wish, to organize and present your recommendations.

- How costly are the mitigative measures relative to project cost? If they are more than one to ten percent of the cost, perhaps, you should recommend re-design.

- Who will be responsible for design, implementation and monitoring the effectiveness of your proposed mitigative measures?

Monitoring

- Select three or four priority impacts/issues to monitor. (Impacts to be mitigated are not necessarily those most important to monitor.) Determine the indicator you will use. There may be several impacts to monitor and several indicators for each, but concentrate on three or four monitoring needs and one (no more than two) indicator each.

- For the selected monitoring indicators:

  Why did you choose them?

  Will comparisons be made to the baseline situation, a control site or situation or both?

  How often (frequency) will the indicators be monitored?

  Who will be responsible for doing the monitoring?

  What will be an approximate cost (person-days per month or year, if you can estimate that) for each indicator?

  Could the indicators be derived from data already being collected **or** could they contribute to a regional, national or other monitoring effort?

  How will the results be used and with whom will results be shared, either for information purposes or because action needs to be taken?

Mitigation Strategy by Activity Phase

Phase / Mitigation Strategy	*Planning/Design*	*Construction*	*Operation*	*Decommissioning*
Avoid Impact				
Minimize or Diminish Effect				
Rectify by Repair or Rehabilitation				
Reduce or Eliminate over Time				
Provide Compensation				
Other				

16. Environmental Monitoring and Mitigation: More on Issues and Methods

Description/Objectives

This module introduces participants to the concepts of monitoring, evaluation (M&E) and mitigation. It defines the underlying reasons for monitoring, and the methods and steps to be followed. The development of a plan for environmental monitoring, evaluation and mitigation is a tool to identify positive and adverse effects of known activities on the environment and natural resources. It is used to suggest and implement mitigation measures for adverse impacts, and to foster positive environment/natural resources management, so that sustainable development is promoted. The results of the plan can also be used by farmers, NGOs and government agents, for learning, problem-solving and decision-making in natural resources management.

The objectives of this module are: (i) to review problems and issues involved in M&E and mitigation (including the issues of establishing controls and baseline, indicators, sample size and reliability, etc.); and (ii) to expose participants to the techniques used for M&E, including tips for minimizing the technical, financial and human resource requirements for effective M&E and mitigation. Topics to be covered under this module include:

- the concept of monitoring, evaluation and mitigation;
- the purpose of monitoring, evaluation and mitigation of programs, sectors, projects and umbrella projects;
- design of a plan for monitoring, evaluation and mitigation;
- implementation of the plan;
- use of monitoring, evaluation and mitigation results;
- mitigation of adverse environmental impacts;
- institutional responsibilities for environmental monitoring, evaluation and mitigation;
- the concept of program or multi-project environmental, monitoring, evaluation and mitigation plans (EMEMPS).

Readings

The Module Backgrounder.

Bingham, Charlotte S., *Role of Monitoring and Auditing in EIA*. 27 June-10 July 1993, CEMP 14th International Seminar on Environmental Assessment and Management, University of Aberdeen, 21 pp., plus one appendix

Chapter 4: 'Monitoring and Evaluation', *Environmental Guidelines for Small-Scale Activities in Africa: Environmentally Sound Design for Planning and Implementing Humanitarian and Development Activities,* USAID, AFR/SD/PSGE, 1996.

Module 13: Annex 1 - Excerpts from 'Indicative List of Factors to be Monitored,' *Volume II Sectoral Guidelines World Bank Environmental Assessment SourceBook,* Electronic Version (1991).

Annex 1 - "Example of an NRM Project Monitoring and Evaluation Plan Outline - Guinea Natural Resources Management Project Monitoring and Evaluation Plan"

Annex 2 - "Excerpts from the electronic copy of *The World Bank Environmental Assessment Sourcebook* on mitigation"

Annex 3 - Selected Mitigation tables from the World Bank *Environmental Assessment Sourcebook,* Volume 2 (1991).

MODULE BACKGROUNDER
Environmental Monitoring, Evaluation and Mitigation

1. Environmental Monitoring and Evaluation

1.1. Introduction

The process of environmentally sound project development does not stop when project or program environmental effects have been identified or decisions have been reached. After an environmental assessment is performed, an environmental monitoring plan may be designed and followed, and mitigation measures devised and implemented. Steps in the process, from initiating the environmental assessment through monitoring and mitigation are (or include):[1]

- Define action
- Predict impacts
- Identify and define major impacts and possible mitigation measures
- Obtain participation of agencies and affected parties
- Identify authority for controlling or mitigating impacts
- Design an environmental monitoring plan (either during the EIA process or thereafter);
    - Define monitoring objectives
    - Determine data requirements
    - Review the relationship of data requirements to monitoring objectives
    - Determine data availability
    - Conduct feasibility evaluation
    - Define monitoring system
- Implement the environmental monitoring plan
    - Collect data
    - Analyze data
    - Evaluate impacts
    - Response by responsible agencies or parties
    - Document changes
    - Refine mitigation strategies
- Implement effective mitigation measures

The Bingham reading accompanying this module: *Role of Monitoring and Auditing in EIA (July, 1993)* includes tables (Marcus, 1979) which provide greater detail on each of these steps.

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[1] Adapted from Marcus, L.G., "A Methodology for Post-EIS (Environmental Impact Statement) Monitoring," Geological Survey Circular 782, U.S. Geological Survey, Washington, D.C., Tables 8 and 9 , and Plates 1 and 2.

1.2. Terminology

1.2.1. Monitoring[2]

Environmental monitoring is defined as "an activity undertaken to provide specific information on the characteristics and functioning of environmental and social variables in space and time" (Bisset and Tomlinson (1988). It may include the systematic collection of data through repetitive measurements (Davies, 1989) or be thought of as a process of continuous assessment (Carley, 1986).

1.2.2. Evaluation

Typically, the objective of evaluation is to determine the extent to which projects are meeting intended goals and objectives. Environmental evaluation refers to the "generic process of analysis and interpretation and incorporates monitoring, surveillance and audit programmes...it involves making subjective, policy-oriented judgements about the effectiveness of EIA procedures and results" (Sadler, 1988).

1.2.3. Indicators

Environmental indicators are measurements or signals of environmental status or change. For example an organism or ecological community whose presence signals the presence of specific environmental conditions.

1.2.4. Baseline Information

Baseline data collection is defined as the "measurement of environmental parameters during a representative pre-project period for the purpose of determining the nature and ranges of natural variation and to establish, where appropriate, the nature of change" (Davies, 1989). In some instances, the establishment of baseline data may require that data survey work be expanded, refined or extended through seasons or years in order to establish reliable environmental information over time. Measuring changes in environmental conditions or progress toward sustainable development can only be done effectively if an adequate and reliable set of baseline data have been acquired. In general, data must be specific, as well as systematically and repetitively collected and organized to achieve some purpose. Unfortunately, often in the rush to meet funding obligation deadlines, programs and projects may be designed and implemented with inadequate baseline information. As a result, many environmental assessments are carried out and interventions implemented with insufficient commitments of time and resources for collection and analysis of baseline data.

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[2] Substantial portions of the text that follows (except where otherwise noted) are taken from Bingham, Charlotte, "*Role of Monitoring and Auditing in EIA*", CEMP 14th International Seminar on Environmental Assessment and Management, 27 June - 10 July 1993, University of Aberdeen.

1.3. Why Monitor the Environment?

Integrating monitoring activities in project design and implementation is not intended to prevent use of natural resources, but rather to promote their sustainable utilization.

Hecht et. al., 1991 emphasize that:

"Before any data collection effort begins, it is essential to understand thoroughly what questions we are trying to answer, what difference the answer will make, and therefore what kind of information we will need to gather." There is no single approach to monitoring. "Anyone who makes decisions needs information; the exact decisions will determine what information will be of value and the form which monitoring should take. Thus, we cannot begin a discussion of monitoring by asking what data to collect or what indicators to follow. Rather, we must begin...by asking what questions we need to answer, and only then can we consider what data or indicators might provide those answers. Monitoring can be an extremely expensive and time-consuming activity; therefore it is essential that we consider what we hope to get out of it before we require anyone to do it."

There are several generic forms of monitoring, the purposes of which overlap:

Tracking: Monitoring to determine if activities are on schedule and to identify any unanticipated constraints or issues. Often tracking is internal to a project or program and carried out by the managers and/or affected parties. However, when tracking is used as a form of oversight or control, or an activity is politically sensitive, it is often desirable to use outside expertise, both to maintain objectivity and additional checks and balances over decision-making.

Impact or Effects Monitoring: Monitoring to assess impacts on target or non-target populations in order to determine whether interventions are having desired outcomes or whether they are creating other unanticipated negative (or positive) effects. This type of monitoring may be particularly important whenever there are uncertainties about possible future environmental impacts, including activities which are expected to have beneficial impacts, or where measures may be needed to mitigate possible negative effects.

The functions of impacts/effects monitoring include:

documenting the accuracy and/or adequacy of predicted effects;

providing a foundation for examining theories of causes and for finding explanations which (when supported by sufficient data accuracy/adequacy) can be used to improve decision-making and policy (see also ***research monitoring*** and ***problem identification monitoring*** below);

providing warning flags to concerned parties (communities, agencies, politicians, etc.) of unanticipated problems or altered conditions and trends, or the approach of critical threshold levels for environmental indicators;

serving as the information base and feedback system for decision-making regarding impact control and management.

Research Monitoring: Often interventions may initially be in the form of limited projects or programs to test a development hypothesis or model. Research monitoring helps determine whether hypotheses are correct; to identify reasons for failure; to help identify alternatives and additional opportunities; and to provide lessons from experience which may then be used to refine more effective approaches. For example, efforts to development community-based irrigation or agroforestry management may require that results and environmental impacts be followed closely to ensure that activities are actually leading to sustainable natural resource management, and to suggest more effective approaches.

Mitigation Monitoring: Monitoring to determine the suitability and effectiveness of mitigation plans or programs which are designed to diminish or compensate for adverse environmental effects from implemented activities (For a full definition of mitigation see Section 3.2 below). Mitigation monitoring programs are frequently required for grants prior to their approval, even when an environmental assessment has not been prepared.

Compliance Monitoring: Monitoring whose objective is to ensure that specific conditions or standards are met, e.g. inspection or periodic checks to determine whether levels of pollutant emissions/discharges are within limits specified by permit. This form of monitoring resembles a policing function (See also Section 1.4.1. below).

Monitoring as Postponed Decision-Making: When decisions must be made under conditions of uncertainty (created, for example, by inadequate information, factual or value conflicts, etc.), the monitoring program can serve as a "kind of relational contract where the parties create a structure through which to address problems and make decisions over time" (Rolf, 1986). See the Bingham reading for further detail.

Problem Identification: This type of monitoring is of broader scope and is used to identify the most important issues and constraints requiring additional analysis or interventions. Ecological monitoring by the Sahelian Heads of State, or by the Southern African Development Community's sectoral groups, fall in this category. Efforts to obtain greater understanding of the natural resource base, and of environmental trends in the region and individual countries, are used by Sahelian and SADC officials to prioritize issues and make the case for developing future programs or projects.

Bingham includes in this category ***indices or indicators of environmental quality,*** i.e. the monitoring of environmental change in a broader context. For example, several programs in Canada, the U.S. and OECD countries monitor environmental change at the national level. Indicators of global climate change, alteration in global atmosphere and marine systems fall in this category.

Also, ***baseline data collection*** can be regarded as a form of monitoring. Sadler (1988) and Davies (1989) consider it to be a continuous process which should be refined both during the environmental assessment and as projects and programs are implemented. This form of monitoring helps influence program or project design changes and mid-course corrections, and define appropriate mitigation measures.

More often than not monitoring approaches fall into one or more of these categories with no clear distinction among them, making it difficult to classify a particular monitoring approach as being of any one form. For example, where do the following aspects of monitoring fall:

- measuring and evaluating program/project goals and sub-goals achievement?
- monitoring/assessing economic and social change: e.g. income, quality of life, increase and diversification of export products, etc;
- monitoring/evaluating effects on the environment and natural resource base in order to support sustainable development?

While specific categorization may not be possible, the exercise of trying to do so can be very useful, because it focuses early attention on the rationale for undertaking monitoring activities, and should therefore improve the efficiency and specificity of monitoring plans.

Environmental monitoring is a tool to ensure that activities do not have significant adverse impacts on the environment and/or natural resources. Environmental impacts can be located in the zone of the activity, as well as affect a more extended area, including a country, an entire region, or the global commons.

The integration of monitoring into program and project design/implementation is not intended to prevent use of natural resources, but rather to promote their sustainable utilization.

The IEE or environmental review should include general guidance for long-term program or project environmental monitoring/evaluation. A monitoring plan should use the findings of the baseline data section as the foundation for measurement of progress and unforeseen impacts on a continuous and/or periodic basis. The plan should also include recommended measures needed to collect, manage and analyze data, and to disseminate information generated.

1.4. When is Environmental Monitoring Needed?

For USAID projects, an environmental monitoring plan, like that of the IEE or the EA, should be completed during project design. The monitoring plan should clearly indicate how adverse impacts will be monitored during project implementation. The need for environmental monitoring is more or less based on the severity of expected environmental impacts.

Design of environmental monitoring plans should take into account the types of USAID activities by level of environmental impact significance:

Categorical Exclusion activities. These generally will not require extensive monitoring, evaluation, or mitigation.

Activities with some foreseeable potential adverse impacts on the environment. These could require mitigation measures such as changes in design and implementation, and monitoring to some degree during the life of the activity to make sure that adverse impacts on the environment are minimized.

Activities having the potential for significant negative impacts. These will require: 1) a responsible monitoring program that can be incorporated into the project, and 2) a comprehensive review and a definition of necessary mitigative actions.

Legislation and environmental monitoring

Legal requirements or regulations normally dictate the development of mitigation measures. However, in many African countries, legal requirements do not exist and little monitoring is done. The long term economic returns from environmental monitoring and mitigation are not always recognized and are thus frequently considered an extra burden and expense.

Reg. 16 requires environmental monitoring of USAID programs and projects under paragraph 216.3(a)(8): "to the extent feasible and relevant, projects and programs for which Environmental Impact Statements or Environmental Assessments have been prepared should be designed to include measurement of any changes in environmental quality, positive or negative, during their implementation. This will require recording of baseline data at the start. To the extent that available data permit, originating offices of USAID will formulate systems in collaboration with recipient nations, to monitor such impacts during the life of USAID's involvement. Monitoring implementation of projects, programs and activities **shall take into account environmental impacts to the same extent as other aspects of such projects, programs and activities** [Emphasis added]. If during implementation of any project, program or activity, whether or not an Environmental Assessment or Environmental Impact Statement was originally required, it appears to the Mission Director, or officer responsible for the project, program or activity, that it is having or will have a significant effect on the environment that was not previously studied in an Environmental Assessment or Environmental Impact Statement, the procedures contained in this part shall be followed including, as appropriate, a Threshold Decision, Scoping and an Environmental Assessment or Environmental Impact Statement."

In practice, USAID's Africa Bureau recommends that a monitoring plan and mitigation guidance be provided whenever activities have uncertain forecasted impacts, even for projects, programs or non-project assistance (NPA) which may have been granted a categorical exclusion or negative determination.

Also, monitoring is required in certain other cases, including: "controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored" [216.1(c)(2)(iii)]; and "provisions...for monitoring the use and effectiveness of the pesticide"[216.3(b)(1)(I)(l)].

1.5. Design of an Environmental Monitoring Plan

Environmental monitoring plans differ depending on the severity of project impacts on the environment, and on the kinds of environmental factors that need to be monitored. The design of the plan requires collaboration among all interested parties as well as environmental specialists and **professionals with backgrounds in statistical Monitoring and Evaluation (M&E) design, data collection, processing and analysis.** Design documents should state clearly ***how, and by whom,*** adverse effects on the environment will be mitigated, if, and when, revealed by monitoring activities. Effective monitoring plan development and implementation requires a fully participatory approach, especially in development settings where constraints on financial and technical resources

may require innovative approaches to monitoring involving local communities, farmers, pastoralists, etc. The institution responsible for project implementation will also oversee: 1) monitoring and evaluation of all project activities; and 2) reporting on the environmental monitoring and evaluation plan to the person or institution in charge of the environment (i.e., Ministry of Environment and USAID Mission or Regional Environmental Officer).

1.5.1. What are the environmental factors and indicators to be monitored?

Indicators used for monitoring need to be clearly identified and described during project and monitoring plan design. The monitoring plan identifies and describes the environmental and natural resources parameters to monitor, such as pH, salinity, productivity, etc. It also identifies indicators and proxies to use to measure or estimate changes (presence of plants attached to a specific environment, plants with different tolerances to changes in soil fertility, exotic species, etc.). The selection of parameters to be monitored, as well as associated indicators, depend on the type of project, its activities, and how those activities affect the environment. Examples of indicators for monitoring changes in the environment and natural resources follow.

Table 1. Indicators for Monitoring Changes in the Environment and Natural Resources[3]

INDICATORS	*TYPES OF DATA TO BE COLLECTED*
WATER	
Quantity	*Rainfall amounts, river discharge, ground water depth, aquifer extent, natural storage and drainage parameters.*
Quality	*Chemical, physical and biological characteristics.*
Reliability	*Seasonal, annual, high/low waters. Recharge rates. Availability of substitute resources. Variability of rainfall and climate over time (e.g. lake sedimentation, etc.)*
Accessibility	*Access rights, conflicts.*
SOILS	
Erosion	*Wind and water erosion of arable lands. Gullies? Sheet erosion?*
Productivity	*Soils physical and chemical characteristics. Productivity of agriculture, pasture, forests, etc.*
Land resources and their potential	*Percent of needs satisfied, percent of unsuitable land under production.*
Fallow periods	*Length of fallow period and relation to soil fertility regeneration capacity.*
VEGETATION/FLORA	
Permanent vegetation ratio	*Ratio of permanent vegetation zones versus zones cleared and put under production.*
Composition and density of natural vegetation	*Species composition and density.*
Cleared zones	*Percent tree and shrub cover.*
Productivity	*Productivity (including secondary products).*
Others	*Habitats quality, species diversity, etc. Also: local community access and control over resources.*
FAUNA	
Populations	*Number of species, density.*
Habitat	*Extent (size, surface) and quality*
OTHERS	
Unique zones (special ecosystems)	*Depends on location and zone type. Can be geological, historical, sacred, archeological, or the density, scarcity of species and type, etc.*

[3] Table provided by Idrissa Samba, REDSO/WCA Environmental Advisor

(See also Module 13: Introduction to Environmental Mitigation and Monitoring - Annex 1, *Indicative List of Environmental Factors to be Monitored, Excerpts from Volume II Sectoral Guidelines, World Bank Environmental Assessment SourceBook Electronic version (1991)* and Annex 1 to this module, *Example of an NRM Project Monitoring and Evaluation Plan Outline, Guinea Natural Resources Management Project Monitoring and Evaluation Plan* for additional indicators and types of data to be collected)

1.5.2. What are some of the problems of testing/monitoring in the real world?

Distinguishing normal change or change that would have occurred regardless of project or program interventions is often difficult, especially since biological, physical and human systems vary over both space and time. Bingham (1993) points out that impacts monitoring is not like a classic laboratory experiment, because the possibility of establishing a strict control situation for comparative purposes is usually not possible. In addition to all the biases that may result from poorly designed test models or misuse of statistics, Bingham identifies a host of others which are listed in her paper under Section 5.1.

Efficient monitoring design attempts to eliminate or hold to a minimum these kinds of confounding factors, a not always easy process. Specialized expertise is required, and those embarking on environmental monitoring design are advised to consult approaches from various disciplines, as well as the more general works, e.g., Blalock, or Campbell and Stanley.

Variability can be dealt with in part by selecting a comparative situation, population, etc. which presumably is subjected to the same set of overall non-project (or program) changes, but is not receiving similar project or program related interventions. At the same time, by focusing monitoring on 'representative' situations and model interventions, the financial and human resource requirements for monitoring and evaluation can be more effectively managed without sacrificing comparative results. The key here, however, is to ensure that the sample situations selected are truly "representative"

Often multiple stations or sampling locations are chosen within a target area, as well as in the area selected as the control. Monitoring of change of both the target and control environments and populations prior to the initiation of interventions establishes an initial baseline, but also helps ensure that comparison areas were validly chosen. Useful technical references for ecological monitoring are: Spellerberg (1991) and Cairns (1991).

The special constraints to monitoring of social and economic systems must be recognized. Pre-intervention monitoring is easier for physical and biological systems than for human populations where the anticipation of an intervention can affect perception and behavior, resulting in responses such as land speculation, depletion of resource stocks, or simply resistance to the potential loss of one's land or culture. For more on social impact assessment effects and procedures the reader is referred to Armour (1988) and the 1990 issue of Environmental Impact Assessment Review (10:1/2,

1990).

1.5.3. How to proceed and implement monitoring activities?

An environmental monitoring plan has three major phases: design, implementation, and data analysis/dissemination. Each of these phases requires planned commitments of competent personnel and monitoring equipment as well as allocation of necessary funds and time.

Baseline data should be gathered prior to project or program implementation to serve as a foundation for measuring change. It is recommended that specialists involved in monitoring activities collaborate closely in order to generate the most accurate information possible at least cost.

1.5.4. What level of detail is appropriate for monitoring and data collection? Timing and frequency? How much is too much?

The expense of data collection, processing and analysis grows rapidly with the level of detail. For this reason, it is important early in the design of monitoring plans to establish the ***necessary and sufficient*** level of detail, time and costs involved to achieve monitoring and evaluation purposes. Frequently, analysts overestimate data needs and then gather and attempt to analyze too much data. The amount of time needed for analysis is often grossly underestimated. These problems can be minimized by devoting sufficient thought and effort to selecting the simplest least-cost indicators and methods for measuring change and developing the most efficient monitoring plan necessary for the achievement of monitoring and evaluation objectives.

Frequency of monitoring, data sampling, collection and analysis depends on site conditions and the size and complexity of the project and also affects the cost of implementing the monitoring plan. It is critical to define data needs, timing and frequency of collection in advance: for example, the start and end of the monitoring program, whether collection is to be seasonal, monthly, or weekly, etc. In programming data acquisition, it also important to take into account special conditions in the project area such as the beginning of the rainy season, harvesting periods, etc. Often specific data are needed on those events, and special attention must be devoted to planning and budgeting for this purpose.

1.5.5. Which institution(s) should be responsible for environmental monitoring?

Responsibilities for implementation, data processing and dissemination must be clearly established under the monitoring plan. Which institution will do what? How will these institutions be supported? What human, financial and material resources will be made available and for how long? Who will collect specifically what information? Who will manage it? Are there conflicting responsibilities or interests? Who will provide funding for monitoring and analysis? Is an independent firm to be involved? These questions must be answered to determine who is responsible for what, and where bottle necks may occur.

1.5.6. How are the results from the environmental monitoring activities to be interpreted?

Analysis and interpretation methods need to be defined in monitoring plan development,

such as (i) the ultimate specific purpose(s) for collecting the data; (ii) the meaning contained in the data and information to be collected; (iii) the level of change observed in indicators that trigger a reaction requiring mitigation action; or (iv) the kinds of interpretive expertise, methods and references needed for data collection and analysis. For example, on a given soil (with known basic original parameters), if the root system is reduced and plant leaves turn yellow, the analyst or user of the results of the monitoring plan should have references to know what it mean in terms of the soil quality, and what type of mitigation it calls for.

1.5.7. What use will be made of the data collected and the information generated?

The design of an environmental monitoring plan should take into account the target users and define: (i) what information they will need; (ii) in what format; and (iii) for what use.

To determine how the information generated from the monitoring activities will be used, the following steps need to be followed:

- List all the potential users, and what they need the information for;
- Determine the format most suitable for their use;
- Determine the level of accuracy and reliability required;
- Devise the most suitable reporting format and the dissemination mechanism needed to satisfy potential users.

1.5.8. How will environmental monitoring and evaluation be funded?

An effective monitoring and evaluation plan depends on an adequate and reliable funding. Too often the need for funding requirements for monitoring are ignored in design, and not recognized until after a program or project has been implemented. It frequently takes several years or even decades to measure changes in the environment or natural resource base, while project cycles are governed by the annual budget cycles of governments and donor agencies. Rarely are agencies able to commit funds beyond a five year period. These constraints can place effective long-term monitoring and evaluation in serious jeopardy. In developing a project or program monitoring and evaluation plan it therefore is important to realistically assess the potential for securing adequate and reliable sources of funding, especially when environmental monitoring and evaluation may be needed well beyond a project or program's life of five or ten years.

The notion of sustainability of a monitoring plan may include other considerations such as those described in the Niger Gouré NRM Interventions Project (See Section 3 examples below); building capacity to continue monitoring activities; the need for continuing long-term data and information, etc.

2. Environmental Mitigation of Adverse Impacts

2.1. Definition

Mitigation: The purposeful implementation of decisions or activities designed to reduce the undesirable impacts of a proposed action on the affected environment. Mitigation is a general

concept that includes: a) avoiding undesirable impacts altogether by not taking a particular action; b) minimizing the impacts by limiting the magnitude of the action; c) rectifying impacts by repairing or restoring particular features of the affected environment; d) reducing impacts over time by performing maintenance activities during the life of the action; and e) compensating for impacts by providing additions to or substitutes for the environment affected by the action.

2.2. Why Mitigate Adverse Impacts on the Environment?

A project's mitigation (or environmental management) plan consists of the set of measures to be taken during implementation and operation to eliminate, offset, or reduce adverse environmental impacts to acceptable levels. Also included in the plan are the actions needed to implement them. Mitigation plans are essential elements of projects with significant impacts on the environment. During the preparation of a mitigation plan, project sponsors: (a) identify the set of responses to potentially adverse impacts; (b) determine requirements for ensuring that those responses are made effectively and in a timely manner; and (c) describe the means for meeting those requirements.

Effective mitigation reduces or eliminates adverse effects on the environment and natural resources of program and project activities. Mitigation measures should promote sustainable use of natural resources. Once the constraints imposed by the environment are taken into account, opportunities for sustainable development are increased.

A project is said to environmentally sound when: 1) there are no, or limited, adverse impacts on the environment and natural resource base; and/or 2) when all reasonable steps have been taken to minimize adverse impacts and maximize positive impacts.

2.3. At What Phase of the Project Should Mitigation Measures Be Implemented?

Once the different interactions between project activities and the environment and natural resource base have been identified and their extent defined, appropriate actions can be devised and implemented to minimize or eliminate adverse effects and maximize beneficial effects. An ounce of prevention can be worth a pound of cure.

Mitigation of adverse environmental impacts can take place at any time in program or project design or implementation:

- During design, mitigation plans may be incorporated to avoid or minimize impacts (often as a preventive strategy). Incorporating mitigation in design can result in changes in: 1) project or program configuration, content, implementation, timing, technology employed in some activities, material used, etc.; or 2) inclusion of correction, rehabilitation or compensation activities in the design.

- During project or program implementation, evaluation can uncover adverse impacts that may jeopardize activities, the environment or the natural resource base. Corrective measures may then be needed to minimize the adverse effects.

- After a project or program ends, a decision may be made to mitigate adverse effects associated with the activities carried out. Should this occur, the costs of mitigation may become significant, e.g. the toxic or radioactive waste cleanup, desalinization of soils, etc.

Effective mitigation design should not significantly increase project or program costs. Mitigation measures can often be implemented in such a way that their impact on total project costs is minimal. However, if mitigation costs appear too high, it may be an indication that proposed interventions should be rethought or redesigned.

2.4. Funding/Budgeting for Mitigation Activities

Funding of mitigation measures has always been a critical issue. Most of the time funds for implementing mitigation measures are not provided or budgeted, and it is often a last minute chore to find the money necessary to implement mitigation measures. Planners should keep in mind that generally, the later mitigation is considered in the project cycle, the greater the costs may be become.

2.5. Sustainability of Mitigation Activities

Sustainability of mitigation activities depends on: 1) availability of funds; 2) its rank in the priority scale of decision-makers; 3) its effectiveness as a problem solving tool.

2.6. Examples of Mitigative Measures

A particulary useful set of mitigative measures is contained in Annex 3 to this module - Selected mitigation tables from the *World Bank Environmental Assessment Sourcebook, Volume 2* (1991).

Monitoring Plan Sustainability Issues Considered In The Niger Goure NRM Interventions

The Goure project has adopted a participatory approach to development in its fullest sense. As such, even after the project ends, the local population will continue to be involved in identifying needs and in project execution at every level of the development process. This process can be summarized as follows:

1) Identification and analysis of problems, constraints, and potential;

2) Conception of an optimal program of action for the sustainable resolution of NRM problems and development of potential;

3) Mobilization and organization of necessary resources to implement action plan;

4) Implementation of the program activities;

5) Monitoring of impact and specific environmental indicators leading to evaluation and analysis of the program;

6) Feedback from the above analyses for the purpose of refining skills and correcting errors at each level of the development process.

The ultimate success of the project will be measured not so much by the number of trees planted or hectares of dunes stabilized, but on how well the local population has mastered the development process. It is only as the project participants fully comprehend and put into practice this process that sustainability of project impacts and activities will be assured.

It is in this context that the sustainability of the CB-EMEMP must be considered. Responsibility for implementation of the monitoring plan has been placed at the field level, with the bulk of necessary measurements made by project participants. Under this approach the monitoring program becomes part and parcel of the development process to help ensure the sustainability of the M & E plan and process. As project participants become adept at making the quantitative and qualitative measurements required under the plan, their findings can be used to enhance positive impacts and mitigate negative ones, and to build upon positive results.

If the bulk of CB-EMEMP responsibilities are to be shouldered by local communities, the required measurements undertaken must be sufficiently simple and straightforward. If the population is to continue to make these measurements after the project is over, they must recognize utility in doing so. Environmental indicators are those recognized by the local community as critical measurements of environmental quality. Wherever more sophisticated measurements are required, the project will attempt to correlate quantitative measurements made by scientific instruments with simpler qualitative observations made by farmers. For example, soil salinity will be initially measured with an electronic probe, but these measurements will be correlated with the observations that farmers now make that indicate soil salinity (leaf yellowing, salt encrustation, etc.). If sound correlations have been found, the electronic probe can be dispensed with as the primary means of data collection. Finally, farmers are to be trained to make appropriate management decisions based on the findings from their monitoring systems.

Under the Africare proposal the approach to sustainability can be summarized as follows: a) building on locally generated initiatives; b) building on efforts of local leaders and local communities; c) using site specific design; d) promoting technology based on local resources and materials; e) training individuals and communities that have a vested interest in improving management of their natural resources.

3. Environmental Monitoring, Evaluation and Mitigation Plans (EMEMP) and Process

3.1. What Are EMEMPS?

EMEMPs are plans that seek to guide host countries into the business of environmental protection through monitoring and mitigation. **Within USAID's Africa Bureau they refer primarily to Mission program or multiproject environmental monitoring and evaluation and mitigation planning.** They identify problems and/or impacts which are discovered during the process of environmental monitoring; they evaluate these problems and/or impacts; then they go one

step further and propose mitigation actions to responsible people. It is the latter process that differentiates the EMEMP process from ordinary M&E programs, common to all USAID projects and programs.

The suggestion here is that environmental protection cannot be guaranteed by monitoring and evaluation alone, mitigation is the critical 'missing link' that is needed.

3.2. Why Use Them?

EMEMPs have several features that make them an attractive tool in project/program implementation:

1. Environmental protection - EMEMPs are safeguards even in cases where direct, significant negative environmental impacts are not anticipated. They are especially useful in connection with activities where long-term impact potentials and long-term environmental effects might reasonably be expected. A case in point would be technical assistance and/or policy reform in sectors such as agricultural production.

2. Program Impact Monitoring - In light of the Agency's recently articulated major strategic objective regarding the environment, EMEMP's are particularly appropriate as they are intended to become an integral part of Missions' efforts to develop comprehensive program impact monitoring in support of sustainability. They should be linked to and supportive of other Mission monitoring activities.

3. Capacity Building - EMEMPS are also a useful framework for helping strengthen host country environmental monitoring and mitigation capacities and institutions. They encourage a process for effective use of findings in developing mitigation strategies and/or re-orientation of program/project implementation.

3.3. EMEMP Examples

Several EMEMPs are already in operation, the most obvious in connection with agricultural production programs where export crops are featured. For example, USAID/Ghana has a large non-project assistance (NPA) Trade and Investment (TIP) Program to stimulate the production and marketing of nontraditional agricultural exports (NTAEs) including: the growth and export of pineapples; forestry products for furniture; salt mining; and prawn fisheries. Briefly, the EMEMP consisted of a series of 4 concise background environmental reviews (one for each sector) and the formulation of a Plan for monitoring, evaluation and mitigation to be carried out by the host country as long as these sectors will be exploited. The plan incorporates the monitoring of run-off from the irrigated pineapple fields. A similar plan has been designed to monitor run-off from the cut flower industry on Lake Naivasha in Kenya, and USAID/Malawi has instituted an EMEMP to monitor (and mitigate) impacts of watershed run-off associated with small-holder tobacco growers. A review of EMEMP experience in four African Countries (Ghana, Malawi, Uganda and Madagascar) was

recently completed for the Bureau for Africa's Office of Sustainable Development.[4]

3.4. The Future of EMEMPs

Over 25 EMEMPs have been designed and implemented in AFR and more are underway.[5] They fill a need, in that environmental protection is not an easy thing to ensure and mitigation is a difficult concept to build into USAID activities. The EMEMP is one way of doing this while also employing M&E principles easily recognized by USAID field staff. In addition, it offers an 'out' for Missions in that the responsibility for mitigation falls squarely on the shoulders of the responsible organization in the host country.

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[4] Hecht, Joy E., Environmental Monitoring, Evaluation, and Mitigation Plans: A Review of Experiences in Four African Countries, Institute for International Research, Prepared for the Division of Productive Sector Growth and the Environment, Office of Sustainable Development, Bureau for Africa, USAID by Environmental and Natural Resources Policy and Training (EPAT) Project, Winrock International Environmental Alliance, Arlington, Virginia, August 1994, 60pp.

[5] Ibid, p.i.

CEMP

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Role of Monitoring and Auditing in EIA

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BETTER ENVIRONMENT Awards for Industry
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Commended 1991

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ROLE OF MONITORING AND AUDITING IN EIA

1. INTRODUCTION

The EIA process need not, indeed should not, stop when the environmental effects of a project or program have been documented or when a decision has been reached. Knowing the consequences of project operation or program implementation is of paramount importance to gauge the efficacy, predictive value and accuracy of impact assessment forecasts and judge the effectiveness of mitigative measures, presumably carried out to reduce predicted adverse consequences or to compensate for unavoidable losses.

The general lack of follow-up, i.e. what really did happen compared to what the environmental impact assessment said would happen, creates a situation in which impact assessors too infrequently learn and impact assessments insufficiently apply the lessons of past experience.

The concept of Total Quality Management (TQM) is commonly applied to manufacturing better products or delivering better services and is increasingly applied to the products of the engineering and environmental professions; finding out why and how mistakes were made or good results were achieved is more than common sense. A TQM postmortem or retrospective analysis provides the means to improve upon results, whether the goal is fewer accidents, a more desirable product or a more effective tool for environmental management and project decision-making.

2. TERMINOLOGY

2.1 Evaluation

Evaluation research has an established history. Typically, the objective is to determine to what extent projects have been successful in meeting their intended goals, e.g. benefit monitoring. Dekker and Leeuw (1989), in their contribution to a special issue of the Impact Assessment Bulletin, review definitions of evaluation from 1955 through 1984 and various evaluation models, in addition to a goal attainment model. Monitoring and auditing in EIA can be construed within this overall framework and should be pursued with reference to or understanding of the research in this field.

Post EIS or EIA evaluation refers to the "generic process of analysis and interpretation and incorporates monitoring, surveillance and audit programmes ... it involves making subjective, policy-oriented judgments about the effectiveness of EIA procedures and results" (Sadler, 1988).

2.2 Monitoring

The key concepts underlying definitions of environmental **monitoring** are that data must be specific, systematically and repetitively collected and organized to achieve some purpose. (For a discussion of purposes, see Section 3.)

The term **monitoring** is defined in the context of environmental impact assessment as "an activity undertaken to provide specific information on the characteristics and functioning of environmental and social variables in space and time" (Bisset and Tomlinson (1988). Davies (1989) refers to monitoring in a similar way as "the systematic collection of data through a series of repetitive measurements." Carley (1986) calls monitoring a process of "continuous assessment" and defines it as the "systematic collection and organization of information..." The terms "surveillance" (repeated measurement of a variable in space and time to detect a trend) or "survey" (variation in space) are frequently used or misused to mean monitoring. While the lack of consistent or common definitions is of concern, the problem of definition is not pursued further here.

2.3 Audit

The term **audit** is more global and encompassing than **monitoring**, which can be used as a tool to accomplish auditing. A conventional use of the term audit for a facility is an "account of the environmental consequences of operational developments, accompanied by an appraisal of the effectiveness of management to ameliorate or prevent harmful impacts" (Bisset, n.d.). The USEPA has defined this kind of auditing as a "systematic, documented, periodic and objective review by regulated entities of facility operations and practices related to meeting environmental requirements" (Allison, 1988).

The EIA audit must be distinguished, however, from corporate or agency internal auditing to determine compliance with regulations or standards at a regulated facility. In the EIA context, an audit is the comparison of predicted environmental impacts with actual impacts.

Neither monitoring nor audits can be discussed fruitfully without reference to their purposes and objectives, which are reviewed next.

3. TYPES AND PURPOSES OF MONITORING

3.1 Baseline Monitoring

Baseline surveys are frequently undertaken to gather data for the EIA. In most instances, the objective is to find out what exists in the environment and how it might be affected. In some cases, these surveys could be or may have been expanded, refined or extended through seasons or years so that they may be adequate to qualify as baseline monitoring.

Baseline monitoring is defined by Davies (1989) as the "measurement of environmental parameters during a representative pre-project period for the purpose of determining the nature and ranges of natural variation and to establish, where appropriate, the nature of change." Many EIAs, however, are not carried out with sufficient time and resources to serve this objective optimally.

Better links among baseline monitoring, impact prediction and the potential requirements of subsequent impact monitoring are needed to ensure feedback in the EIA process, both within a project itself and among projects. Sadler (1988) and Davies (1989) consider baseline monitoring to be a continuous process, refined and refocused during the preparation of an EIA, and continued through proper implementation and operation. This kind of monitoring data can help to influence project design changes and/or to define and refine mitigation.

3.2 Impacts or Effects Monitoring

3.2.1 Documentation of Predictive Accuracy and/or Adequacy

Verifying past impact predictions and improving the accuracy and/or adequacy of future impact predictions by documenting the actual impacts of operating projects is a fundamental objective of "impacts" (Bisset) or "effects" monitoring (Davies, 1989; Sadler, 1991). This objective was enunciated in one of the earliest publications directed to post-EIS monitoring (Marcus, 1979). The point is not necessarily to keep an accuracy score nor to bash EIAs for their inaccuracies of prediction, but to improve the practice of EIA and the knowledge base about how specific kinds of projects affect the environment. "It is this lack of knowledge which, in part, makes impact prediction such a difficult and uncertain task ... It is precisely because of this prevailing degree of uncertainty that many mitigating and monitoring schemes are implemented" (Bisset and Tomlinson, 1988).

The importance of feedback and continuity in the EIA process cannot be overemphasized. A past project's monitoring or audit results can be used to inform the next project, with a consequent improvement not only in accuracy but a more efficient use of resources, which can be better targeted, and a more appropriate selection of methods and techniques.

3.2.2 Policy and Theory Benefits

An especially pertinent role for impacts or effects monitoring is to guide policy-making and, thus, subsequent EIA decision-making. (See Sadler, 1988 and Marshall et al., 1986.)

The objective of accuracy and/or adequacy and better decision-making can be taken one step further. DiSanto and Frideres (1986), in reviewing the work of Munro et al. (1986), decry an apparent preoccupation with methods and emphasize the importance of establishing theoretical statements and directing attention to causes and explanations rather than to effects and predictions.

3.2.3 Warning Functions

Monitoring the effects of activities provides the ability to warn agencies or the public of unanticipated problems, changes in trends or the approach of an impact indicator to a threshold or critical level (Marcus, 1979 and Armour, 1988).

3.2.4 Impact Control and Management

As impacts occur, Marcus (1979) posits, they can be managed and controlled, as long as monitoring data are available to support decision-making. Thus, monitoring information can be used as a feedback tool in managing operations, assessing the usefulness of monitoring techniques or devising different or more refined monitoring programs. This monitoring objective is linked to and overlaps with the objective of monitoring the effectiveness of prescribed mitigation procedures (See 3.3) to reduce or compensate for the predicted adverse effects of projects. (See also Davies, 1989; Carley, 1986; and Sadler, 1988.)

3.3 Mitigation Monitoring

Mitigation monitoring aims to determine the suitability and effectiveness of mitigation programs, designed to diminish or compensate for adverse effects of projects. Regulations of the U.S. Council on Environmental Quality emphasize this type of environmental

monitoring. When mitigation is specified in a Record of Decision pursuant to an EIS, agencies are to adopt a monitoring program (U.S. Council on Environmental Quality, 1978). Monitoring of mitigation programs is often required as a condition for grants, approvals or permits, even when an EIS has not been prepared.

Mitigation in the U.S. is defined as: avoiding impact; minimizing impact by limiting the action; rectifying the impact by repair, rehabilitation, or restoration of the affected environment; reducing or eliminating the impact over time by preservation and maintenance operations; or compensating for the impact by replacing or providing substitute resources or environments.

3.4 Compliance Monitoring

This form of monitoring has as its objective ensuring that specific conditions or standards are met. In its simplest form it might be inspection. Compliance monitoring is often conducted, continually or at specified periods, to check that conditions of a permit specifying limits to the amount or level of a discharge are being met. This type of monitoring focuses on the discharge or the emission itself and not the ambient quality of the environment. Bisset explicitly refers to this type as emissions monitoring.

Compliance monitoring does not require baseline monitoring to which impacts can be compared nor reference or control sites. In general, one might view this monitoring as a "policeman" function (Carley, 1986).

3.5 Monitoring as Postponed Decision-Making

In a discussion of how impact monitoring is negotiated, Rolf (1986) points to the value of a negotiated monitoring program, when decisions must be made under conditions of uncertainty, inadequate or unobtainable information and factual or value conflicts. "A monitoring program can be conceived as a kind of relational contract where the parties create a structure through which to address problems and make decisions over time" (Rolf, 1986). Thus, the way to solve potential problems, rather than the solution itself, is agreed upon.

Additional advantages are inherent in this procedure, as suggested by Rolf (1986). Fairness and equity are enhanced, because participants who would have no role or no major role in making a decision are more easily brought into the monitoring negotiation process. Likewise, he contends that better implementation of monitoring can be achieved, because those who participate in the negotiation have more interest and commitment to it.

Two related roles for monitoring are: 1) countering, in advance, fears that unanticipated problems will occur gradually over time and not be detected; and 2) establishing the basis, or lack thereof, for impact compensation claims (Armour, 1988). Monitoring can provide to affected publics "needed reassurance" and a means of "regaining some measure of control over the quality of their environment" (Armour, 1988).

Proposed monitoring, however, should not legitimize or justify a determination of project acceptability (Carley, 1986). One may conclude that promises or commitments to monitor are no substitute for substantive EIA in the first place.

3.6 Indices or Indicators of Environmental Quality

Monitoring environmental change can occur in a broader context, not directly linked to project or program EIA. Alberti and Parker (1991) briefly review several programs in Canada, the U.S., and OECD countries, which were established to monitor environmental indicators or indices at a national level. (Simply put, an indicator is based on measuring one variable, while an index aggregates several indicators or measure.) The controversy surrounding the utility and credibility of environmental quality measures is beyond the scope of this review, but it should be indicated that they have not yet gained the acceptability of comparable economic indicators, e.g., Gross National Product or Price Indices, or Quality of Life social indicators.

The purposes behind environmental indicators and environmental indices are similar to EIA impact monitoring. One objective is to provide information and feedback to adjust environmental policy. A specific purpose of the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program is to determine whether impacted ecosystems respond to mitigation. If and/or when they are credible, such environmental indicators and indices can be useful in the future by serving as comparisons to equivalent indicators at the project monitoring level and as yardsticks to gauge potential benefits of mitigation plans.

4. AUDITS

4.1 Types and Purposes

Four kinds of environmental audits have been distinguished by Canter (1985).

(i) The draft EIS audit or review is an "independent opinion on the environmental implications of a project based on the EIS at the authorization stage ... to determine 'completeness' in relation to objectives and the terms of reference placed upon it."

(ii) The implementation audit is an enforcement audit undertaken by a regulatory body to verify that mitigation measures and levels of emissions are within limits.

(iii) A performance audit or a regulatory audit, following the categories of Canter (1985), is a means to identify compliance status of facilities and is a tool employed by corporate or agency management.

One form of compliance auditing might, indeed, be to determine whether EIA documentation is being prepared (Sigal and Cada, 1991).

(iv) **Impact prediction audits** have as their primary purpose examination of the accuracy and efficacy of impact assessment predictions in comparison to actual effects that occur.

Audits, as defined in Section 2, employ monitoring, but in EIA have come to refer specifically to Canter's fourth definition: "The organization of monitoring data to establish the record of change associated with a project" (Davies, 1989 from Sadler and Davies, 1988).

A defining feature of an audit is the "independent and objective examination of whether practice complies with expected standards" (Sadler, (1988). The point is not just individual project evaluation; the ultimate goal is to better the science and practice of EIA (Davies, 1989).

In one of the earliest reviews of relatively few existing EIA audits undertaken at the time, Bisset (1980) identified the multiple problems associated with carrying out scientifically acceptable audits. The audits he reviewed concerned physical or biological impacts, which arguably could employ scientific designs and measurement techniques more amenable to monitoring than social or economic impacts. Bisset points out the proverbial "Catch-22" -- the location of stressed, i.e., impacted monitoring stations is based upon EIA predictions, but if the impact predictions were incorrect in terms of locations, then such stations will provide misleading information.

Murdock et al. (1982) assessed a sample (225) of U.S. socio-economic assessments. Because of data deficiencies, only 44 could be assessed quantitatively for the relatively straightforward task of judging how accurate their demographic projections were when compared to the 1980 census. Population projections for 149 various administrative units considered in these 44 were not generally found to be sufficiently accurate for practical use.

Canter (1985) reviewed nine case studies of impact prediction audits, analyzing over 100 projects. He concluded that the methodological difficulties of auditing impact predictions included: the lack of sufficient data, the vagueness of the original predictions and the lack of information about prediction techniques. Most audits were not comprehensive with respect to evaluating physical, biological, cultural and socio-economic categories. Accuracy was, indeed, quite variable.

Bisset and Tomlinson (1988) reviewed a number of the same audits, including one undertaken by the Centre for Environmental Management and Planning. After screening many projects, the anticipated versus actual impacts of two oil terminals, a steelworks and a reservoir were studied in detail. Among the most striking results was that the vast majority of impact predictions (88 percent) could not be audited. There were changes in project design after the impact predictions; the predictions were ambiguous or fuzzy; assumptions upon which predicted impacts were contingent, e.g., weather conditions for an oil spill were not realized; and monitoring data were lacking or insufficient. For the 12 percent of predictions that could be audited, over 50 percent were accurate or at least could not be shown to be inaccurate within the time period that an impact could be expected. It was also found that impacts not addressed in the EIA occurred, particularly secondary impacts.

In reporting on the Canadian experience, Sadler (1988) also describes the record as mixed. The kind and direction of impacts tended to be accurately anticipated in environmental impact studies, while quantitative predictions erred. In addition, his review of Canadian audit and evaluation studies found that procedural effectiveness was deficient -- "... lack of follow-through from EIA and authorizing decisions is evident even at the rudimentary level of surveillance."

Twenty-nine U.S. federally-sponsored projects for which EISs were prepared between 1974-1978 were evaluated by Culhane et al. (1987). Accuracy was not especially high, but neither were EISs especially inaccurate. Inaccuracies tended to be the result of too vague predictions or the differences between actual and predicted impacts were subtle. One of the problems with this evaluation, however, is that interview data, not independent field measurements, were the basis for determining whether predicted impacts had been realized.

The authors of this review audit also challenge the assumption of an EIS as a rational, decision-making model. Perhaps, it is sufficient that the EIS is not used to manipulate data and that impacts of public, rather that scientific interest, are legitimately given attention.

Additional examples of audits can be found in Canter (1985) and Bisset and Tomlinson (1988) and increasingly in EIA professional journals. See, for example: "The Intrinsic Difficulty of Predicting Impacts: Lessons from the James Bay Hydro Project" (Berkes, 1988) concerning predicted and unpredicted impacts on fish stocks, mercury accumulation, caribou migration, wetland ecosystems, roads, hunting territories and access; or Dickman (1991) on "Failure of an Environmental Impact Assessment to Predict the Impact of Mine Tailings on Canada's Most Northerly Hypersaline Lake."

As many of the reviews by Bisset and Tomlinson (1988), Canter (1985), and Bisset (1980) have indicated, baseline monitoring, careful and documented impact predictions, and impact monitoring are essential to effectuate a successful audit. Without such a process, there is no way to advance the art (science) of EIA nor to achieve long term improvement in theory and practice.

5. METHODOLOGICAL ISSUES IN AUDITS AND MONITORING

5.1 Problems of Testing in the Real World

The overall method of auditing is described by Bisset and Tomlinson (1988) and in the works cited by Sadler (1988) and Canter (1985). Questions about the specific methods underlying the audit, however, are fundamentally related to monitoring methods. It is difficult to generalize about the appropriateness of methods in disciplines/subject matter so vastly different as water quality, aquatic ecology, terrestrial fauna and flora, soil erosion and sedimentation, land use, land tenure, population, employment, fiscal and tax matters, community cohesion or cultural change.

For impact monitoring specifically, the question is similar to the one faced for impact prediction: how does one distinguish normal change or change that would have occurred without the project from change occurring as a result of the project? Biological and physical systems as well as human ones are subject to variability spatially and over time.

Some instructive issues can, however, be identified. Impacts monitoring is not at all equivalent to a classic laboratory experiment, because there is no strict control situation to which impacts of the project situation can be compared. In addition to all the other biases that can result from illy designed schemes or the misuse of statistics, consider these.

(i) Before and after comparisons of the pre- and post project situation suffer from the problem of history, i.e., events occurring between the measurements, such as a major flood or earthquake or project design changes.

(ii) Maturation processes occurring within a population, such as getting older or wiser, can intervene.

(iii) Effects of the monitoring itself can cause different results.

(iv) Effects can occur as a result of the measuring instruments or the measurers using the instrument, e.g., differences among observers or samplers when personnel change over a period of time and reinterpret protocols or, worse yet, have no strict protocols to follow.

(v) Mortality can take its toll, e.g., differential loss of the population from the comparison or from the test situation but not attributable to the project.

(vi) Interaction effects among monitoring methods, choices of sites and other factors can jeopardize one's ability to generalize about the situation based on the samples taken.

(vii) Choices regarding units of analysis can lead to different results, e.g., correlated statistics for large aggregates like census tracts or regions produce different results than when individuals are the units of analysis.

In general, the aim of monitoring design is to reduce or eliminate confounding factors, not always easy to do when operating in the messy nature of reality as opposed to the laboratory. Individuals embarking upon the design of monitoring programs are urged not simply to consult the approaches recommended by various disciplines, but more general works, e.g., Blalock or Campbell and Stanley.

One typical way of dealing with variability is to select a comparison, or reference, site, population or situation, one presumably subjected to all the overall non-project related changes but not experiencing the effects of the project. In addition, a representative project-affected situation must be selected, with emphasis on the word "representative."

Multiple stations or sampling locations are often chosen within the "experiment" or treatment area, i.e., the project, and the "control" or reference area, as one would expect variation within each area. Monitoring of both areas prior to the construction or operation of a project is also recommended to establish that the comparison areas are validly chosen. Some useful sources for ecological monitoring are: Spellerberg (1991) and Cairns (1991).

A review and evaluation of socio-economic impact monitoring systems was conducted by Leistritz and Chase (1982), based on the literature and ten monitoring systems implemented for projects in the late 1970s. Monitoring focused on indicators providing data on work force characteristics, community service systems, and fiscal impacts, such as property valuation or public finance. This review stressed the importance of:

(i) selecting key indicators, while considering costs of data collection and processing, monitoring frequency, and utility of already existing mechanisms/reporting processes;

(ii) procedures to update impact projections as projects change;

(iii) reporting procedures in a form that can be used by decision-makers; and

(iv) the role of monitoring as a management tool to revise mitigation strategies and plans.

Monitoring of social and economic systems has some special constraints. Pre-project monitoring is more easily accomplished for biological or physical systems than for human ones in which the anticipatory or planning phases of the project can affect perception and behavior, e.g., land speculation or fear about loss of the familiar place. In the context of social impacts, Armour (1988) raises another important issue apart from the methodological: might it be "more productive to conceptualize monitoring less in scientific terms and view it more as sociopolitical process ... collective reality testing?" For a review of social impact assessment procedures with case studies of third world settings and an analysis of differing institutional constraints, see the 1990 special issue of the Environmental Impact Assessment Review (10: 1/2, 1990).

Methodological problems entailed in social, emphasizing sociocultural or sociopsychological, impact monitoring are amply reviewed by Armour (1988), who asks a set of questions relevant to all monitoring programs.

(i) What are the key factors to monitor?

(ii) What is the baseline condition?

(iii) How can cause-effect be demonstrated, particularly when there are cumulative impacts?

5.2 A General Framework for Post-EIA Monitoring

While each monitoring program must be tailored to its specific objectives and, hopefully, to advancing the accuracy and utility of impact predictions, the overall framework for devising a monitoring system developed by Marcus (1979) and reviewed and expanded by Canter and Fairchild (1986) is a helpful tool. Charts and tables from Marcus (1979) are reproduced at the conclusion of this paper for the convenience of readers. Two phases of making plans for a monitoring system are distinguished:

(i) Developing a monitoring system; and

(ii) Implementing and operating the system.

Central to the developmental phase of the framework are not only consideration of objectives and data requirements, but also a feasibility evaluation of institutional, cost, funding, personnel and time constraints. Important premises underlying this framework are: the use of routine monitoring data already collected to reduce costs; and the need for intergovernmental coordination. Canter and Fairchild (1986) demonstrate the use of a weighting technique to allocate limited budgets among monitoring indicators, based on the relative importance of each indicator and the relative cost of collecting data for each.

The second phase of a monitoring program entails its implementation. Central to this phase are not simply the collection and analysis of data, but its evaluation and interpretation, a critical point stressed in nearly all EIA monitoring discussions. Some practical problems of implementation pointed out by Canter and Fairchild (1986) were pointedly experienced in the case study presented in Section 7. These are: the importance of quality control in storing and retrieving data; contradictory, incompatible or inconsistent sources; and the communications gap between technical specialists and computer specialists. To these dilemmas, this author adds: the importance of performing pilot studies; training and monitoring the monitors in following established protocols; and re-examining protocols periodically.

6. THE MONITORING AUDIENCE/CLIENTELE

The clientele or audience for a monitoring program is to some extent defined by its objectives (see Section 3). An explicit discussion of the potential audience or clientele is, however, warranted. More often than not there are multiple recipients and potential beneficiaries, other than the targeted audience. The possibilities are:

(i) EIA scientists and practitioners, who can advance EIA theory and practice;

(ii) Affected community groups or individuals, who can be reassured or not about the realization of impacts or who can use monitoring information to help justify additional mitigation or compensation;

(iii) Policy-makers and decision-makers, both inside and outside the affected community, who can effectuate changes specific to the monitoring situation, or apply lessons learned to future situations or to policy changes;

(iv) Project developers, whether agencies or corporations, who can respond to problems based on monitoring results, modify future courses of action on similar projects, or justify their activities;

(v) Regulators, who must demonstrate compliance or who may be able to utilize monitoring information to modify permit conditions on the specific project or a future project; and

(vi) Lobby and special interest groups, NGOs, and others, who may use the results of monitoring to support advocacy positions.

While the intent of monitoring may not include the needs of all these groups, the evaluator or party responsible for presenting monitoring results needs to be mindful of potential use of data by many different groups with different agenda.

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TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*

[See plate 1 in pocket]

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
1. Define action	To determine type, scope, level, location, and timing of action(s) causing impacts.	1. Determine probable level of resource development, project market demands, formulate development schedule. 2. Describe action by its activity components. (Understanding of the specific activities is needed for impact prediction and for impact modification.) 3. Determine activities schedule. (Timing and duration of activities affects timing of impacts.) 4. Determine location of action.	Development level schedule, see figure 2.
2. Predict impacts	To determine type, magnitude, timing, and location of impacts resulting from the action.	1. Prepare environmental impact statement. (EIS identifies impacts associated with each aspect of the environment and the activities causing the impact.) Predict impact magnitude, timing, and area to be affected.	EIS description of impacts; see table 1 and figure 1. Map delimiting boundaries of study area and identifying location of activities and probable impact areas.
3. Identify and define major impacts	To identify impacts that should be monitored.	1. Identify impacts to be monitored on the basis of impact significance described in the EIS.	List of impacts to be monitored or activity/impact matrix with impacts requiring monitoring identified. See tables 5 and 6.

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
4. Obtain participation of agencies	To obtain participation of agencies in development of a monitoring system.	1. Contact all agencies having pertinent program responsibilities in area to be impacted. 2. Set up interagency meetings.	Interagency participation in the development of a monitoring system.
5. Identify agencies' authority for controlling or mitigating impacts	To identify agency potential for responding to impacts through their decisionmaking, planning, regulation, and enforcement authority.	1. Identify agencies' major areas of environmental concern. Determine for what aspects of the environment and for what type of impacts the agencies are responsible. (This focuses common areas of concern among agencies.)	List of agencies' areas of concern.
		2. Identify individual agency basis of authority to control impacts through decisionmaking, planning, regulation, and enforcement. 3. Identify additional agency authority necessary to integrate and coordinate the monitoring system.	List of potential agency decisionmaking, planning, regulation, and enforcement responses to impacts.
6. Define monitoring objectives	To define monitoring objectives.	1. Define monitoring objectives in terms of major potential impacts and in terms of agency authority. (The scope of the monitoring objectives determines the scope of the monitoring system. A general objective espoused by the author is that monitoring should be restricted to data collection that provides only that information necessary for carrying out impact reduction measures. Many of the	Statement of objectives of monitoring system.

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
6. Define monitoring objectives—Continued		within the jurisdiction of a particular agency. However, agencies presently may have no authority for ameliorating some impacts. For such instances, agencies must determine whether their objectives will include monitoring some impacts that do not fall under the purview of their agency. Monitoring of such impacts may justify creation of appropriate control mechanisms in the future. However, agencies must not require a needlessly complex data collection effort.)	
7. Determine data requirements	To determine data needs for achieving monitoring objectives. (Reiterations of this element may be necessary, based on revision of monitoring objectives, testing, and evaluation of data usefulness. See feedback loops on plate 1, in pocket.)	1. Reevaluate impacts on the basis of monitoring objectives; eliminate overlap in monitoring objectives and monitoring effort. (Some activities result in related environmental impacts. For example, ore extraction causes land surface disturbance, soil loss, and increased sediment yield. It may be sufficient to monitor only one of these impacts. 2. Select impact indicator. (This is the parameter that must be monitored to assess the magnitude of an impact. Several parameters may be indicative of a particular impact. Any impact indicator should be selected on the basis of	Descriptive list or table of monitoring requirements for each selected impact, including impact indicator, frequency and timing of collection, location of monitoring sites or areas, method of collection, and format.

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
7. Determine data requirements—Continued		its utility for decisionmaking, planning, regulation and enforcement. However, it may be necessary to use an alternative indicator if the necessary data are already being collected or the cost of monitoring the preferred parameter is high.) 3. Determine frequency and timing of data collection. (Frequency of data collection should be the minimum necessary for trend analysis, enforcement of regulations, and correlation of cause and effects. For some parameters the timing of data collection may be more important than the frequency level; for example, collection of water-quality data during a major runoff event is more important than a precise data collection frequency. Timing of data collection should relate to the timing of activities causing the impact. Different phases of an action may produce different impacts that persist after an activity ceases.) 4. Determine monitoring sites or collection areas. (These should be based on the location of the activities causing the impacts, predictions of areas most likely to be affected, and locations where inte-	

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
7. Determine data requirements—Continued		grated measurements would assist in gaining comprehensive understanding.) 5. Determine method of data collection. (Data can be collected in several ways. For example, vegetative-cover data can be collected by field collection methods or by remote-sensing techniques. Some factors to consider when selecting method of collection are: degree of accuracy, level of detail or scale, agency capability to use method, cost, and how well the method represents resultant impacts.) 6. Determine data type and storage format. (Data format possibilities include statistical tables, charts, graphs, summaries, maps, map overlays, computer printouts, and graphics. Criteria for selecting suitable format include: easy and convenient access to data by all users, intelligibility, interrelatability among formats, and ease of updating.) 7. Determine data analysis method.	
8. Review data requirements in terms of monitoring objectives	To ascertain that data needs defined in work element 7 will fulfill monitoring objectives.	1. Review data needs for conformance with monitoring objectives. 2. Revise data needs as necessary to meet monitoring objectives.	Revised list of data requirements.

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
9. Determine data availability	To determine extent to which data needs can be met under existing agency programs, and to define data gaps.	1. Identify what requirements are being met under existing programs, including frequency and timing of data collection, data collection location, accuracy, and method of collection.	Table relating data availability to data requirements and defining data gaps.
10. Conduct feasibility evaluation	To determine if proposed monitoring system is feasible within institutional, cost, funding, personnel, and time constraints.	1. Determine cost, personnel, and time requirements for obtaining data. 2. Determine agencies' capability for providing data. 3. Determine whether proposed monitoring system is feasible. If so, work element 11 has been achieved. If not, work elements 1 through 10 must be repeated at a reduced level. (There are several potential approaches for reducing the monitoring system to a feasible level: the scope of monitoring objectives can be reduced; alternative impact indicators can be selected; the frequency of data collection can be reduced; and alternative methods of data collection can be used.)	Description of cost, personnel, and time requirements for obtaining data.

From Marcus (1979).

TABLE 8.—*Explanation of flow chart of monitoring methodology: Phase I. Development of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
11. Define monitoring system. (This is a decision point. At this point participating agencies have decided what objectives the monitoring system will achieve, what impacts will be monitored, and what data will be collected. The next phase is implementation and operation of the monitoring system.)			

From Marcus (1979).

TABLE 9.—*Explanation of flow chart of monitoring methodology: Phase II. Implementation and Operation of a Monitoring System*—Continued

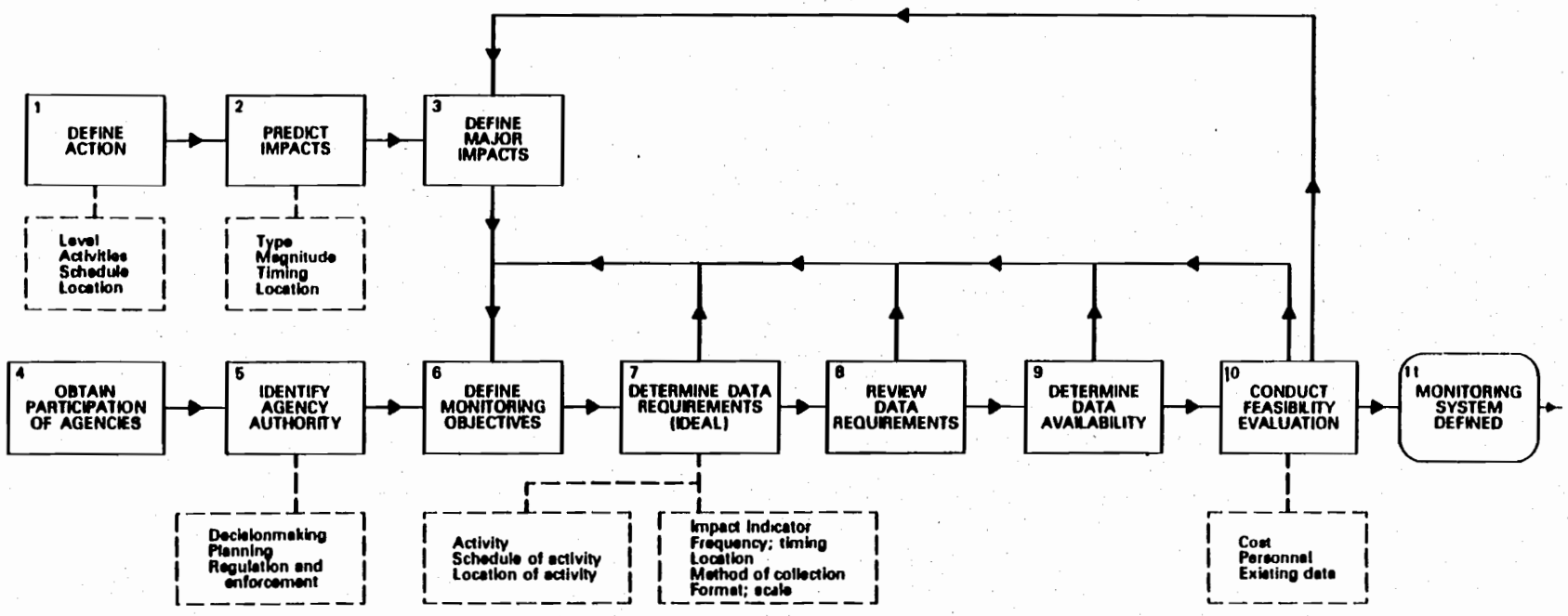
Work element	Objectives	Tasks necessary to achieve objectives	Products or results
12. Implement monitoring system—Continued		system; and assisting agencies obtain funding for data collection and for carrying out mitigating measures as needed.)	
		4. Prepare formal written agreement of agency responsibilities; obtain approval.	Formal agreement among participating agencies establishing monitoring system.
		5. Obtain needed funding.	Funding arrangement for operation of the monitoring system.
13. Collect data	To collect data required for defined monitoring objectives.	1. Collect data and submit results.	Data formatted for integrated storage/retrieval.
14. Analyze data	To determine the level, location, and duration of activities and impacts.	1. Determine activity and impact levels. 2. Define location of activities and impacts. 3. Determine duration of activities and impacts. 4. Correlate activity and impact data.	Analytical report of relationship of activities to impacts.
15. Evaluate impacts	To evaluate the significance of impact levels.	1. Identify impact trends; identify rate of change. (The rate at which an impact is increasing is significant because of the need to respond to impact trends in a timely fashion before critical impact levels are reached.) 2. Identify impacts that have reached critical impact levels. (Critical impact levels requiring immediate notification of participants should be set for each impact being monitored.) 3. Identify impacts that have exceeded legal limits.	Report(s) describing impact trends, critical level impacts, impacts not in conformance with regulations and standards, and successful mitigating measures.

From Marcus (1979).

TABLE 9.—*Explanation of flow chart of monitoring methodology: Phase II. Implementation and Operation of a Monitoring System*—Continued

Work element	Objectives	Tasks necessary to achieve objectives	Products or results
15. Evaluate impacts—Continued		4. Evaluate effectiveness of mitigating measures.	
16. Response by regulatory or responsible agencies	To use agencies' decision-making, planning, regulation, and enforcement authorities to reduce and prevent impacts.	1. Plan responses to impact trends. (Responses to unacceptable impacts can be directed at the activity causing the impact or at the impact itself. For example, surface mining causes destruction of wildlife habitat. Wildlife habitat destruction can be mitigated by: (1) stopping or reducing the activity, e.g., reducing the area of land surface disturbance or converting from surface to underground mining, or (2) modifying the impact, e.g., developing wildlife habitat areas to replace destroyed habitat.)	Plans for responding to impact trends.
		2. Respond to critical impact levels: stop or modify activities causing impact; treat impact.	Implementation of actions that reduce impact levels.
		3. Respond to nonconformance with regulations and standards through enforcement and prosecution. Develop additional regulations, standards, and legal authority as needed.	Enforcement of regulations and standards; establishment of additional legal constraints.
		4. Respond to evaluations of mitigating measures: revise, terminate, or add mitigating measures as appropriate.	Effective mitigating measures.
17. Document changes	To maintain record of (1) impact levels that result from projects and (2) effectiveness of mitigating measures in reducing impact levels.	1. Prepare report.	Annual summary report.
End products:	Input to future EIS; reduction, control of impacts.		

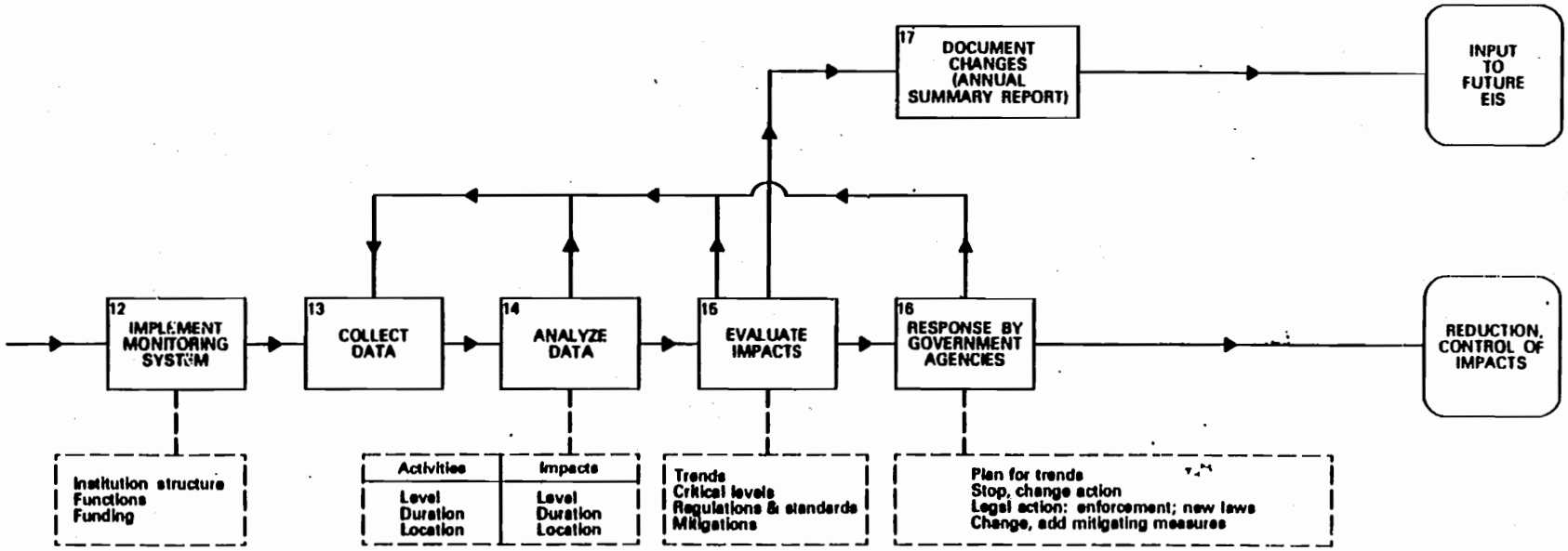
From Marcus (1979).



MONITORING METHODOLOGY FLOW CHART: PHASE I. DEVELOPMENT OF A MONITORING SYSTEM

Flow chart should be used with explanation provided in table 8. The solid numbered boxes correspond to the work elements listed in the table. Dashed boxes are annotations. The rounded box represents a decision point.

From Marcus (1979).



MONITORING METHODOLOGY FLOW CHART: PHASE II. IMPLEMENTATION AND OPERATION OF A MONITORING SYSTEM

Flow chart should be used with explanation provided in table 9. The solid numbered boxes correspond to the work elements listed in the table. Dashed boxes are annotations. The rounded boxes represent end points.

From Marcus (1979).

Annex 1

EXAMPLE OF AN NRM PROJECT MONITORING AND EVALUATION PLAN OUTLINE
GUINEA NATURAL RESOURCES MANAGEMENT PROJECT MONITORING AND EVALUATION PLAN [1]

1. EXECUTIVE SUMMARY

2. PROJECT BACKGROUND

2.1. General Description of the GNRM Project
2.2. Description of the Three Target Watersheds

3. PROJECT MONITORING AND EVALUATION

3.1. M&E Objectives
3.2. M&E and the NRM Analytical Framework

4. BASELINE DATA

4.1. Categories of Baseline Data

4.1.1. Demographic data
- Total population of each watershed
  - Population of each village
  - Number of households in each village
  - Disaggregate by gender
  - Disaggregate by age
  - Disaggregate by educational level
- Seasonal migration of population

4.1.2. Updated maps of villages
- Names and distances between all villages
- Total surface area of each target watershed
- Location of all project interventions

4.1.3. Socioeconomic data
- Proxies for household income/expenditures
  - Household inventories (radio, stove, cooking materials, agricultural tools, bicycles, etc.)
  - Type of housing construction
  - Number of grain storage facilities
  - Number of livestock
  - Marketed farm production
  - Expenditures on social events

4.1.4. Current and targeted locations of all project interventions
- Names of villages and families participating in each type of project activity
- Number of new adopters and size of fields, enterprises

1 Source: Son Nguyen, AID Guinea, A/CONF.151/26 (Vol. III), English

- Number of beneficiaries/intervention

4.1.5. Enterprises

- Numbers and types of small enterprises and project-supported enterprises per village
- Type of products sold and prices
- Household-level information on occupation of family members

4.1.6. Land use/tenure

- Woodland vs crop land
- Classified forest location, size
- Tenant vs land owners (gender rights to land
- Resource user groups and functions (number of trees planted, where)
- Household use of wood for fire

4.1.7. Agricultural Practices

- Number and types of interventions practiced
- Types and sizes of fields (tapades, external, low land)
- Types of crops, field size and yields (by gender)
- Types and number of livestock
- Marketed production of each crop/livestock (by gender)
- Market prices of agricultural goods
- Grain storage facilities
- Period of food shortage

4.1.8. Climatic data

- Monthly rainfall and number of days of precipitation
- Monthly temperature fluctuations
- Humidity

4.1.9. Natural resource endowment

- Soil fertility (organic matter, N, P, K/ Ca, Mg, pH, soil texture and structure, moisture content, water erosion)
- Number of spring and water flow
- Water quality (physical and chemical properties, biological contamination)
- Fallow period/length
- Natural vegetation (ratio of areas of natural vegetation over total area; percentage of trees/shrubs cover of total cultivated area)
- Wildlife (list and numbers of permanent and migratory species occurring, mapping of habitats)

4.2. Baseline Data Collection Procedures

4.2.1. Secondary data sources

4.2.2. Household surveys

4.2.2.1. Sample selection

4.2.2.2. Questionnaire

4.2.2.3. Timing of household surveys

4.3. Reporting Responsibilities

4.4. Establishment of a Data Base

5. PROGRESS INDICATORS

5.1. Categories of Progress Indicators

5.1.1. Primary Progress Indicators

- Types and number of training sessions, number of participants attending, and locations
- Extension activities in villages, number of participants, and locations
- Tables of all monthly interventions by locations

5.1.2. Secondary Progress Indicators

- Number (by gender) of people participating in each intervention
- Number of villagers (by gender) adopting each intervention
- Surface area covered by each agricultural intervention
- Quantity produced/marketed and value sold/traded by project supported enterprises
- Number of resource user groups (RUG) still functioning vs total number of RUGs formed
- Number of live trees vs total number of trees planted (survival rate)
- Total area protected by fire breaks established
- Number of capped springs and wells maintained by RUGs vs the number of sites completed
- Number of flood control canals maintained by RUGs vs the number of sites completed

5.2. Progress Indicator Collection Procedures

5.2.1. Project technicians' records

5.2.2. Field visits

5.2.3. Interviews of participating villagers

5.3. Reporting Responsibilities and Frequency

5.4. Database Maintenance

6. IMPACT INDICATORS

6.1. Categories of Impact Data

6.1.1. Biophysical Impact Indicators

- Changes in soil fertility
- Changes in water flow
- Changes in water quality
- Changes in vegetative cover
- Changes in wildlife population and habitat

6.1.2. Socioeconomic Indicators

- Changes in land use and tenure
- Changes in agricultural productivity and marketing
- Changes in household incomes and expenditures

6.2. Collection Procedures

6.2.1. Socioeconomic surveys

6.2.2. Field surveys

6.2.3. Soil and water analysis

6.3. Reporting Responsibilities and Frequency

6.4. Database Maintenance

7. USE OF M&E FINDINGS

- 7.1. Improvement of Project Performance
- 7.2. Project Reorientation and/or Redesign
- 7.3. Mitigation of Negative Environmental Impacts
- 7.4. Design of Future Projects

8. IMPLEMENTATION PLAN

- 8.1. Financing and Budgeting
- 8.2. Responsibilities
  - 8.2.1. Management Consultants
  - 8.2.2. Chemonics
  - 8.2.3. Farmers
  - 8.2.4. GOG/MARA/DNFC
  - 8.2.5. USAID
- 8.3. Calendar of Activities

9. ISSUES

- 9.1. Sustainability
- 9.2. Establishment of a National M&E System

Annex 3

EXCERPTS FROM THE ELECTRONIC COPY OF THE WORLD BANK ENVIRONMENTAL ASSESSMENT SOURCEBOOK ON ENVIRONMENTAL MITIGATION[1]

Environmental Mitigation or Environmental Management Plan

1. A project's mitigation or environmental management plan consists of the set of measures to be taken during implementation and operation to eliminate, offset, or reduce adverse environmental impacts to acceptable levels. Also included in the plan are the actions needed to implement them. Mitigation plans are essential elements of category A projects (see Annex E). Mitigation plans alone suffice for many category B projects. During the preparation of a mitigation plan, project sponsors and their EA design team (a) identify the set of responses to potentially adverse impacts; (b) determine requirements for ensuring that those responses are made effectively and in a timely manner; and (c) describe the means for meeting those requirements.

2. A mitigation or management plan should include the following items:

(a) identification and summary of all the significant adverse environmental impacts that are anticipated;

(b) description and technical details for each mitigation measure, including the type of impact to which it relates and the conditions under which it relates and the conditions under which it is required (e.g., continuously or in the event of contingencies), together with designs, equipment descriptions, and operating procedures, as appropriate;

(c) institutional arrangements -- the assignment of the various responsibilities for carrying out the mitigatory measures (e.g., responsibilities which involve operation, supervision, enforcement, monitoring of implementation, remedial action, financing, reporting, and staff training);

(d) implementation schedule for measures that must be carried out as part of the project, showing phasing and coordination with overall project implementation plans;

(e) monitoring and reporting procedures to (i) ensure early detection of conditions that necessitate particular mitigation measures, and (ii) provide information on the progress and results of mitigation; and

(f) integration into the total project cost tables of the cost estimates and sources of funds

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Produced from the *World Bank Environmental Sourcebook* Electronic Copy (1991), by using the *keyword*: 'mitigation.'

for both the initial investment and the recurring expenses for implementing the mitigation plan.

3. To strengthen environmental management capability in the agencies responsible for implementation, most mitigation plans cover one or more of the additional topics identified below:

a) technical assistance programs;

(b) staff development;

(c) procurement of equipment and supplies, and;

(d) organizational changes.

4. The borrower's decision to proceed with a project, and the Bank's decision to support it, will be in part predicated on the expectation that the mitigation plan will be executed effectively. Consequently, it is important to integrate the plan into the project's overall planning, design, budget, and implementation. Such integration should be achieved by establishing the mitigation plan as a component of the project. This precaution ensures that the plan will receive funding and supervision along with the other investment components.

5. Specific links should exist for (a) funding, (b) management and training (strengthening local capabilities), and (c) monitoring. The purpose of the first link is to ensure that the proposed actions are adequately financed. The second link helps embed in the overall management plan the training, technical assistance, staffing, and other institutional strengthening needed to implement the mitigatory measures. The third link is necessary to provide a critical path for implementation and to enable the sponsors and the Bank to evaluate the success of mitigation as a part of project supervision and as a means for improving future projects. These linkages may be part of the conditionality in Loan Agreements or in the Minutes of Negotiations.

Annex 3

WORLD BANK TECHNICAL PAPER NUMBER 140

Environmental Assessment Sourcebook

Volume II
Sectoral Guidelines

Environment Department

The World Bank
Washington, D.C.

Table 8.1. Agroindustry

Potential Negative Impacts	Mitigating Measures
Direct: Site Selection	
1. Siting of plant or facility complex on/near sensitive habitats.	1. • Location of plant in rural area away from estuaries, wetlands, or other sensitive or ecologically important habitats, or in industrial estate to minimize or concentrate the stress on local environment and services. • Involvement of natural resource agencies in review of siting alternatives.
2. Siting of agroindustry along water courses leading to their eventual degradation.	2. • Site selection examining alternatives which minimize environmental effects and not preclude beneficial use of the water body using the following siting guidelines: • on a watercourse having a maximum dilution and waste absorbing capacity • in an area where wastewater can be reused with minimal treatment for agricultural or industrial purposes • within a municipality which is able to accept the plant wastes in their sewage treatment system
3. Siting of agroindustry so that air pollution problems are aggravated.	3. Location of plant at a high elevation above local topography, in an area not subject to air inversions, and where prevailing winds are away from populated areas.
Direct: Agricultural Practices	
4. Environmental deterioration (erosion, contamination of water and soil, loss of soil fertility, disruption of wildlife habitat, etc.) from intensification of agricultural land use.	4. Control of agricultural inputs and cropping/grazing practices to minimize environmental problems.

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Plant Operation	
5. Aggravation of solid waste problems in the area.	5. • For facilities producing large volumes of waste, incorporation of the following guidelines in site selection: • plot size sufficient to provide a landfill or on-site disposal • proximity to a suitable disposal site • convenient for public/private contractors to collect and haul solid wastes for final disposal
6. • Water pollution from discharge of liquid effluents. • Plant: TSS; temperature; pH • Materials storage piles runoff: TSS; pH	6. Laboratory analysis of liquid effluent (including cooling water runoff from waste piles) in O/G, TDS, TSS, BOD, COD and in-situ temperature monitoring. <u>All plants, or as indicated by agroindustry type</u> • No cooling water discharge; if recycling not feasible, discharge cooling water only if receiving water temperature does not rise >3°C. • Maintain pH level of effluent discharge between 6.0 and 9.0. • Control effluent to EPA specified limitation (40 CFR 405-409;432) for specific process. • Land application of waste effluents where appropriate; the "Industrial Hazard Management" section should be consulted for guidelines regarding industrial hazardous materials.
7. Particulate emissions to the atmosphere from all plant operations.	7. Control of particulates by fabric filter collectors or electrostatic precipitators.

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Plant Operation (continued)	
8. Gaseous and odor emissions to the atmosphere from processing operations.	8. Control by natural scrubbing action of alkaline materials; an analysis of raw materials during feasibility stage of project can determine levels of sulfur to properly design emission control equipment.
9. Accidental release of potentially hazardous solvents, acidic and alkaline materials.	9. Maintenance of storage and disposal areas to prevent accidental release; provide spill mitigation equipment.
Indirect	
10. • Occupational health effects on workers due to fugitive dust, materials handling, noise, or other process operations. • Accidents occur at higher than normal frequency because of level of knowledge and skill.	10. • Development of a Safety and Health Program in the facility designed to identify, evaluate, and control safety and health hazards at a specific level of detail to address the hazards to worker health and safety and procedures for employee protection, including any or all of the following: • site characterization and analysis • site control • training • medical surveillance • engineering controls, work practices and personal protective equipment • monitoring • information programs • handling raw and process materials • decontamination procedures • emergency response • illumination • regular safety meetings • sanitation at permanent and temporary facilities

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures
Indirect (continued)	
11. Regional solid waste problem exacerbated by inadequate on-site storage.	11. Plan for adequate on-site disposal areas assuming screening for hazardous characteristics of the leachate is known.
12. Transit patterns disrupted, noise and congestion created, and pedestrian hazards aggravated by heavy trucks transporting raw materials and products to/from facility.	12. Site selection can mitigate some of these problems, but special transportation sector studies should be prepared during project feasibility to select best routes to reduce impacts; transporter regulation and development of emergency contingency plans to minimize risk of accidents.
13. Disease transmission from inadequate waste disposal.	13. Develop specifications for product preparation and/or processing, and waste disposal processes; monitor fecal coliform or other bacteria; and require documentation of waste disposal site monitoring.

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures

The following guidelines are World Bank guidelines. If they cannot be achieved, the appraisal and/or supervisory mission should fully document the reasons for deviations. Where local regulations differ from those below, the stricter regulations should prevail.

Leather Tanning and Finishing

Waste constituents:

Washing and soaking	BOD_5, TSS
Degreasing	BOD_5, TSS, O/G
Dehairing	BOD_5, TSS, pH, sulfides, nitrogen
Bating	Ammonia nitrogen
Pickling	Acids, salt
Tanning	Chromium, vegetable tannins
Retanning, coloring	Color, oil
Finishing	none

Leather Tanning and Finishing

EPA Effluent Guidelines and Standards or use the following general guidelines.

Constituent	A	B	C	D	E	F
BOD_5	2.8	3.2	2.6	1.0	3.2	1.4
TSS	3.0	3.6	2.8	1.2	3.6	1.6
O/G	1.1	1.3	1.0	0.48	1.3	0.68
Sulfides	0.010	0.012	0.010	0.004	0.012	0.006
Tot. Cr.	0.10	0.12	0.10	0.04	0.12	0.06
TKN	0.54	0.64	0.50	0.20	0.62	0.28
pH		6.0 to 9.0				
Fecal Col.		Not over 400 per 100 ml				

Plant Categories by Primary Process

A: Beamhouse - pulp hair; tanning-chrome; finishing
B: Beamhouse - save hair; tanning-chrome; finishing
C: Beamhouse - save hair; tanning-vegetable; finishing
D: Beamhouse - hair previously removed; tanned previously; finishing
E: Beamhouse - hair previously removed or retained; tanning-chrome; finishing
F: Beamhouse - pulp or save; tanning-chrome or no tanning; no finishing

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures
Palm Oil Mills Waste streams are acidic and have high TSS, O/G, and BOD_5.	**Palm Oil Mill Effluent Control** Limitations for liquid effluent include: pH 6 to 9 BOD <100 mg/l COD <1000 mg/l TSS <500 mg/l It is feasible to achieve 100 percent reduction of pollutant and waste effluent discharged to surface waters by one of the following: • spray irrigation • land application • evaporation ponds • discharge to municipal sewage treatment systems
Slaughterhouses Most important liquid effluent parameters are: BOD_5, TSS, O/G, pH, and fecal coliform organisms.	**Slaughterhouse Maximum Daily Effluent Limitations** Plant Type — BOD (a) — TSS (b) — O/G — pH simple — 0.12 — 0.20 — 0.06 — 6-9 complex — 0.21 — 0.25 — 0.08 — 6-9 a) per kg Live wt killed — b) per megagram MPN fecal coliform count <400 per 100 ml

Table 8.1. Agroindustry (continued)

Potential Negative Impacts	Mitigating Measures
<u>Wool Scouring</u>	
Raw waste contains significant quantities of O/G whose biodegradability constituents a special problem.	Grease recovery step is necessary to decrease potential pollution from O/G.
Sulfur is brought in with wool, as well as phenolic and other organic compounds; this could be discharged to receiving waters.	Liquid Effluent Guidelines: Mg = megagram; mg = milligram BOD_5 5 Kg/Mg product TSS 4 Kg/Mg product COD 20 Kg/Mg product O/G 7.2 mg/l Total Chromium 0.1 mg/l Phenol 0.1 mg/l Sulfide 0.2 mg/l Pesticides 0.01 mg/l

Table 8.2. Dams and Reservoirs

Potential Negative Impacts	Mitigating Measures
Direct	
1. • Negative environmental effects of construction: • air and water pollution from construction and waste disposal • soil erosion • destruction of vegetation, sanitary and health problems from construction camps	1. • Measures to minimize impacts: • air and water pollution control • careful location of camps, buildings, borrow pits, quarries, spoil and disposal sites • precautions to minimize erosion • land reclamation
2. Dislocation of people living in inundation zone.	2. Relocation of people to suitable area, provision of compensation in kind for resources lost, provision of adequate health services, infrastructure, and employment opportunities.
3. Loss of land (agricultural, forest, range, wetlands) by inundation to form reservoir.	3. Siting of dam to decrease losses; decrease size of dam and reservoir; protect equal areas in region to offset losses.
4. Loss of historic, cultural or aesthetic features by inundation.	4. Siting of dam or decrease of reservoir size to avoid loss; salvage or protection of cultural properties.
5. Loss of wildlands and wildlife habitat.	5. Siting of dam or decrease of reservoir size to avoid/minimize loss; establishment of compensatory parks or reserved areas; animal rescue and relocation.
6. Proliferation of aquatic weeds in reservoir and downstream impairing dam discharge, irrigation systems, navigation and fisheries and increasing water loss through transpiration.	6. Clearance of woody vegetation from inundation zone prior to flooding (nutrient removal); provide weed control measures; harvest of weeds for compost, fodder or biogas; regulation of water discharge and manipulation of water levels to discourage weed growth.

Table 8.2. Dams and Reservoirs (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
7. Deterioration of water quality in reservoir.	7. • Clearance of woody vegetation from inundation zone prior to flooding. • Control of land uses, wastewater discharges, and agricultural chemical use in watershed. • Limit retention time of water in reservoir. • Provision for multi-level releases to avoid discharge of anoxic water.
8. Sedimentation of reservoir and loss of storage capacity.	8. • Control of land use in watershed (especially prevention of conversion of forests to agriculture). • Reforestation and/or soil conservation activities in watersheds (limited affect). • Hydraulic removal of sediments (flushing, sluicing, release of density currents).
9. Formation of sediment deposits at reservoir entrance creating backwater effect and flooding and waterlogging upstream.	9. Sediment flushing, sluicing.
10. Scouring of riverbed below dam.	10. Design of trap efficiency and sediment release (e.g., sediment flushing, sluicing) to increase salt content of released water.
11. Decrease in floodplain (recession) agriculture.	11. Regulation of dam releases to partially replicate natural flooding regime.

Table 8.2. Dams and Reservoirs (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
12. Salinization of floodplain lands.	12. Regulation of flow to minimize effect.
13. Salt water intrusion in estuary and upstream.	13. Maintenance of at least minimum flow to prevent intrusion.
14. Disruption of riverine fisheries due to changes in flow, blocking of fish migration, and changes in water quality and limnology.	14. Maintenance of at least minimum flow for fisheries; provision of fish ladders and other means of passage; provide protection of spawning grounds; aquaculture and development of reservoir fisheries in compensation.
15. Snagging of fishing nets in submerged vegetation in reservoir.	15. Selective clearance of vegetation before flooding.
16. Increase of water-related diseases.	16. • Design and operation of dam to decrease habitat for vector. • Vector control. • Disease prophylaxis and treatment.
17. Conflicting demands for water use.	17. Planning and management of dam in context of regional development plans; equitable allocations of water between large and small holders and between geographic regions of valley.
18. Social disruption and decrease in standard of living of resettled people.	18. Maintenance of standard of living by ensuring access to resources at least equalling those lost; provision of health and social services.

Table 8.2. Dams and Reservoirs (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
19. Environmental degradation from increased pressure on land.	19. • Choice of resettlement site to avoid surpassing carrying capacity of the land. • Increase of productivity or improve management of land (agricultural, range, forestry improvements) to accommodate higher population.
20. Disruption/destruction of tribal/indigenous groups.	20. Avoid dislocation of unacculturated people; where not possible, relocate in area allowing them to retain lifestyle and customs.
21. Increase in humidity and fog locally, creating favorable habitat for insect disease vectors (mosquitos, tsetse).	21. Vector control.
Indirect	
22. Uncontrolled migration of people into the area, made possible by access roads and transmission lines.	22. Limitation of access, provision of rural development and health services to try to minimize impact.

Table 8.2. Dams and Reservoirs (continued)

Potential Negative Impacts	Mitigating Measures
Indirect (continued)	
23. Environmental problems arising from development made possible by dam (irrigated agriculture, industries, municipal growth).	23. Basin-wide integrated planning to avoid overuse, misuse, and conflicting uses of water and land resources.
External	
24. Poor land use practices in catchment areas above reservoir resulting in increased siltation and changes in water quality.	24. Land use planning efforts which include watershed areas above dam.

Table 8.3. Fisheries

Potential Negative Impacts	Mitigating Measures
Direct Impacts: Capture Fisheries	
1. Overexploitation of fisheries stock and long-term degradation of the resource base.	1. • Fisheries management for optimum sustained yield: • restricted harvests (minimum size limits, catch quotas, seasonal closures) • gear restrictions (trawl bans, specified net mesh sizes) • closure of areas (permanent reserves, periodic closures) • limited entry systems (licensing, exclusive access) • prohibited practices (use of explosives, drift nets) • consideration of sustainable traditional fishery practices and incorporation to extent possible in modern fisheries management systems
2. Capture of non-target species and habitat damage through use of certain equipment and fishing practices.	2. • Limitation or prohibition of use of such equipment and fishing practices. • Testing and pilot scale use prior to large scale introduction of new technologies. • Expanded use of fish by development of new products and markets.
3. Pollution from oil and fuel spills and leakage, and from bilge flushing.	3. • Public education programs on proper fuel and oil handling and bilge waste disposal. • Provision of storage and handling facilities, bilge evacuation and disposal services. • See "Inland Navigation" and "Port and Harbor Facilities" sections in Chapter 9.

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
Direct Impacts: Capture Fisheries (continued)	
4. Diver and anchor damage.	4. • Public education programs for fishermen on effects of damage and ways to avoid it. • Installation of mooring buoys. • Designation of anchoring locations.
5. "Ghost-fishing" and navigational hazards from abandoned or lost fishing nets and traps.	5. Public education programs for fishermen on hazards of abandoning gear.
6. Use of explosives and poison.	6. Prohibition of practices and enforcement of regulations.
7. Introduction of exotics leading to degradation of native stocks.	7. Prohibition of exotics introduction.
Direct: Culture Fisheries	
8. Clearing/conversion of coastal wetlands for construction of ponds.	8. • Prohibition of ponds in area of particular ecological significance. • Limitation of area converted to ponds. • Intensified management in existing and new ponds to discourage "shifting aquaculture" and low-input, extensive aquaculture which converts large areas.

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Culture Fisheries (continued)	
9. Erosion and siltation problems arising in construction phase.	9. • Restriction of clearance to area needed for ponds. • Pond construction during dry seasons. • Stabilization of exposed soil with grasses or other ground covering.
10. Competition of ponds for water and land resources demanded by other users.	10. • Assessment of existing traditional land and water use and agricultural, industrial and municipal demands. • Planning, management and continuing negotiations to reach acceptable distribution of resources. • Siting of pond to avoid disruption of traditional uses of water for washing and drinking. • Coordination of aquaculture ponds with other activities to double-up on water use (e.g., pond water reused for irrigation).
11. Loss of productivity or formation of toxic conditions in ponds from high temperatures, low oxygen and waste accumulation.	11. Adequate pond water exchange and frequent pond flushing.
12. Acidification of pond water due to hydrogen sulfide formation.	12. • Siting in areas not susceptible to acidification (avoid waterlogged soils high in pyrite and organic matter). • Adequate pond water exchange and flushing.

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Culture Fisheries (continued)	
13. Local depletion of larval and juvenile organisms for pond stocking.	13. Production of larvae and juveniles in nursery.
14. Water pollution from pond effluent (nutrient-rich and with varying chemical content depending on intensity of pond management).	14. • Release into water body with adequate dilution and dispersal capability. • Dilution prior to release. • Timing of release with period of high water. • Shorter retention time of water in pond: more frequent pond water exchange and flushing. • Treatment of water prior to release.
15. Introduction of exotics with subsequent damage to native stocks by competition, predation, spread of disease and parasites.	15. • Avoidance of exotic introductions except where adequate knowledge of biology and life history of species indicates low risk of negative impacts and where adequate safeguards against escape are taken. • Regular monitoring for disease and parasites; if present and spreading, elimination of infected populations. • Consideration of using sterile hybrids.

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Culture Fisheries (continued)	
16. Spread of disease in aquaculture stocks and into natural stocks when stocking becomes too dense.	16. • Monitoring of disease incidence. • Limitation of numbers when disease is positively correlated with fish densities. • If disease spreads, elimination of diseased individuals.
17. Concentration of pens, pilings, and rafts in natural (non-pond) water bodies to extent that navigation is hampered, water circulation is restricted, water quality is decreased, and capture fisheries precluded.	17. Regulation of aquaculture activity to limit it to acceptable intensity.
External Impacts: Capture Fisheries and Culture Fisheries	
18. Dams which alter water quality and stream flows and disrupt riverine and floodplain fisheries.	18. • Establishment of reservoir fishery. Water release management to minimize damage to fisheries (see "Dams and Reservoirs" section).
19. Irrigation schemes which alter water quality and quantity.	19. • Development of fishery activities in conjunction with irrigation systems (e.g., use of pond water for irrigation, traps and nets in irrigation canals). • Management of irrigation schemes to minimize damage to fisheries (see "Irrigation and Drainage" section).

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
External Impacts: Capture Fisheries and Culture Fisheries (continued)	
20. Land use and agricultural practices in watersheds affecting sediment content and water quality.	20. • Integrated watershed planning and management. • Close coordination between fisheries and government agencies responsible for resource management in watersheds to alert them to impacts on fisheries.
21. Flood control measures damaging to water quantity and quality and aquatic habitats.	21. See "Flood Protection" section.
22. Pollution from industrial effluent, sewage and agrochemicals affecting fish survival and tainting fish.	22. See "Wastewater Collection, Treatment, Reuse, and Disposal Systems" section in Chapter 9; see also the sections on "Plant Siting and Industrial Estate Management" and "Industrial Hazard Management" in Chapter 10.
23. Air pollution and acid rain affecting fish survival.	23. See "Atmospheric Pollution" section in Chapter 2.
24. Coastal development involving dredging, filling, destruction of mangrove swamps, construction and infrastructure development.	24. See "Coastal Zone Management" section; "Port and Harbor Facilities" projects are discussed in Chapter 9.
25. Oil pollution from coastal and inland navigation, and spills from drilling, transport operations, and oil tankers (cleaning of tanks).	25. See the following sections in Chapter 9: "Inland Navigation" and "Port and Harbor Facilities"; "Oil and Gas Development--Offshore" and "Oil and Gas Development--Onshore" are examined in Chapter 10.
26. Water-based tourism development which conflicts with fishing activities.	26. See "Tourism Development" section in Chapter 9.

Table 8.3. Fisheries (continued)

Potential Negative Impacts	Mitigating Measures
Indirect Impacts: Capture Fisheries and Culture Fisheries	
27. Creation or expansion of port areas, shore facilities and infrastructure (roads, water, power) for processing and transport of fish products.	27. See "Plant Siting and Industrial Estate Management"; "Coastal Zone Management"; and "Port and Harbor Facilities."
28. Pollution from effluent discharged from industrial fish processing plants.	28. • Discharge into waters with adequate dilution and dispersal capabilities. • Water quality monitoring for suspended solids, oil and grease, dissolved oxygen, nitrogen and coliform. • Reduction of wastes by recycling into usable products, reduction of water use. • Treatment of waste prior to release.

Table 8.4. Flood Protection

Potential Negative Impacts	Mitigating Measures
Direct	
1. Flooding of lesser magnitude, but greater duration of floodplain downstream due to dam releases.	1. Adaptation by changes in agricultural practices.
2. Potential for structural failure and floodwaters higher than capacity of control structures/measures, leading to increased risk to life and property because local pre-project adaptations are relaxed or abandoned or increased development on the floodplain has occurred post-project.	2. Implementation of non-structural measures to prevent increased flood risk, and of a flood warning system.
3. Cycle of enrichment and groundwater recharge in floodplain soils broken.	3. Where dams are present, partial mitigation of effect by regulation of discharge to imitate natural flooding in a controlled way.
4. Resettlement of populations and other negative socioeconomic effects on populations and communities affected by the project.	4. • Identification of at-risk population groups or groups who may be adversely affected by flood control measures. • Incorporation of their interests and protection into project planning and cost analysis to minimize losses or provide in-kind compensation for losses.
5. Adverse effects on fisheries and other aquatic resources by disruption of migratory routes, deterioration of habitat and changes in water quality (e.g., sediment load), leading to reduced productivity of riverine, coastal and marine fisheries.	5. • Installation of fish passageways. Protection of reproductive sites for fish. • Incorporation of fishery management, including hatchery and restocking programs.

Table 8.4. Flood Protection (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
6. • Negative impacts of channelization measures: • disruption of fish habitat by elimination of pools, riffles and channel irregularities • increased water temperature by removal of vegetation on banks and in stream • increased erosion and sedimentation problems • bed and bank erosion • downstream flooding and sedimentation	6. • Careful selection of engineering options at planning stage. • Limitation of degree of channel modification or maintenance. • Mitigating measures after construction phase. • Minimize reduction of channel length and preserve some meanders. • Limit excavation and fill. • Limit destruction of bank and streamside vegetation. • Replant/reseed banks. • Excavate only one and not both banks, etc. (See Brookes 1988.)
7. Adverse effects of construction.	7. • Minimization of effects by avoiding impediments to natural drainage, uncontrolled run-off and soil erosion, and air pollution. • Provision for adequate filling of borrow areas, control of land clearing, and disposal of spoil. • Limitation of access of vehicles to stream bank.

Table 8.4. Flood Protection (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
8. Reduction of floodplain grazing, both through ecological changes on the floodplain and intensified development (e.g., irrigated agriculture).	8. • Production of fodder crops and usage of byproducts of irrigated food crops and development of alternative water sources. • Integration of existing rangeland use (e.g., semi-nomadic herding) with planned developments, to ensure substantial grazing and watering possibilities in valley during dry season.
9. Reduction of recession agriculture.	9. Maintenance of natural flooding regime to extent possible in most productive lands (and intensification of production) by maintaining water courses free of flood control structures or installing structures to enable semi-controlled flooding.
10. Obstacles (levees, dikes, etc.) to wildlife passage.	10. Construction of bridges or special crossing places.
11. Loss of wildlands and wildlife habitat.	11. Identification of critical habitats and planning of flood control measures to minimize effects; where habitats or species are dependent on natural flooding regime, minimize disruption of flow in that area to extent possible.
12. Flooding problems created downstream.	12. • Protection of natural overflow areas downstream. • Creation of overflow basins.

Table 8.4. Flood Protection (continued)

Potential Negative Impacts	Mitigating Measures
Indirect	
13. Improved accessibility, development opportunities in floodplain, and sense of security after flood control measures taken, leading to influx of people with associated agricultural development, deforestation, wildlife poaching, infrastructure development, etc.	13. • Limitation of access, if possible. • Planning for anticipated influx and implementation of companion rural development activities. • Introduction of non-structural control measures.
14. Increased fertilizer use on agricultural fields to compensate for loss of fertility, leading to water pollution and dependence on imported supplies.	14. • Optimal timing and rate of application. • Use of nitrogen fixing cover crops. • Use of organic instead of chemical fertilizers.

Table 8.5. Natural Forest Management

Potential Negative Impacts	Mitigating Measures
Direct: Logging	
1. • Soils • Erosion: disturbance of the forest understory and soil, increasing susceptibility to water erosion. • Slope stability: roadcuts across sloping terrain and clearing of vegetation on the slopes resulting in landslips and landslides. • Nutrient loss: loss of nutrients from timber harvesting and increased leaching; exposed, disturbed soils where vegetation has been removed. • Temperature: dramatic increase in temperature after removal of forest canopy, killing soil organisms or drying the soil to extent that regeneration is hindered. • Structure: compaction and loss of organic matter altering soil structure, and reducing infiltration, water holding capacity, aeration and root penetration; laterization.	1. • Avoid logging in the rainy season and establish criteria for logging on slopes and near water; and clearly mark areas that should not be harvested. • Supervise logging to reduce damage and encourage rapid regeneration. • Use low impact harvesting equipment and methods and minimize skid trail distances. • Locate log landing in well drained, easily accessible areas downslope so a straight skid road can be followed. • Restore land by grading and reseeding disturbed areas, including guidelines, locating them away from slopes and water and keeping them well maintained. • No whole-tree harvest in areas of low nutrient levels, leaving all but boles on the site.
2. • Vegetation • Species composition: species diversity decreased by selectively harvesting the best stems of valuable species. Soil conditions and light regimes created by various harvesting methods influencing regeneration dynamics of forest stands.	2. • Collect information or sponsor research on plant community dynamics, regeneration biology and silviculture of forest type. • Consider (and perhaps research) various regeneration and harvesting methods.

Table 8.5. Natural Forest Management (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Logging	
2. • Vegetation (continued)	
• Weeds: opening of the forest canopy resulting invasion of weeds, impeding natural regeneration and reforestation efforts. • Slash: logging debris as a fire hazard and impediment to regeneration. • Blow downs: increased danger due to opening up patches by logging.	• Collect information or sponsor research on plant community dynamics, regeneration biology and silviculture of forest type. • Consider (and perhaps research) various regeneration and harvesting methods. • Choose silvicultural system that will ensure regeneration and sustainable production and minimize damage (leave adequate number and quality of seed trees, selective harvest, small cuts to avoid large gaps). • Establish preserves/parks of ecologically significant forest areas, ensuring that area is large enough to maintain biological diversity, ecological processes and cultural assets.
3. • Wildlife	3. • Maintain inventory of and collection of research results on species present in the area.
• Fisheries: sedimentation, nutrient loading, changes in streamflow and water temperature caused by logging causing dramatic changes to fish populations. • Wildlife habitat: disruption of habitat, loss of tree species on which wildlife species depend, and disturbing migratory routes of wildlife leading to depletion of wildlife. • Presence of machines and people: disturbance of wildlife through logging and transport activities. • Poaching: increased poaching of wildlife due to influx of people resulting directly and indirectly from forestry activities.	• Plan harvesting intensity, methods and timing based on this information. • In particular, ascertain presence of or migratory use by endangered species through contact with wildlife professionals in government, NGOs and universities.

Table 8.5. Natural Forest Management (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Logging (continued)	
4. • Air • Dust: logging activities and timber transportation on dirt roads generating large amounts of dust in dry season or semi-arid zones.	4. • Reduce burning. • Avoid creating large tracts of open land. • Limit operations when dust and fire are a problem and plan transportation routes to avoid population centers.
5. • Water • Extremes of flow: soil infiltration and water holding capacity of harvested areas reduced such that water runoff is much more pronounced, aggravating flooding when rains come and low flow during dry season. • Groundwater recharge: rain water recharge of aquifers reduced due to increased runoff. • Ponding and stagnation: land form changes, water course obstruction and soil compaction causing localized ponding and stagnation. Increased sedimentation altering natural aquatic biology and water course features. • Increased temperature: opening of the forest canopy adjacent to water body increasing water temperature, which alter aquatic biology and water chemistry. • Contamination: water pollution from petroleum products, herbicides and organic waste associated with forestry operations. Turbidity due to increased sediment loading altering sunlight penetration, affecting aquatic plants and damaging fish species.	5. • Maintain vegetation as buffer zones adjacent to every body of water. • Assess impact of forestry on sediment and nutrient loading on stream flow and methods used to reduce impact. • Provide adequate waste disposal facilities. • Procedure for use and storage of chemicals, oil and fuel to minimize potential for pollution.

Table 8.5. Natural Forest Management (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Logging (continued)	
6. • Social and Cultural • Local economic and social customs: impacts on labor market and labor availability for food production, a shift to more cash-based economy, alteration of daily living patterns and political power structure changes are common. • Land tenure and traditional forest uses: hunting, gathering and traditional exploitation of forest resources disrupted; limitation of access of resources by local populations. • Overloading of infrastructure and social services (e.g., housing, education and health services) by in-migration of forest workers and spontaneous settlers and social problems such as an increase in crime, alcoholism, disease and violence.	6. • Incorporate local communities in planning and execution of project. • Develop local infrastructure to handle increase in population (i.e., waste disposal, school, health care and law enforcement). • Protect significant cultural landmarks and traditional land and resource use patterns. • Establish clear, long-term jurisdiction over the forest emphasizing local involvement in decision making. • Involve local leaders in protection to avoid illegal harvesting or settlement. • Monitor and control disease.
Indirect: General	
7. • Increased access: roads opening forest areas causing uncontrolled population in-migration with subsequent problems.	7. See "Rural Roads" section.
Indirect: Road Construction and Transport	
8. • Direct impacts (e.g., increased soil erosion and sedimentation of surface water) and indirect impacts of road construction (see "Rural Roads" section).	8. Align route, drainage works, etc. (See No. 7.)

Table 8.5. Natural Forest Management (continued)

Potential Negative Impacts	Mitigating Measures
Indirect: Road Construction and Transport (continued)	
9. • Degradation of existing public roads by heavy timber loads.	9. • Restrict load size. • Use road taxes to upgrade road.
External	
10. Cattle-ranching operations that clear forests for pasture.	10. See "Livestock and Rangeland Management" section.
11. Conversion to commercial agriculture (rubber, oil palm, coffee, rice, etc.).	

Table 8.6. Plantation Development/Reforestation

Potential Negative Impacts	Mitigating Measures
Direct: Site Preparation	
1. Soil erosion from clearing site.	1. • Reestablishment of forest cover as soon as possible after clearing. • Use of fast growing, intermediate tree crops or mulching of exposed soils. • No clearing on steep, unstable slopes or highly erosive soils. • Limitation of plantation size or stand sizes. • Limitation of site preparation to dry season.
2. Soil compaction and puddling by machinery.	2. • Limitation of use of machinery. • Manual site preparation.
3. • Loss of organic matter and nutrients by removal of vegetation and leaching. • Development of hardpans and laterization.	3. • Rapid replanting. • Cover crops. • Mulching.
4. Where burning is involved, air pollution from smoke.	4. • Limitation of use of fire and size of burn where possible. • Burning in wet season.

Table 8.6. Plantation Development/Reforestation (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Plantation Management and Harvesting	
5. Soil erosion from harvesting.	5. • Replanting as soon as possible after cut. • Avoidance of clear cutting; practice of "small coupe logging" (characterized by checkerboard pattern of alternating small cuts with unlogged areas). • Limitation of harvesting to dry season or season of low rainfall. • Planning of felling to minimize log skidding and avoidance of skidding logs parallel to slope. • Stabilize skid trails as soon as possible after use. • Use of animals instead of skidders for extraction.
6. Loss of nutrients from the system by thinning and clear cutting and by whole-tree harvest.	6. • Logging debris left on ground after harvesting and removal of boles only (no whole-tree harvesting). • Planting of cover crops between rotations; addition of fertilizer to compensate for nutrients loss.
7. Use of fertilizer, pesticides and herbicides having negative impacts on-site and on quality of local water bodies.	7. • Limitation of potential of pest and disease infestations by choice of resistant species. • Choice of chemicals with least potential negative impacts. • Controlled use of chemicals.

Table 8.6. Plantation Development/Reforestation (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Plantation Management and Harvesting (continued)	
8. Chemical and biological changes in the soil as litter becomes dominated by one or a few species and decomposition dynamics are altered.	8. Limitation of size of stands and interspersal with stands of native vegetation.
9. • Direct damage in harvesting operations by dragging and skidding logs causing compaction. • Localized soil erosion and unequal distribution of debris and organic matter over the site.	9. • Use of manual methods or animal power for clearing forest instead of mechanical means. • In short rotation plantations plan use of same tracks and loading areas in harvesting operations to protect as much of site as possible.
10. In semi-arid zones depletion of soil moisture and lowering of water table in plantation area.	10. • Choice of low water demanding species. • Water catchment and conservation techniques to minimize runoff and evaporation losses and maximize infiltration.
11. Build up of organic matter under plantations posing a fire hazard.	11. Periodic clearing or burning to keep volume low.
12. Increased sedimentation of streams.	12. • Buffer zones of undisturbed forest 20-40 m wide along streams. • Avoidance of earthfill dams across streams as crossings. • Sediment traps in streams. • Avoidance of skidding trees in stream.

Table 8.6. Plantation Development/Reforestation (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Plantation Management and Harvesting (continued)	
13. Increased organic matter entering surface waters in form of leaf litter and logging debris or from logs transported on river leading to decrease in water quality and perhaps eutrophication, and navigational hazards.	13. • Buffer zones along streams. • Spaced transport of logs in river over time.
14. Soil erosion from logging roads.	14. • Siting of roads on ridge tops or valley bottoms and avoidance of steep grades on hillsides. • Engineering to ensure proper drainage or provision of drainage measures. • Stabilization of road cuts with mulch, wood chips, etc. • Minimized use of borrow pits or stabilization after use. • Proper road maintenance. • Use of rivers for log transport (see also "Rural Roads" section).
Displacement of Other Ecosystems	
15. Loss of habitat and decreased biological diversity by replacement of natural forest by plantations with limited number of species and increased uniformity of forest structure.	15. • Protection of natural forest area with particularly high or unique biological diversity. • Limitation of plantation establishment to degraded sites or sites of low diversity.

Table 8.6. Plantation Development/Reforestation (continued)

Potential Negative Impacts	Mitigating Measures
Displacement of Other Ecosystems (continued)	
	• Increase in number of species planted and avoidance of monocultures over large area.
	• Restriction of size of individual stands and mixing of stands of various age classes.
	• Conservation of islands of untouched forest or natural vegetation.
	• Separation of stands by belts of native vegetation and use of native species as plantation species.
16. Increased potential for massive loss by pests or pathogens (through simplification of natural ecosystem, provision of abundant food for pest, increased pest habitat, absence of natural controls (e.g., in the case of introduced exotic tree species).	16. • Use of native species.
	• Choice of species and provenances with pest or disease resistance.
	• Rotation length to minimize susceptibility (e.g., cutting before trees are overmature).
	• Thinning and other stand improvement measures to remove dead and diseased material, and wood residues which act as centers for infection.
	• Direct pest or disease control.
17. Loss of forest products from native species.	17. Careful evaluation of local use of forest products to accommodate continued use and determine feasibility of developing local industries based on these goods.

Table 8.6. Plantation Development/Reforestation (continued)

Potential Negative Impacts	Mitigating Measures
Displacement of Other Ecosystems (continued)	
18. Spread of plantation species outside of plantation becoming a nuisance, competing with native species and becoming weeds in agricultural fields.	18. Species choice to avoid ones that will grow out of control from desired site.
Socioeconomic Impacts	
19. Social impacts from influx of people from outside, both wage earners and spontaneous setters, induced by road building into remote areas (direct and indirect impacts).	19. See the following sections: "New Land Settlement"; "Indigenous Peoples"; and "Induced Development."
20. Problems related to land tenure and land and resource use rights leading to unequitable sharing of costs and benefits of the project.	20. • Genuine integration of local communities and peoples in project planning and implementation. • Pre-project socioeconomic surveys and assessments and land and resource use studies. • Provision of alternatives which fairly compensate local people who incur losses.

Table 8.7. Irrigation and Drainage

Potential Negative Impacts	Mitigating Measures
Direct	
1. Soil erosion (furrow, surface).	1. • Proper design and layout of furrows or field avoiding too steep a gradient. • Land leveling. • Design of terraces on hillside minimizing surface erosion hazard.
2. Soil erosion (with sprinkler irrigation on hilly area).	2. Design of sprinkler system minimizing erosion hazard assuring infiltration rate exceeds application rate of the sprinklers.
3. Waterlogging of soils.	3. • Regulation of water application to avoid overwatering (including controlled turn-out to allow cutting off water supply to irrigation ditches). • Installation and maintenance of adequate drainage system. • Use of lined canals or pipes to prevent seepage. • Use of sprinkler or drip irrigation.
4. Salinization of soils.	4. • Measures to avoid waterlogging: • leaching of salts by flushing soils periodically • cultivation of crops with salinity tolerance

Table 8.7. Irrigation and Drainage (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
5. Scouring of canals.	5. Design of canal system to minimize risk and use of lined canals.
6. Clogging of canals by sediments.	6. • Measures to minimize erosion on fields. • Design and management of canals to minimize sedimentation. • Provision of access to canals for removal of weeds and sediments.
7. Leaching of nutrients from soils.	7. • Avoidance of overwatering. • Replacement of nutrients by fertilizers or crop rotations.
8. Algal blooms and weed proliferation.	8. Reduction of input to and release of nutrients (nitrogen and phosphorous) from fields.
9. Clogging of canals by weeds.	9. • Design and management of canals to minimize weed growth. • Provision of access to canals for treatment or removal of weeds.
10. Deterioration of river water quality below irrigation project and contamination of local ground water (higher salinity, nutrients, agrochemicals) affecting fisheries and downstream users.	10. • Improved water management; improved agricultural practices and control of inputs (particularly biocides and chemical fertilizers). • Imposition of water quality criteria.

Table 8.7. Irrigation and Drainage (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
11. Sea water intrusion into downstream freshwater systems.	11. • Reduction of takeoff to maintain adequate downstream flow. • Recharge of coastal aquifers through injection wells.
12. Reduction of downstream flows affecting flood plain use, flood plain ecology, riverine and estuarine fisheries, users of water, dilution of pollutants.	12. • Relocation or redesign of project. • Regulation of takeoff to mitigate effects. • Compensatory measures where possible.
13. Encroachment on swamps and other ecologically sensitive areas.	13. Siting of projects to avoid or minimize encroachment on critical areas.
14. Alteration or destruction of wildlife habitat or impediment to movement of wildlife.	14. • Siting of project to minimize loss or avoid encroachment on most sensitive or critical areas. • Establishment of compensatory parks or reserved areas. • Animal rescue and relocation. • Provision of corridors for movement.
15. Impediment to movement of livestock and humans.	15. Provision of passageways.

Table 8.7. Irrigation and Drainage (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
16. Threat to historic, cultural or aesthetic features.	16. • Siting of project to prevent loss. • Salvage or protection of cultural sites.
17. Alteration or loss of flood plain vegetation and disturbance of coastal ecosystems (e.g., mangroves).	17. • Siting of project to less vulnerable area. • Limitation and regulation of water take-off to minimize problems to extent possible.
18. Dislocation of populations and communities.	18. • Siting of project to minimize effect. • Resettlement scheme ensuring at least equal standard of living.
19. Introduction or increase in incidence of water-borne or water-related disease (schistosomiasis, malaria, onchocerciasis, etc.).	19. • Prevention measures: • use of lined canals or pipes to discourage vectors • avoidance of stagnant or slowly moving water • use of straight or slightly curving canals • installation of gates at canal ends to allow complete flushing • filling or draining of borrow pits along canals and roads • disease prophylaxis • disease treatment

Table 8.7. Irrigation and Drainage (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
20. Disease and health problems from use of wastewater in irrigation.	20. • Wastewater treatment (e.g., settling ponds) prior to use. • Establishment and enforcement standards for wastewater use.
21. Conflicts over water supply and inequalities in water distribution throughout service area.	21. Means to ensure equitable distribution among users and monitor to assure adherence.
22. Overpumping of groundwater.	22. Limitation of withdrawal so that it does not exceed "safe yield" (recharge rate).
Indirect	
23. Increased pollution and health hazards from downstream industrial and municipal pollutants caused by decreased flow (decreased dilution) of river water.	23. • Control of waste sources downstream. • Reduction of water take-off.
External	
24. Water quality deteriorated or made unusable by upstream land use and pollutants discharge.	24. • Control of land use in watershed areas. • Control of pollution sources. • Water treatment prior to use.

Table 8.8. Livestock and Rangeland Management

Potential Negative Impacts	Mitigating Measures
Direct	
1. Degradation of vegetation resources due to overgrazing.	1. • Limitation of animal numbers. • Control of length of grazing time on particular areas. • Mixing of livestock species to maximize use of vegetation resource. • Reseeding and fodder production. • Cut-and-carry. • Strategic placement of water points and salt.
2. • Increased soil erosion due to clearing of vegetation and trampling. • Increased saltation of surface waters.	2. • Restriction of livestock access to unstable areas (e.g., stoop slopes). • Soil erosion control measures (e.g., reforestation, reseeding of grasses, land preparation, terracing).
3. • Deterioration of soil fertility and physical characteristics through: • removal of vegetation • increased erosion • soil compaction	3. Same as 1 and 2.
4. Increased rapid runoff due to vegetation clearing and soil compaction (decreased infiltration capacity).	4. • Water conservation measures and water spreading. • Same as 1 and 2.

Table 8.8. Livestock and Rangeland Management (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
5. • Degradation of vegetation and soil around water points. • Overtapping of groundwater. • Lowering of watertable and degradation of vegetation locally by drilling and use of boreholes.	5. • Development of many small-capacity water sources. • Strategic placement of water points. • Control of use of water points (animal numbers and time of year). • Closure of permanent water sources when temporary pools and streams are available. • Limitation of well capacity by choice of technologies (e.g., handpumps or buckets instead of motor pumps).
6. • Displacement or reduction of wildlife populations by reduction of habitat. • Disruption of migratory routes. • Competition for food and water resources. • Introduction of diseases. • Impacts of burning. • Increased poaching and killing of wildlife considered as pests or predators to livestock.	6. • Planning and implementation of range management strategies (choice of species, livestock numbers, grazing areas) that minimize negative impacts on wildlife. • Establishment of compensatory wildlife refugees. • Investigation of management of wildlife ranching which will help protect wildlife resources.

Table 8.8. Livestock and Rangeland Management (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
7. Pollution environmental disruption and health hazards from disease and pest control measures.	7. • Choice of chemical that is species-specific, short residence time (active period), and has low impact on other biologic resources. • Protective measures for field workers. • Spraying methods and timing to minimize potential of water pollution. • Selection of disease-resistant livestock breed.
8. Reduction of genetic variability due to selective breeding.	8. Conservation of genetic diversity in-site (protection of wild relatives in natural habitat, maintaining variability within populations by breeding) and ex-situ (e.g., preservation of genetic material in "banks").
9. Negative effects of uncontrolled burning for brush control on soil and vegetation (deterioration of soil fertility and soil structure, altered wildlife habitat, destruction of vegetation).	9. Implementation of well-planned and controlled burning programs.
10. Conversion of moist tropical lowland forests for livestock production resulting in long-term environmental degradation and unsustainable production.	10. Avoidance of clearing such forests for livestock production.

Table 8.9. Rural Roads

Potential Negative Impacts	Mitigating Measures
Direct: During Construction	
1. Erosion from fresh road cuts and fills and temporary sedimentation of natural drainage ways.	1. • Limitation of earth moving to dry periods. • Protection of most susceptible soil surfaces with mulch. • Protection of drainage channels with berms, straw or fabric barriers. • Installation of sedimentation basins, seeding or planting of erodible surfaces as soon as possible.
2. Ground and water contamination by oil, grease, and fuel in equipment yards.	2. • Collection and recycling of lubricants. • Precautions to avoid accidental spills.
3. Creation of stagnant water bodies in borrow pits, quarries, etc. suited to mosquito breeding and other disease vectors.	3. Assessment of vector ecology in work areas and employment of measures (e.g., improved landscaping, filling or drainage) to avoid creating habitats.
4. Environmental and social disruption by construction camps.	4. Careful siting, construction and management of construction camps.
Direct: Permanent	
5. Destruction of buildings, vegetation and soil in the right of-way, borrow pit sites, waste dumps, and equipment yards.	5. • Alternative alignments. • Harvest and utilization of public domain forest resources prior to construction.

Table 8.9. Rural Roads (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Permanent (continued)	
	• Compensation given to private landowners.
	• Restoration of sites to original condition to extent possible through reclamation measures.
6. Interruption of subsoil and overland drainage patterns (in areas of cuts and fills).	6. Installation of adequate drainage works.
7. Landslides, slumps, slips and other mass movements in road cuts.	7. • Route alignment to avoid inherently unstable areas.
	• Design of drainage works to minimize changes in surface flows and adequate to local conditions, according to prior surveys.
	• Stabilization of road cuts with structures (concrete walls, dry wall masonry, gabions, etc.).
8. Erosion of lands below the roadbed receiving concentrated outflow carried by covered or open drains.	8. • Increase in number of drain outlets.
	• Drain outlets placed so as to avoid cascade effect.
	• Lining of receiving surface with stones, concrete.
9. Increased suspended sediment in streams affected by road cut erosion, decline in water quality and increased sedimentation downstream.	9. • Establishment of vegetative cover on erodible surfaces as soon as possible.
	• Establishment of retention ponds to reduce sediment load before water enters stream.

Table 8.9. Rural Roads (continued)

Potential Negative Impacts	Mitigating Measures
Direct: Permanent (continued)	
10. Marred landscape (scars from road cuts, induced landslides and slumps, etc.).	10. • Tourist site access roads planned with regard for visual aesthetics. • Grade limitations to avoid cutting and filling where scenery would be spoiled. • Maintenance and/or restoration of roadside vegetation.
11. Health hazards and interference of plant growth adjacent to road by dust raised and blown by vehicles.	11. Dust control by application of water or chemicals.
12. Contamination of ground and surface waters by herbicides for vegetation control and chemicals (e.g., calcium chloride) for dust control.	12. • Reduction of use. • Alternative (non-chemical) methods of control.
13. Accident risks associated with vehicular traffic and transport, that may result in spills of toxic materials (see "Hazardous Materials Management" section), injuries or loss of life (see "Public Health and Safety" section).	13. • Regulation of transport of toxic materials to minimize danger. • Prohibition of toxic waste transport through ecologically sensitive area.
14. Creation of a new pathway for disease vectors affecting humans and animals.	14. Establishment of plant and animal sanitation service and related checkpoints.
15. Disruption/destruction of wildlife through interruption of migratory routes, disturbance of wildlife habitats, and noise related problems.	15. Siting to minimize impacts.

Table 8.9. Rural Roads (continued)

Potential Negative Impacts	Mitigating Measures
Indirect	
16. Unplanned or illegal timber cutting.	16. See "Natural Forest Management" section.
17. Unplanned or illegal land clearing.	17. See "New Land Settlement" section.
18. Long-term or semi-permanent destruction of soils in cleared areas not suited for agriculture.	18. See 17 above.
19. Planned development and illegal invasion of homelands of indigenous peoples by squatters and poachers causing serious social and economic disruption.	19. See "Indigenous Peoples" section.
20. Destruction or damage of terrestrial wildlife habitats, biological resources or ecosystems that should be preserved by induced development.	20. See "Biological Diversity" and "Wildlands" sections.
21. Damaging alteration of wetland ecosystems traversed by causeways.	21. See "Wetlands" section.
22. Excessive and/or destructive development of coastal areas or other use of coral for cement and landfill, destroying parts of reef uniquely endowed recreational environments made accessible by roads.	22. See "Tourism Development" section.

Table 9.7. Tourism Development

Potential Negative Impacts	Mitigating Measures
Direct	
1. • Beach mining of sand for construction.	1. • Control of construction contractor.
• Destruction of reef for aggregate materials used in construction.	• Submission of plans in accordance with local ordinances on beach sand mining.
2. Destruction of wetlands, forests, other unique/sensitive habitats or cultural, historical and archaeologically important sites.	2. • Areas considered for development should have zoning plans to account for natural geographic and socioeconomic condition.
	• Base development phase on an inventory of resources.
3. Erosion resulting from uncontrolled clearing, infrastructure construction such as roads and marinas.	3. Develop erosion and sediment control plans.
4. Loss of "free" environmental services from natural systems and degradation of air, water, land resources.	4. • Carrying capacity should be defined so that target tourist population can be sustained without overburdening existing infrastructure and resources.
	• Include improvements in project design.
5. • Water pollution from inappropriate sewage or solid waste disposal. • marine effluent disposal • residential sewage disposal • marinas • infiltration to groundwater	5. • Allowance made for use of existing municipal or regional collection and disposal system or construction of on-site sewage treatment plant.
	• Liquid waste should not be discharged onto beaches, coral reefs, or other sensitive areas.
	• Verify local capacity to monitor and enforce pollution regulations.

Table 9.7. Tourism Development (continued)

Potential Negative Impacts	Mitigating Measures
Direct (continued)	
6. Solid and liquid waste disposal creates nuisance conditions adjacent to amenities.	6. • Appropriate waste disposal options required to manage potential problem. • Landfill versus incineration alternatives, as well as waste minimization will be considered.
7. • Access problems created: • traffic congestion • noise • minor and localized air pollution • people density greater than services available	7. Access problems minimized by integrated planning to reduce traffic and pedestrian congestion, noise.
8. Sea turtle nesting affected (special case).	8. • Beach monitoring for turtle protection coupled with beach zoning and development guideline to preserve the natural beach environment from the primary dune seaward. • Restricting night activities on nesting beaches during egg-laying and incubation periods.
9. Displacement of human population.	9. • Plan and implement program of compensation and resettlement. • See Chapter 3 for discussion of involuntary resettlement concerns.

Table 9.7. Tourism Development (continued)

Potential Negative Impacts	Mitigating Measures
Indirect	
1. Conflicts with other resource use such as fisheries, agriculture.	1. • Conceive tourism development in framework of national, regional, local socioeconomic development plans to integrate new objectives into development strategies. • Identify zones most suitable for tourism.
2. • Stress to capacity to manage the "tourist or related environment." • legislation and polling constraints • agency support lacking • staffing and financial resources to mitigate impacts absent/reduced • inadequate training in environmental management	2. • Comprehensive legislative action frequently required to address direct and indirect impacts and their monitoring and evaluation. • Staffing and equipment support must be budgeted, including whatever training necessary to mitigate impacts and monitor the "environmental protection plan" or other mitigation plan.
3. Multiplier effect on other industries causes increased stress on natural resources or services (craft market, vendor, taxi driver, suppliers, farmers/fishermen).	3. • Provide adequate infrastructure and services support to meet physical, social and economic needs of the region. • Recognize that "overbuilding" may be a persistent problem.
4. Congestion, overcrowding.	4. Design (urban areas and transport networks, etc.) according to carrying capacity of natural setting.
5. Natural hazards peculiar to developed site such as coastal storms, flooding, landslides, earthquakes, hurricanes, volcanos, may stress infrastructure and reduce long-term benefits.	5. Design facilities to: (a) meet best possible specifications for natural hazard amelioration; (b) take advantage of natural resources such as wetlands ability to buffer storms or absorb treated wastewater (see "Natural Hazards" section).

17. Working Group: Developing Plans for Monitoring and Mitigation for Case Studies: Presentation and Discussion

Description/Objectives

This session provides you with hands on exposure to the design of acitivity, project and program plans for monitoring and mitigation. Participants will use the material produced as part of the field Environmental Review drafting exercise, especially the recommendations, and any other relevant material, to produce a sketch of a project plan for monitoring and mitigation. Workgroup reports will be summarized by rapporteurs in general session 5-10 minute presentations on flip chart paper of your draft plan(s). In preparing your monitoring and mitigation plan(s) we ask you to:

Mitigation

- Select threee to five most critical impacts that need to be mitigated. If you have extra time, you can do more.
- Use the chart "Mitigation Strategy by Activity Phase" in Module 15, if you wish, to organize and present your recommendations.
- How costly are the mitigative measures relative to project cost? If they are more than, say, one to ten percent of the cost, you should perhaps recommend re-design.
- Who would be responsible for design, implementation and monitoring of the effectiveness of the proposed mitigative measures?

Monitoring

- Select three or four priority impacts/issues to be monitored and the indicator to be used (In all likelihood there may be many more possible indicators, but because of the time constraints for the workgroups we ask that you concentrate on only three or four);
- Indicate why you have chosen these indicators;
- Indicate whether comparisons will be to baseline situations, to control situations or both;
- Explain who will be responible for monitoring;
- Explain how often monitoring will be done (frequency);
- Include cost considerations for each indicator;
- State how the results will be used and what analysis will need to be done;
- Who will the results be shared with?

18. Additional Issues in Environmental Review (Detailed Environmental Impact Assessment: Steps and Requirements)

Description/Objectives

This module covers issues in environmental assessment and review in further detail, to deepen your knowledge and familiarity with methods that you can either use or may otherwise encounter in future project-related activities. The material included in this section of the sourcebook describes some of the more detailed environmental impact assessment processes and techniques that are commonly used by the EIA community around the world today. You would need to be fully conversant in these tools and methods if you had to conduct an EA or EIA yourself. However, such a situation is unlikely for participants of most courses.

The purpose for presenting this material is to familiarize you with the universe of options and technical requirements:

- should such a document (EIA, EA, etc.) ever be required for a project you are associated with; or,
- should you ever need to probe more deeply into a specific, potential environmental problem than the simpler tools of information gathering and judgment seem to enable.

Most likely, there are scientific experts within the government or research institutions of your country that can assist you should such a situation arise.

This module also provides you with the opportunity to clarify assessment procedures and requirements that still remain unclear at this point. With your input, the facilitators can adapt this session to meet your needs. Options might include: a) repeating and clarifying USAID Environmental Review and IEE procedures; or b) a free-wheeling group discussion on the relevance of IEE/environmental procedures, the level of input to be expected on USAID activities, and your need for additional support requirements.

It is therefore important for you to let one of the facilitators know whether you would like them to cover any of these or other topics during this module.

Readings

Module Backgrounder: "Environmental Impact Assessment: Methods and Tools"

MODULE BACKGROUNDER
Environmental Impact Assessment: Methods and Tools

In this module backgrounder, we introduce you to the various procedural steps and analytical tools involved in the full environmental impact assessment process. After a brief overview of the practice of environmental assessment in various countries, we describe present the initial steps to determine whether an EA is necessary, and some specific tools and methods.

1. Introduction

Environmental impact assessment (EIA), first and foremost, is a formal study process to predict the environmental consequences of a proposed major development project (UNEP, 1988). It is also a decision-making tool for achieving environmental sustainable development (CIDA, 1994). And, it is a process for identifying the likely consequences for the biogeophysical [and socioeconomic, some argue] environment and for man's health and welfare of implementing particular activities and for conveying this information, at a stage when it can materially affect their decision, to those responsible for sanctioning the proposals" (p. 6, Wathern, 1988).

The primary function of environmental impact assessment (EIA) in the decision-making process is to ensure that decisions on proposed actions take the environment into account or, to quote from Reg 216, "to ensure that environmental factors and values are integrated into the decision-making process." This means that the environmental effects (both positive and negative) of an action are considered along with other factors. To do this, the information acquired and evaluated in the EIA process should be organized and presented in a manner that facilitates understanding of quantifiable, non-quantifiable or qualitative environmental considerations as well as technical and economic factors.

The term *environmental impact assessment* is roughly synonymous with *environmental assessment*; although some countries and institutions may prefer one term or assign each a slightly different meaning. The term "environmental assessment" has become increasingly popular, as proponents have emphasized its tangible benefits and positive planning-oriented aspects and the term "impact" has been seen as having too negative of a connotation. However, impacts can be either positive or negative. Here, we use the term EIA for the more general process to avoid possible confusion with the EA process specific to USAID and Reg. 16. In either, case the focus is on the environment and on the assessment of impacts on it.

The EIA process should consider in comparative fashion several reasonable alternatives that could meet the purpose and need of the proposed action. These alternatives should include the option of not carrying out an action in any way (the no-action alternative) and describe the reasoning for the preference of one alternative over another. While there has been criticism leveled at this process (see Box 1), there are few today who would seriously question the validity and usefulness of examining environmental impacts of development projects.

Although EIA laws and regulations may differ from country to country, many nations have included both formal statements of environmental policy and a set of procedures designed to integrate these policies into the planning routines of government agencies and private developers.

An EIA program will often require that environmental specialists and planners consider a broader range of alternative solutions and/or locations for proposed actions than might have been considered in the absence of such a program. An EIA program may also require that potential impacts to environmental resources be evaluated in detail, and that a preferred alternative be selected on objective merits. This procedure for reviewing proposed projects before they are implemented means that traditional planning methods may have to be altered or adapted to accommodate all of the EIA program requirements.

The aspects of traditional planning that are most likely to be affected by the adoption of formal EIA procedures are precisely those aspects that constitute the core of an effective EIA program. These aspects are balanced decision-making and public participation (see Box 1.2). In the absence of an EIA program, decisions on development, redevelopment, or remedial actions can be made unilaterally, often by individuals or organizations that have some degree of bias or preference toward how the action should be oriented in location, design, or both. Such unilateral decision-making provides minimal information about the planning process to the concerned public, and eliminates the opportunity for public participation and comment on the proposed action. An effective EIA program, conversely, precludes unilateral decision-making by informing decision-makers and involving the public.

In the United States, the passage of National Environmental Protection Act (NEPA) in 1969 mandated the EIA process for all projects involving federal actions, including the issuance of permits, licenses, and financial assistance. In the years following NEPA, a number of states enacted environmental policy acts mandating similar EIA requirements for state-level projects, and some local municipalities have followed this lead. As a result, an EIA in some form is likely to be required by statute for many development or redevelopment projects in the United States.

Following concern over U.S. funds used to purchase dangerous pesticides abroad, environmental groups sued USAID over its lack of compliance with NEPA in the 1970s. Regulation 16 and the environmental review procedures it requires, which form the basis for the present course, was the resulting compromise.

In the past several years, an increasing number of countries and multinational institutions have enacted laws and directives establishing EIA requirements for project reviews. In 1985, the European Economic Community issued a directive establishing minimum requirements for EIA in all member countries. The United Nations Environment Program adopted Goals and Principles of EIA in 1987. In 1991, twenty-six nations of the United Nations Economic Commission for Europe signed a Convention on EA in a Transboundary Context, requiring all signatory nations to establish EIA procedures for transboundary impacts.

Increasing emphasis on EIA is also being observed by members of the donor agencies and international banking community (see Box 1.3 for a discussion of EIA preparation in developing countries). The World Bank issued in 1989 an operational directive requiring EIAs for certain categories of projects, while multilateral development banks are working to incorporate EIA

procedures into their lending practices. Legislation in the U.S. provided some of the impetus for the adoption of EIA policies at these multilateral institutions.[1]

Differences in EIA policies among bilateral and multilateral agencies can confront host governments and project collaborators with a bewildering array of procedures and requirements, particularly where several funders are involved in a single project (Campbell, 1993). An international effort coordinated by OECD and UNEP is presently underway to address the lack of coherence in EIA procedures.

While a number of African countries have recently adopted strategies and legislation that call for the establishment of EIA procedures and protocols, and plans are underway in several others, most African countries have no specific environmental legislation. (See background readings "Institutional set-ups in selected African Countries" from UNEP, 1994, and Kakonge and Ivembore, 1993). In South and East Africa, these include, but are not limited to, Zimbabwe, Zambia, Swaziland, and the Seychelles.

Box 1.1 Common Misconceptions about EIA (adapted from Yates, 1989 and Ahmed and Sammy, 1985)

EIA is "anti-development". It is rare that an EIA and its identification of a particular impact will lead to the abandonment of a project. The role of EIA is to generate information and options for decision-makers, not to mandate specific decisions. EIA provides the decision-maker with environmental information, just as an economic feasibility provides economic information. An EIA can show a project to be environmentally unsound, just as an economic study could show a project to be economically unsound. Few rational observers would condemn economic analysis for this reason.

EIA is too expensive or a waste of money. The median estimate for EIAs is that they cost about one-half to one percent of a project's construction cost. In Thailand, for instance, suggested allowances for EIA costs are from 0.1% to 1.1%, with the higher percentages for smaller projects (less than $1 million US). The cost savings in improved project design and avoided environmental impacts is often many times this amount. In the long-run, not doing an EIA can turn out to be far more expensive.

EIA is ineffective. A common criticism of EIAs are that they are carried out too late to affect a decision, and often simply justify a decision already taken. Witnessing this outcome, EIA observers in Latin America and Asia have suggested earlier incorporation of EIA in project design is necessary. Arguably, EIAs conducted too late in the decision process or as mere formalities are ineffective and a waste of time and money. Well-timed EIAs, however, have proven quite effective on many levels (see examples below): increasing public awareness and input, improving accountability, reducing costs, and improving the environment.

The Pelosi Amendment of 1989 requires that multilateral institutions receiving US funding must subject their projects to environmental assessment.

2. Initial Stages of an EIA

The following sections summarize the steps involved in determining whether to conduct an EIA - screening, preliminary analysis, and scoping. The stages involved in doing the EIA itself (i.e., baseline study, selection of alternatives, impact identification, impacts quantification/prediction, evaluation of alternatives, and mitigation) have been discussed in their earlier module on EIA and will be touched on only briefly here.

Box 1.2 The EIA process and public participation

Public participation in the EIA process is a critical component in achieving the open decision-making goal. Public participation should begin in the earliest phases of project planning and continue through the decision-making process. Public involvement can be formalized by scheduling public hearings and public information sessions, creating public advisory and/or liaison groups, and periodically distributing information concerning the status of project planning. Public involvement in the EIA process gives communities and individuals a voice in issues that may bear directly on their health, welfare, and quality of life. An open flow of environmental information can foster objective consideration of the full range of issues involved in project planning and can allow communities and citizens to make reasoned choices about the benefits and risks of proposed actions.

Despite the importance of public participation in EIA, and all that has been written about it, it has been notably absent in most developing countries (Kakonge and Ivembore, 1994). As noted by Campbell (1993), "little progress has been made in addressing the practical issues involved in achieving this desirable target in developing countries. *The result is that public participation does not feature strongly in developing country EIAs.*" (original emphasis, p.9) According to participants at an international EIA conference in New Delhi, "it is difficult, often even impossible, to obtain or consult copies of the EIA reports. The public has an equally limited, if any, role in most developing countries to question or comment on the quality of the reports or conduct of the environmental clearance process."

A major obstacle to public participation in most African countries has been the lack of domestic legislative frameworks for EIA. As noted by Cook and Donnelly-Roark (1994) in a review of public participation in World Bank sponsored environmental assessments in Africa, "without such a legislative framework, there can be no domestic policy on public participation in environmental assessment. Countries needing to meet World Bank requirements for environmental assessment have had to develop participation procedures on a project-specific, ad hoc basis." (p.86)

Therefore, public participation remains an important goal and benefit of institutionalizing EIA procedures in African countries. Zimbabwe's recent EIA policy, for example, explicitly allows the public "unrestricted access" to all formal EIA documents, and requires public consultation for both the preliminary and draft EIAs.

The summary provided here is distilled from numerous sources (EPA, 1993; UNEP, 1988; Wathern, 1988; and others). Many books and articles have been written to describe these procedures in far greater detail, and often use somewhat different categories and titles to describe similar procedures.

Box 1.3 Observations about EIA and Environmental Standards (from UN, 1994)

The preparation of EIA documents in developing countries often encounters difficulties. It is not an exaggeration to state that environment-related data are virtually non-existent in many developing countries. Such data were initially not available in the industrialized countries either. While governments are expected to collect and make available such information, there are typically enormous costs involved in doing so. Thus, data availability still remains a problem in the industrialized world; it is one of the greatest hindrances to environmental planning in developing countries.

Developing countries often lack technical know-how, and trained personnel are a priority need in most developing countries. Skills are required at all levels of environmental planning-field research, analysis of information, reviewing EIA reports, etc. While it is true that environmental problems often exhibit common characteristics, many environmental problems faced by the developing world are fundamentally different to those faced by developed nations. As a result, the EIA process in the developing countries requires different types of training and expertise. This is particularly true of social assessment and risk analysis, where perceptions differ greatly between the two groups. This underscores the importance of regional cooperation among developing countries in sharing information among countries with similar economic, social, and cultural backgrounds.

Despite these differences, it is still possible for the developing countries to learn and borrow-from the experience of the industrialized nations. For example, some environmental standards in industrialized countries, such as those for ambient air quality are based on extensive analyses of epidemiological, medical and industrial occupational exposure data. These standards are designed to achieve "safe" ambient levels in these countries. It would be imprudent for developing countries to recreate these analyses, since they can freely adopt the scientific data readily available. Note that this does not necessarily mean, however, that they adopt identical ambient standards. Most standards, such as those developed in the United States, include a margin of safety. It is not clear that other countries would necessarily want to adopt the same politicized margins of safety as the United States. It is thus extremely important that developing countries recognize what parameters are readily usable (and what parameters are not) from the environmental experience of developed countries.

EIAs in developing countries are becoming more sophisticated, particularly as experience is gained over time. Although they still tend to be less comprehensive than the EIAs prepared within the donor nations themselves, they are nonetheless improving consideration of environmental factors in these countries.

A fundamental goal of the EIA process is to incorporate environmental considerations as part of the decision-making process; therefore, agencies should integrate the EIA process with other planning processes at the earliest possible time. This will ensure that planning and decisions reflect environmental values, avoid unnecessary delays or procedural corrections later in the planning

process, and minimize potential conflicts. In addition, design changes can be incorporated into the project planning to avoid or reduce environmental impacts identified by an EIA.

2.1 Screening

Screening is the first and simplest stage of environmental review. Its purpose is to determine the nature and extent of environmental analysis needed to assess and manage a project, and is generally undertaken at the stage of project identification.

Most environmental impact assessment processes involve initial screening protocols to evaluate the level of likely impacts and the extent of environmental review needed. In the case of both USAID and the World Bank, there are categories of activities, which are either likely or unlikely to have a significant effect on the environment, and thus distinguish the level of environmental review needed. Table 2.1 below compares these two sets of categories.

Environmental screening can involve some initial and limited efforts to assess the nature and significance of likely impacts. Under some definitions of screening, this step includes using simple impact identification methods, such as checklists, to help redesign projects at early stage to avoid potential environmental problems. (See "Environmental Screening of NGO Development Projects," Canadian Council for International Cooperation, 1994; see also attached "Environmental Screening," World Bank Environmental Sourcebook Update). In other cases, these efforts are part of a preliminary assessments -- an Initial Environmental Examination, in USAID parlance, or a preliminary environmental impact assessment in Zimbabwe's protocols -- which may or not be required depending on a simple screening protocol.

2.2 Preliminary Assessment

Preliminary assessments and environmental screening procedures are closely related and somewhat overlapping. Where full EIAs are not necessarily required, yet the potential for significant impacts exists, a rapid preliminary assessment can be useful. This is one of the purposes of the Initial Environmental Examination. Based on the IEE, a decision on whether to conduct a full EA is usually made or deferred. Preliminary assessments such as IEEs can be require from less than one person-week to more than one person-month of effort, depending on the need for background studies and site surveys. They can involve the use of many of the simpler methods, such as checklists and matrices, often used in full environmental impact assessments.

Table 2.1: Comparison of USAID and World Bank Categories for Screening Projects

USAID CATEGORIES	WORLD BANK CATEGORIES
Classes of Activities With Environmental Impacts, 22 CFR Part 216.2(d)(1): EA or EIS typically required.	**Category A: Full EA required. The projects or components included in this list are likely to have adverse impacts that normally warrant classification in Category A.**
a) river basin development b) irrigation and water management c) agricultural land leveling d) drainage projects e) large scale agricultural mechanization f) new lands development g) resettlement projects h) penetration road building or road improvement projects i) power plants j) industrial plants k) potable and water sew sewerage, other than small-scale l) the use of pesticides	a) dams and reservoirs; b) forestry and production projects; c) industrial plants [large-scale]; d) irrigation, drainage, and flood control [large-scale]; e) land clearance and leveling; f) mineral development [including oil and gas]; g) port and harbor development; h) reclamation and new land development; i) resettlement and new land development; j) river basin development; k) thermal and hydropower development; and l) manufacture, transportation, and use of pesticides and other hazardous and/or toxic materials.
Classes of projects not listed above or below that are subject to Initial Environmental Examinations to determine whether further analysis (EA/EIS) is needed.	**Category B: A Full EA is not required, some environmental analysis is. The following projects and components may have environmental impacts for which more limited analysis is appropriate.** a) agro-industries; b) electrical transmission; c) aquaculture and mariculture; d) irrigation and drainage [small-scale]; e) renewable energy; f) rural electrification; g) tourism; h) rural water supply and sanitation; i) watershed projects j) small-scale rehabilitation, maintenance, and upgrading
Categorical Exclusion: IEE or EA generally not required (See Rg 216 for important exceptions) a) educational, technical assistance and training b) controlled experimentation c) studies, academic or research workshops d) projects in which USAID is a minor donor e) non-project-specific contributions to organizations f) institution building grants to U.S. institutions g) nutrition, health care, family planning services h) commodity import program assistance i) support for intermediate credit institutions for capitalization j) maternal or child feeding k) food for development programs l) matching and support grants to PVOs m) local capacity building for development planning n) the application of design criteria approved by USAID	**Category C: No EA or other analysis required.** a) education; b) family planning; c) health; d) nutrition; e) institution development; f) technical assistance; and g) most human resource projects.

2.3 Scoping (EPA, 1993)

Once a decision to conduct an EIA is made, the scoping process is initiated to determine the key boundaries, issues, and impacts (e.g. time scale, geographical scale, budget, project alternatives, affected environment, significant impacts) that the assessment should address. These are defined through discussions with decision-makers, project proponents, local experts, and the general public.

Scoping is the early, open process of considering the issues and choices of alternatives to be examined in the EIA of a particular action, policy, or program. Scoping helps insure that real problems are identified early and studied properly, that issues of no real concern do not consume undue time and effort, and that the EIA 'report when made public is balanced and thorough. Scoping is used to determine the breadth of issues to be addressed, to identify the significant issues related to a proposed action, and to identify and eliminate from detailed study the issues that are not significant or that have been treated in prior EIAs.

In the U.S., scoping originated in response to early applications of NEPA by federal agencies. In some early environmental impact studies, great lengths were made to study every conceivable impact, regardless of its significance, and consequently enormous EIAs were submitted in which critical issues were obscured by the volume of details. Other environmental impact studies went to the opposite extreme, presenting too little information and analysis to be of use in the environmental decision-making process. To remedy these problems, the existing EIA regulations were supplemented to include a requirement for all agencies to engage in scoping at the beginning of the EIA process (Environmental Law Institute, 1991).

Scoping typically is conducted in a meeting or series of meetings involving the project proponent, the public, and the responsible government agencies. The structure of the meetings may vary depending on the nature and complexity of the proposed action and on the number of interested participants. Small-scale scoping meetings might be conducted like business conferences, with participants contributing in informal discussions of the issues. Large-scale scoping meetings might require a more formal atmosphere, like that of a public hearing, where interested parties are afforded the opportunity to present testimony. Other types of scoping meetings could include "workshops," with participants in small work groups exploring different alternatives and designs. As is the case with all procedural and analytical stages of the EIA process, documentation of the scoping process should be systematic and thorough.

2.4 Doing the EIA Itself

The previous sections have summarized the steps involved in determining whether an EA should be conducted. Conducting the EA itself involves a number of activities such as conducting the baseline study, selecting alternatives, identifying impacts, quantifying and predicting impacts, evaluating alternatives, and selecting mitigation options. We refer the reader to the earlier module where the specific tasks and steps involved in each of these activities have been described. We note here that the process and findings of an EIA need to be documented, so that the results can be effectively communicated to decision-makers and the public. The effectiveness of an EIA is a function not only of the analysis, but how well the findings are conveyed by the EIA managers and specialists to the larger audience. Good documentation should address the questions that decision-makers are likely to ask, and present straightforward and easy-to-find answers. Sample and

indicative outlines of USAID and World Bank EA documents are provided for reference at the end of this module backgrounder.

3. Resources Required for Preparing an EIA

The minimum resources "needed to perform EIAs that can successfully shape major projects" are described in UNEP (1988, p.15; see attached reading). These include:

- Qualified multi-disciplinary staff;
- Technical guidelines, agreed with the competent authority;
- Information about the environment;
- Analytical capabilities;
- Administrative resources;
- Institutional arrangements;
- Review, monitoring, and enforcement powers.

One item missing from UNEP's list is perhaps the most obvious, but cannot be overlooked: detailed information about proposed activity itself. "You can't assess the impact of something if you don't know what the something is."[2]

Other than qualified staff, the most essential resources are time and money. The following are some estimates from various sources:

- Generic, preliminary assessments take from 2 to 10 weeks of time (UNEP, 1988).

- In the case of the **World Bank EA**, "the time required to prepare an EA, and the resulting cost, vary with the type, size and complexity of the project; the characteristics of its physical, sociocultural and institutional settings; and the amount and quality of environmental data already available. EAs need as much time as the feasibility study, of which EA is essentially a part. Therefore, EAs can take from less than six months to more than 18 months to complete, but many require about 12 months. EAs conducted according to Bank procedures do not delay projects; on the contrary, in many cases, they have shortened the total time from identification to operation, by revealing promptly environmental issues that might have halted work altogether, had they emerged at a later stage. Whether or not a particular EIA actually delays a project depends largely on how well it is coordinated with feasibility studies and other preparation activities." (from World Bank, 1991).

- The World Bank also cites the rule of thumb that "**EA preparation cost** rarely exceeds one percent of the total capital cost of the project and is frequently less than that. The cost of implementing mitigating measures can range from 0 to 10 percent of total project cost, with 3 to 5 percent being common. These estimates do not take into account possible cost savings that result from implementing EIA

[2] C. Bingham, personal communication.

recommendations that reduce or avoid the costs of environmental impacts or allow environmental objectives to be met in a more cost-effective manner. For example, project-induced epidemics of malaria or schistosomiasis, ignoring the costs in human misery, may cost millions (US$) to bring under control, compared to the relatively minor costs of preventing them." (from World Bank, 1991).

- Requests for **USAID categorical exclusions** typically require less than a day to prepare.

- Simple IEEs can be done in a few days, depending on the characteristics of the proposed activity and whether a field visit is necessary. **IEEs of a complex nature** can take several person-weeks or, sometimes, months to prepare. The IEEs for projects with multiple components, covering a wide geographic area or affecting many aspects of the environment require a full-time environmental expert and may require assistance from others for specialized expertise. Consultation and/or coordination is typically needed with country officials, NGO representatives, the USAID country mission, regional offices, Washington or other donors and most likely with some combination of these.

- Generically, the length of time for **standard EIA** ranges from 3 months to 2 years. The cost is nearly always less than 1 percent of the cost of a major development project, a figure cited frequently in the literature (UNEP, 1988).

- In comparison, the **USAID EA** can be a relatively modest analysis requiring a team of two or three people from three weeks to four months to complete, once the scoping sessions are completed. The scoping process, it should be noted, can be rather time consuming.

3.1 Expertise Required for Conducting an EIA

For USAID procedures, EAs and EISs are usually carried out by teams of outside consultants, while IEEs have been conducted by internal staff. EA and EIS teams may be strengthened with qualified local expertise and may also benefit from participation of the regional environmental staff (Hecht, 1991).

World Bank experience is similar. "Although there are countries where government agencies themselves are capable of preparing EAs, the usual method is for the borrower to obtain specialist consultants, just as they often do for feasibility studies. EAs require interdisciplinary analysis and are therefore prepared by teams: members work together in the field. The disciplines listed below are generally represented on the core team for any EA:"

- project manager: often a planner, social or natural scientist, or environmental engineer who has experience in preparing several and/or similar EAs and has management skills and experience to provide overall guidance and to integrate the findings of individual disciplines;
- ecologist or biologist (aquatic, marine or terrestrial specializations, as appropriate);
- sociologist/anthropologist: with experience with communities similar to that of the project;
- **geographer or geologist/hydrologist/soils scientist.**

"If the project is in the agricultural sector, an agronomist, land-use specialist, forest scientist, or fisheries biologist, as appropriate, should be included in the core team. For industrial or energy projects, an engineer with the corresponding expertise (such as in pollution control) will be needed." (World Bank, 1991, formatting and emphasis added).

EIA specialists can be retained from a variety of sources. Large international environmental consulting firms have many of the necessary disciplines on staff or in subconsultant arrangements, and can form and manage teams for any EIA. There are also smaller firms that specialize in EA and manage EIAs. They are more likely to need subconsultants to fill out EIA teams. The expertise of local consulting firms varies from country to country. Frequently a local firm will be able to provide experts (e.g., from local universities or institutions) to participate in an EIA as a core team member or as a specialist. It is less common, at present, to find local firms with experience and capability to carry out an EIA on their own. Where such firms do exist, they should be seriously considered for EIA projects. Therefore, local firms should be participants in EIAs being managed by international firms. This provides the local staff with on-the-job training and provides the international staff with essential local knowledge, and experience.

Other sources of experts include research institutions (e.g., marine institutes, tropical medicine research centers, national research institutions), colleges and universities, academies of science and technology, government agencies in the country and in other countries (loans and exchanges may be possible), and NGOs.

4. Tools and Methods for Environmental Impact Assessment

4.1 Introduction

Tools and methods for environmental impact assessment have received considerable attention in the 25 years since the first EIAs were conducted. The existing set of tools and methods ranges from the simple and straightforward, such as matrices and checklists, to the sophisticated and resource intensive, such as geographic information systems, ecological risk assessments, and detailed simulation modeling.

The various procedures, their appropriate roles, and their advantages and disadvantages are discussed extensively in the literature. No attempt is made here to replicate these documents; instead, the reader is urged to closely review the attached background readings or references.[3]

Much of the "EIA methodology" literature, including the material included here, is oriented towards impact identification, data assembly, prediction, and evaluation (see Table 4.1). Since most course participants are unlikely to conduct full-blown EIAs, but rather focus on preliminary assessments, these objectives may be the most relevant here. Public participation, communication,

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Selected sections from Sadar et al. (1994) provide a rudimentary overview of the most basic impact identification and assessment techniques. Bisset (1987) provides a more detailed review of methods for EIA in developing countries with selected case studies. Participants can also review two of the readings provided in Appendix B.

and management techniques are discussed extensively in a number of the supplementary background readings, including Cook and Donnelly-Roark (1994) and World Bank (1991, Volume 1).

In this course, the focus is on the simpler EIA impact assessment tools and methods. Much could also be said about more resource-intensive and sophisticated techniques; see, for example, the background reading on GIS methods included here. In general, however, it is important to avoid "the considerable gulf between the sophisticated EIA methodologies developed in some academic institutions and large consultancies which are emphasized in some training programmes, and the more modest EIA methods which have been found to be of practical relevance in many field situations" (p.43, Lee, 1987).

Table 4.1: Classification of Assessment Methods by Task (adapted from Lee, 1987)

Class of Method	Role
Identification	To assist in identifying the project alternatives, project characteristics and environmental parameters to be investigated in the assessment.
Data assembly	To assist in describing the characteristics of the development and of the environment that may be affected.
Prediction	To predict the magnitude of the impacts which the development is likely to have on the environment.
Evaluation	To assess the significance of the impacts which the development will have on the environment.
Communication	To assist in consultation and public participation, and in expressing the findings of the study in a form suitable for decision-making purposes.
Management	To assist in managing the scoping of the study, the preparation of the impact study, the efficient conduct of the consultation process, etc.
Decision-making	To assist decision-makers in assessing and understanding the significance of environmental impacts relative to other factors relevant to a decision on the proposed development.

4.2 Summary and Examples of Some EIA Tools

Participants should review the principal background readings: Sadar (1994), Bisset (1987), and UNEP (1988), for a more thorough discussion of basic EIA tools and methods. This section supplements the background readings with brief summaries and examples for the following, and draws some text from USEPA (1993).

- ad hoc (identification);
- checklists (identification);
- matrices (identification, data);
- overlays (identification, data, prediction);
- networks (identification, data, prediction, communication);
- simulation modeling (identification, data, prediction);
- risk assessment (prediction, evaluation, decision-making);
- cost-benefit analysis (evaluation, decision-making).

The latter four methods are unlikely to be used at the level of environmental assessments most course participants will need to undertake; they are nonetheless briefly included since they are generally categories of analysis commonly conducted. This list is also by no means comprehensive. Many other methods, such as multi-criteria analysis, Habitat Evaluation Procedure (HEP) models, system diagrams, and public participation techniques are not included; for a full overview of EIA methods, see the background materials. A summary of the first five impact assessment methods is shown on Table 4.2.

4.2.1 Ad Hoc Approaches

As the name implies, ad hoc methods are relatively crude and informal techniques that are usually qualitative and unsystematic, such as a collection of expert and lay opinions. As such, they generally fall short on the systematic and replicable characteristics of ideal EIA methodologies, as discussed in the earlier

EIA session. As noted by Sadar et al. (1994), these methods focus on broad areas of possible impacts (e.g. forests, animals, etc.), rather than defining specific parameters to be investigated.

Table 4.2: Comparison of Impact Assessment Methods (adapted from Chatzimikes, 1983)

Type of Method	Impact Identification	Impact Measurement	Impact Interpretation	Impact Evaluation	Ease of Application
Ad Hoc	Fair	n/a	n/a	n/a	Not Difficult
Checklists	Good	n/a	n/a	n/a	Not Difficult
Matrices	Excellent	Fair	Fair	Good	Moderately Difficult
Overlays	Good	n/a	n/a	n/a	Moderately Difficult
Networks	Excellent	Excellent	Excellent	Excellent	Difficult

n/a = not applicable to task

4.2.2 Checklists

The use of checklists for identifying and, to a limited extent, characterizing, environmental impacts, is very common throughout existing EIA processes. A checklist forces the assessment to consider a standardized set of activities or effects for each proposed action, thus bringing uniformity to the assessment process. Checklists can be used to determine environmental impact thresholds, thus indicating whether a full-scale EIA is needed for a particular project or whether a finding of no significant impact could be issued. Following Bisset (1987), four different types of checklists can be distinguished as shown below. A summary of advantages and disadvantages is shown on Table 4.3.

- **Simple checklists**, simply list environmental factors to check for. They usually provide no guidance on a) the assessment of impacts on these factors, b) any useful predictive techniques, or c) the type of data needed (see Table 1.1 in Bisset, 1987).
- **Descriptive checklists**, provide guidance on assessment, with corresponding information on appropriate measurements and predictive techniques (see Table 1.2 in Bisset, 1987).
- **Scaling checklists**, attempt to indicate the importance of impacts to decision-makers (see Table 1.3 in Bisset, 1987).
- **Questionnaire checklists,** can provide a thorough and useful step-by-step procedure, particularly useful to non-experts. The USAID "Project Environmental Impact Checklist" included in an earlier module provides a very thorough and useful questionnaire checklist for initial screening and examination of USAID projects. The checklist provides a systematic method capable of incorporating subjective assessments of impact significance. Other useful checklists can be found in CCIC (1994), designed for the screening of the following types of NGO development projects: pest control, coastal ecosystems, domestic water supply and sanitation, irrigation, and small dams and reservoirs.

4.2.3 Matrices (Impact Identification)

The main disadvantage of checklists -- that they generally fail to link specific development activities with given impacts -- led to the development of matrices, perhaps the most popular and widely used EIA methodology (Bisset, 1987). In a typical matrix, alternative actions (measures, projects, sites, designs) are listed as column headings, while the rows are the criteria that should determine the choice of alternative. In each cell of the matrix, a conclusion can be listed indicating whether the alternative action is likely to have a

positive or negative effect relative to the indicated criterion. In some matrices, the conclusion is stated as a numerical value or symbol indicating the level of intensity of the effect. There is an opportunity, moreover, to apply relative weighting to the various criteria when evaluating the completed matrix (EPA, 1993).

The progression of an EIA methodology from checklist to matrix is intuitively and easily accomplished. A checklist can be viewed as a single-column summary of a proposed action, with only a broad characterization of the nature and magnitude of potential environmental impacts provided. An EIA matrix provides a finer degree of impact characterization by associating a set of columns (effects) with each row (environmental attribute) of the matrix.

Table 4.3: Some Advantages and Disadvantages of (adapted from Bisset, 1987)

EA Tool	Advantages	Disadvantages
Checklists	· Useful for structuring initial stages of assessment · Help to ensure that vital factors are not neglected · Easy to apply, particularly by non-experts	· Danger of "tunnel vision", limiting consideration to items on a given checklist · Deal only with the environment; do not indicate causal linkages between activities and impacts
Matrices	· Indicates causal linkages between activities and impacts · Can include weights to signify relative impact significance · Can help to distinguish among phases of project development (operation, construction, dismantling, etc.)	· Danger of "tunnel vision", as with checklists, which can be overcome by expanding the matrix
Overlays	· Excellent for showing spatial dimension and location of impacts · Most useful for assessing alternative routes for linear developments, such as pipelines, roads, transmission lines, etc.	· Deals less successfully with timing, reversibility, and probability of impacts · Sharp boundary definitions can be misleading; transitions within and among land types can be less dramatic than mappings may indicate
Networks (See Principles of Practice Module)	· Provides visual summaries that are easily understood and communicated to decision-makers and the public · Useful for identifying important indirect impacts	· May oversimplify relationships; can be hard to show adequate level of detail to illustrate individual system impacts · As with all other methods above, static analysis doesn't show changes over time · Doesn't show relative significance of impacts

One of the most famous matrices is the "Leopold Matrix", formulated for use by the U.S. Geological Survey. The Leopold matrix consists of 100 columns representing examples of causative actions, and 88 rows representing environmental components and characteristics. As a first step, the columns that correspond with the nature of the proposed action are checked off. Then, for each column that is marked, the cells

corresponding to environmental effects are examined. Two scores (on a scale from 1 to 10) are listed in each cell, separated by a slash (/); the first score represents the magnitude of the possible impact, while the second score represents the *importance* of the possible impact. Beneficial impacts are indicated by a plus (+) sign. The interpretation of the matrix is based on the professional judgment of those individuals performing the EIA. See Sadar (1994), attached, for a visual example and further explanation of the Leopold and other common matrices. A summary of advantages and disadvantages is shown on Table 4.

4.2.4 Overlays (Impact Identification and Prediction)

This technique has always been extremely useful in identifying areas that have high environmental sensitivity. The technique entails the separate mapping of various critical environmental features - wetlands, steep slopes, soils, floodplains, bedrock outcrops, wildlife habitats, vegetative communities, and cultural resources - at the same scale as the project's site plan. The environmental features are mapped on transparent plastic in different colors. The several environmental maps can then be overlaid on the project map to highlight the areas of highest environmental sensitivity (EPA, 1993).

Geographical Information Systems (GISs) are essentially computerized graphical overlays and interacting data files. Environmental features are mapped, and the mapping digitized and stored in the GIS data base. The mapped features can be combined to produce computer-generated displays of one or more environmental features in a specified geographical area. If the GIS mapping is conducted systematically, information acquired on specific projects can be combined, and the GIS data base becomes more detailed over time (EPA, 1993).

4.2.5 Simulation Modeling (Impact Prediction)

In this approach to environmental impact assessment, the principal cause-effect relationships of a proposed action are described in terms of mathematical functions and combined to yield a mathematical model capable of predicting future environmental conditions. Mathematical models come in all degrees of complexity, from simple variations on mass balance equations (e.g., for estimating nitrate-nitrogen in groundwater) to highly complex multivariate systems. The mathematical functions may be purely determined by existing conditions, or may have strong random elements contributing to the model output. Some models include statistical routines for estimating error associated with model outputs. Most commonly used mathematical models for impact assessment have been adapted for computers, in either batch or interactive modes (EPA, 1993).

A listing, though certainly a non-inclusive one, of environmental effects that have been mathematically modeled would include: energy, thermal plumes, noise, transportation, air emissions, stormwater runoff, pollutant transport in water, pollutant transport in soils, risk assessment, ecological risk assessment, and wasteload allocations (EPA, 1993).

4.2.6 Risk Assessment

This refers to a category of analyses by which the potential risk of harm to individuals, communities, and ecosystems can be evaluated. The general techniques include comparison of expected conditions with prevailing environmental standards, modeling of expected conditions and estimation of error terms associated with model estimates, and Monte Carlo simulation of the frequency of certain events under expected conditions.

4.2.7 Cost-Benefit Analysis

This is a formalized accounting of the anticipated costs and benefits of an action. The cost-benefit analysis is of particular use when comparing alternative forms of an action. The "costs" of an action include, but are not limited to the economic costs, the risks to long-term environmental quality and public health, and the impacts to natural and man-made resources. The benefits include monetary benefits, but also extend to positive changes in the quality of life, protection of sensitive environmental resources, and long-term enhancements to human health and welfare.

5. Choosing Among Methods

As indicated above, there may be several alternative methods available to perform a single assessment task. The following are some overarching criteria to apply when selecting a method to use in particular assessment situations (text below adapted from Lee, 1987).

Appropriateness. The assessment method chosen should be appropriate to the specific task for which it is to be used. Therefore those involved in the choice of the assessment methods to be used should clearly understand the specific EIA tasks to be undertaken and the nature of the 'output' which the EIA methods selected should ideally produce - for example whether the output should be quantitative or qualitative, its desirable temporal and spatial distribution, its required degree of accuracy, etc. They also require a good understanding of the 'attributes' of the alternative methods from which the choice is to be made in order to match method with task as closely as possible. For example, during scoping, fairly simple assessment methods which provide 'order of magnitude' assessments of impact may be entirely appropriate - therefore, it may be inappropriate at this stage of the EIA process to use sophisticated methods which provide very detailed and precise output. However, simple methods may be too crude and approximate for use in some of the later stages of impact prediction.

Replicability. Ideally a method should be sufficiently free from assessor bias that different assessors, using the same method, would obtain similar results if carrying out an assessment of the same project. Some methods leave more opportunity than others for the intrusion of the assessor's own subjective judgments and are likely to less satisfactory from this standpoint. In evaluating the likely replicability of an EIA method, the following questions might be considered:

- Does it provide a clearly expressed and precise measure of impact?
- Is the nature and extent of any uncertainty attaching to the estimate made explicit?
- Are the essential features of the method which is used to derive the measure clearly stated?
- Are the sources and quality of data used when applying the method clearly stated?
- Are any assumptions made in the use of the method (including those related to data deficiencies) clearly indicated?

Consistency. Ideally, a method should be capable of being consistently applied to alternative forms of the same project and to different projects within the same investment programme. This is desirable if alternatives are to be compared on a consistent basis and competing projects within a programme are to be prioritized according to a common method of evaluation. In assessing the consistency of a method, the following questions may be considered:

- Does it ensure that data inputs for evaluating alternatives are obtained on a consistent basis?
- Does it ensure that the output measures for the alternatives under consideration are strictly comparable?

- Does it provide sufficient guidance on the treatment of uncertainty (e.g. in the prediction of the magnitude of impacts) and in the use of subjective judgment (e.g. in assessing the significance of a particular impact) to ensure that the assessments of alternatives are broadly comparable?

Economy. A method should be cost-effective in the sense of enabling an environmental impact assessment of the required quality for a project to be completed as economically as possible. The resource needs of the alternative assessment methods available for similar kinds of task vary considerably according to the quantity and quality of data input requirements, the quantity and skills of staff required for their use, the overall length of time required to obtain usable output, etc, It is important to recognize that environmental impact assessment studies are not primarily undertaken as research studies to advance knowledge but as inputs to planning and decision making processes for which time, technical and cost constraints are operative.

The ranking of alternative assessment methods, according to the above criteria, may differ. For example, in some circumstances, considerations of economy may conflict with those of appropriateness, replicability, and consistency. If so, a trade-off between these different goals of good assessment practice will have to be faced. However, in a well-organized EIA system, the resolution of such conflicts should not be a serious problem, for the following reasons:

- the most sophisticated and resource demanding methods are often in practice not the most appropriate ones to use;
- the resource constraints on EIA studies, though real, need not be over-restrictive on the use of best practice if, for example,
- the impact studies to be prepared by developers are commenced sufficiently early in the planning and design process;
- adequate training is given in the selection and correct use of appropriate EIA methods and in the effective management of the EIA process;
- as experience shows, the costs of satisfactorily conducted EIA studies normally account for a very small percentage of a new project.

6. Typical Report Structure for Environmental Impact Assessments

In the following examples, we provide report outlines for environmental impact assessments. These are adapted from the USAID and World Bank materials, and provide potentially useful background material for preparing environmental assessments, scoping sessions, or more preliminary documents. Since they lay out the content of these analyses, they help to suggest the nature of the work required.

6.1 Indicative Outline of a USAID Environmental Assessment Report

Below is a typical outline for Environmental Assessment reports submitted to the USAID. It is based on communications from USAID environmental advisors (see 22 CFR Part 216.6 in the Sourcebook Appendix for a more complete description of EA contents).

1. **Summary:** This section stresses major conclusions, areas of controversy, and issues to be resolved.
2. **Introduction:**
   a. Description of proposed action.
   b. Purpose of project.
   c. Results of the scoping exercise

3. **Alternatives:** This section discusses which alternatives were chosen and why; contrasts impacts among alternatives, and identifies preferred alternative(s) and appropriate mitigation measures.
   a. Environmental impacts of proposed action
   b. Environmental impacts of no action
   c. Environmental impacts of alternative 1...
4. **Affected Environment:** This section, essentially the baseline study, succinctly describes affected environment, using data and analyses commensurate with the significance of the impacts.
5. **Environmental Consequences:** The section presents the basis for section 3 above. This section can be organized by discipline category (e.g. ecology, land use, geology, etc.) or by the nature of the impacts (long-term, short-term, irreversible, etc.) Organizing by topic can be efficient, since specialists can be assigned to write appropriate sections.
6. **List of Preparers**
7. **Appendices**

6.2 Indicative Outline of a World Bank Project-Specific EA Report

Below is a typical outline for a project-specific environmental assessment report submitted to the World Bank. It is adapted from World Bank, 1991, Annexes A1 and 1-3 (note: Bank-specific language and requirements have been deleted). The Banks requires that full EA reports should be concise and should focus on the significant environmental issues. The report's level of detail and sophistication should be commensurate with the potential impacts. The following items should be included in the report:

(a) **Executive Summary.** Concise discussion of significant findings and recommended actions.

(b) **Policy, Legal, and Administrative Framework.** Discussion of the policy, legal, and administrative framework within the EA is prepared. The environmental requirements of any cofinanciers should be explained.

(c) **Project description.** Concise description of the project's geographic, ecological, social, and temporal context, including any off-site investments that may be required by the project (e.g., dedicated pipelines, access roads, power plants, water supply, housing, and raw material and product storage facilities).

(d) **Baseline Data.** Assessment of the dimensions of the study area and description of relevant physical, biological, and socioeconomic conditions, including any changes anticipated before the project commences. Current and proposed development activities within the project area (but not directly connected to the project) should also be taken into account.

(e) **Environmental Impacts.** Identification and assessment of the positive and negative impacts likely to result from the proposed project. Mitigation measures, and any residual negative impacts that cannot be mitigated, should be identified. Opportunities for environmental enhancement should be explored. The extent and quality of available data, key data gaps, and uncertainties associated with predictions should be identified/estimated. Topics that do not require further attention should be specified.

(f) **Analysis of Alternatives.** Systematic comparison of the proposed investment design, site, technology, and operational alternatives in terms of their potential environmental impacts; capital and recurrent costs; suitability under local conditions; and institutional, training, and monitoring requirements. For each of the alternatives, the environmental costs and benefits should be quantified to the extent possible, and economic values should be attached where feasible. The basis for the selection of the alternative proposed for the project design must be stated.

(g) **Mitigation Plan.** Identification of feasible and cost-effective measures that may reduce potentially significant adverse environmental impacts to acceptable levels, and estimation of the potential environmental impacts; capital and recurrent costs; and institutional, training, and monitoring requirements of those measures. The plan (sometimes known as "action plan," or "environmental mitigation or management plan," outlined in Annex C) should provide details on proposed work programs and schedules. Such details help ensure that the proposed environmental actions are in phase with engineering and other project activities throughout implementation. The plan should consider compensatory measures if mitigation measures are not feasible or cost-effective.

(h) **Environmental Management and Training.** Assessment of the existence, role, and capability of environmental units on-site, or at the agency and ministry level. Based on these findings, recommendations should be made concerning the establishment and/or expansion of such units, and the training of staff, to the point that EA recommendations can be implemented.

(i) **Environmental Monitoring Plan.** Specification of the type of monitoring, who would do it, how much it would cost, and what other inputs (e.g., training) are necessary.

(j) **Appendices**

- (i) **List of EA Preparers**--individuals and organizations.
- (ii) **References** -- written materials used in study preparation. This list is especially important given the large amount of unpublished documentation often used.
- (iii) **Record of Interagency/Forum/Consultation Meetings** -including lists of both invitees and attendees. The record of consultations for obtaining the informed views of the affected people and local NGOs should be included. The record should specify any means other than consultations that were used to obtain the views of affected groups and local NGOs.

6.3 Indicative Outline for a USAID Scoping Statement (adapted from Samba, 1992)

Below is a typical outline for a scoping statement submitted to the USAID. It is adapted from Samba, 1992.

1. **Preface:** The statement can begin with an overview of Reg. 16.
2. **General Project Description**
3. **Environmental Assessment Issues**
   - a. **Significant Issues:** This section lays out the scope and significance of issues to be analyzed in the Environmental Assessment or Impact Statement. Significant issues are numbered, and their significance for the environment and natural resources is described, including direct and indirect effects of the project on the environment. Following are examples of significant issues that have emerge in scoping activities: accelerated erosion; laterization of soils; loss of soil structure and fertility; tropical forest conservation; wetland conservation; species and habitat loss; disease transmission; etc..
   - b. **Issues That Are Not Significant:** These issues are also numbered, with a brief presentation of why they will not have significant effect on the environment.
   - c. **Environmental Assessment Preparation:** This section suggests the timing of the preparation of environmental analyses, variations required in the format of the Environmental Assessment, and the tentative planning and decision making schedule.
   - d. **Conduct of Analysis and Disciplines Participating in the EA or EIS.**
4. **Identification of the Participants in the Scoping Session**

19. Environmental Assessments of Pesticide Use in USAID Projects: Issues and Methods

Description/Objectives

This module introduces participants to environmental concerns in pesticide purchase, handling and use and to USAID procedures for environmental assessment of pesticide use in projects. Although pesticide environmental assessment is generally performed by specialists, participants may be involved in the interpretation of results from a pesticide environmental assessment, as well as in the implementation of recommended monitoring activities. USAID policy and procedures regarding pesticide use are described in Reg 16 § 216.3(b): "Except as provided in § 216.3(b)(2), all proposed projects involving assistance for the procurement or use, or both, of pesticides shall be subject to the procedures prescribed in § 216.3(b)(1) (I) through (v) below..." [See Appendix A]

Readings

Consortium for International Crop Protection, 1991. *How to prepare environmental assessments of pesticide use in AID agricultural projects*, January.

HOW TO PREPARE ENVIRONMENTAL ASSESSMENTS OF PESTICIDE USE IN A.I.D. PROJECTS

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FOREWORD AND ACKNOWLEDGEMENTS

To meet its objectives in developing country projects, the U.S. Agency for International Development (A.I.D.) has to deal with a range of insects, diseases, weeds, rodents, and other harmful pests. Pesticides are often used to control these organisms.

Use of pesticides in developing countries requires special understanding and responsibilities. Some developing countries have no laws to govern the importation, domestic use, and disposal of pesticides. Countries with laws often lack the resources to enforce proper use.

Since 1978, A.I.D. has required an "Environmental Assessment" (EA) of pesticides for use in its projects. The purpose of an EA is to alert A.I.D. officials and host country decision makers of potential risks and to avert use of unacceptable pesticides. The EA identifies less hazardous pesticides and nonchemical alternatives, and specifies safety measures, training, and research so that pesticides will be used properly as a component of integrated pest management (IPM).

A.I.D. has depended heavily on the Consortium for International Crop Protection (CICP) in preparing the Environmental Assessments. CICP in fact has developed more A.I.D. Assessments of pesticides than any other organization. CICP staff and consultants, representing a diverse range of expertise in pest and pesticide management and related fields, have assisted nearly every A.I.D. mission and overseas office with EAs. In addition, CICP personnel have helped with follow-up training, research, and monitoring.

This guide was developed to help CICP consultants, A.I.D. staff, and A.I.D. contractors conduct accurate and complete Assessments of pesticides. It is based on the experience of many who have participated (through CICP) in developing EAs.

The assistance and experience of CICP consultants, developing country collaborators, and A.I.D. employees and contractors were invaluable in preparing the guide. We especially acknowledge the efforts of the late Dr. Frederick W. Whittemore and Mr. Carroll W. Collier (retired), both formerly of the A.I.D. Bureau of Science and Technology, Office of Agriculture. Dr. Whittemore and Mr. Collier directed and assisted the CICP staff and CICP consultants in developing dozens of EAs. We also acknowledge the following colleagues for reviewing and commenting on a draft of the guide: Mr. Bill Barclay (Greenpeace), Dr. Carl S. Barfield (University of Florida), Dr. Hiram Larew (A.I.D. Bureau of Science and Technology), Dr. Angel A. Chiri (A.I.D. Bureau for Latin America and the Caribbean), and Dr. William A. Overholt (A.I.D. Bureau of Science and Technology). We are grateful for their guidance and assistance.

We also are grateful for the very special and untiring efforts of CICP's founder and former Executive Director, Dr. Ray F. Smith. As Executive Director of CICP, Dr. Smith was the principal architect of A.I.D. efforts that emphasized environmentally less hazardous and economically efficient pest and pesticide management.

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ACRONYMS AND ABBREVIATIONS

ADI	-	Acceptable Daily Intake
A.I.D.	-	U.S. Agency for International Development
CFR	-	Code of Federal Regulations
CICP	-	Consortium for International Crop Protection
EA	-	Environmental Assessment
EIS	-	Environmental Impact Statement
EPA	-	U.S. Environmental Protection Agency
FAO	-	Food and Agriculture Organization of the United Nations
FDA	-	U.S. Food and Drug Administration
FIFRA	-	Federal Insecticide, Fungicide, and Rodenticide Act
IEE	-	Initial Environmental Examination
IPM	-	Integrated Pest Management
MRL	-	Maximum Residue Limit
U.S.	-	United States of America
WHO	-	World Health Organization of the United Nations

INTRODUCTION

The introduction after World War II of synthetic organic pesticides such as the insecticide DDT and the herbicide 2,4-D began a new era in pest control. Hundreds of synthetic organic insecticides, herbicides, fungicides, nematicides, rodenticides, and other chemical pesticides entered commercial markets.

The availability of modern pesticides led to widespread acceptance and reliance upon them. Chemical control soon became the predominant method of pest control in many countries. Current trends indicate that the use of pesticides in developing countries is increasing more rapidly than in developed countries. Pesticide use in Africa, Asia, and Latin America could double over the next ten years if trends continue.

Most pesticides being used in developing countries originate in industrialized nations. About 30% of total U.S. pesticide production is exported. The exports include pesticides not registered for any use, or considered too dangerous for unrestricted use, in the U.S.

Chemical pesticides have spread much faster in developing countries than the capability to ensure their effective and proper use. Many of these countries do not have laws to govern importation, use, and disposal of toxic chemicals. Even if they have laws, governments frequently lack the means to enforce them.

The U.S. Agency for International Development (A.I.D.) now requires a risk-benefit evaluation of pesticides and pest control practices used in the Agency's overseas assistance projects. A.I.D. policy is to encourage use of nonchemical pest control methods and practices that reduce reliance on chemical control. When pesticides are used, it is A.I.D. general policy to avoid using pesticide chemicals that the U.S. Environmental Protection Agency (EPA) has not registered or has registered with restriction because their toxicity warrants special handling. A.I.D. approves use of pesticides only if a review indicates a favorable benefit-risk ratio.

The purpose of this guide is to assist consultants of the Consortium for International Crop Protection (CICP), A.I.D. staff, and A.I.D. contractors when developing Environmental Assessments of pesticides in A.I.D. projects. The guide tells what is needed and how to proceed when conducting the Assessments. It will help to minimize time spent on the Assessments and avoid errors and omissions that can delay A.I.D. decision making.

WHAT IS AN ENVIRONMENTAL ASSESSMENT?

In the A.I.D. system, an Environmental Assessment is "a detailed study of the reasonably foreseeable significant effects, both beneficial and adverse, of a proposed action on the environment of a foreign country or countries."[1] The purpose of the EA is to alert A.I.D. and host country decision makers of the

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[1]International Development Cooperation Agency, Agency for International Development, 22 CFR Part 216, Environmental Procedures, §216.1(c)(3), October 9, 1980.

potential for significant environmental effects in A.I.D. projects and outline steps for avoiding or minimizing adverse effects. Procedures for the EA appear Title 22 of the Code of Federal Regulations, Part 216 (abbreviated as 22 CFR Part 216), known as Environmental Procedures, which appears as Annex 1.

Steps Leading to an Environmental Assessment

Need for an EA is determined as the A.I.D. project is developed (see Figure 1). The A.I.D. project document (Project Identification Document or Project Paper) includes an Initial Environmental Examination (IEE), which precedes the EA. The IEE is the first review of the foreseeable effects of a proposed action (e.g., use of pesticides) on the environment. Its function is to provide A.I.D. officials the basis for reaching a "Threshold Decision". A Positive Threshold Decision indicates that the proposed action may have a significant effect on the environment. A Negative Declaration indicates that the proposed action should not have a significant impact on the environment. A Positive Threshold Decision requires preparation of an EA or, rarely, Environmental Impact Statement (EIS). An EIS is similar to an EA except it requires a more rigorous review (by both U.S. and host country agencies) and usually public hearings on the proposed action.

The EAs may cover a range of proposed environmental actions, such as road building, etc. Some of the EAs are devoted entirely to pesticide use. This guide considers assessment of pesticides.

WHAT IS MEANT BY "PESTICIDE"?

"Pesticide," from the words "pest" and "cide" (a Latin derivative meaning killer), is a chemical agent that kills or in some other way diminishes the actions of pests. Pests include harmful insects and other invertebrate organisms, weeds, microorganisms, rodents, and birds.

Pesticides are classified according to their function -- insecticide to control insects, fungicide to control fungi, etc. The principal types of pesticides appear in Table 1.

In A.I.D. livestock production projects, it is important to distinguish pesticides used to control parasites that harm animals or cause disease from drugs used to combat disease directly. Drugs come under the jurisdiction of the U.S. Food and Drug Administration (FDA) and are handled differently. If in doubt about the status of a livestock chemical, contact EPA's Registration Division, Insecticides and Rodenticides, Washington, DC 20460 (telephone: 703-557-2400).

Sometimes a pesticide may appear to be the only method for controlling a pest. However, by assessing the situation it is often possible to find cheaper, longer lasting, and less hazardous methods. Integration of effective nonchemical control methods (Table 2) within an ecological framework may reduce or even eliminate the need for chemical pesticides.

Figure 1. Steps Leading to the Decision for an Environmental Assessment in A.I.D. Projects Per Title 22 of the Code of Federal Regulations, Part 216, Environmental Procedures

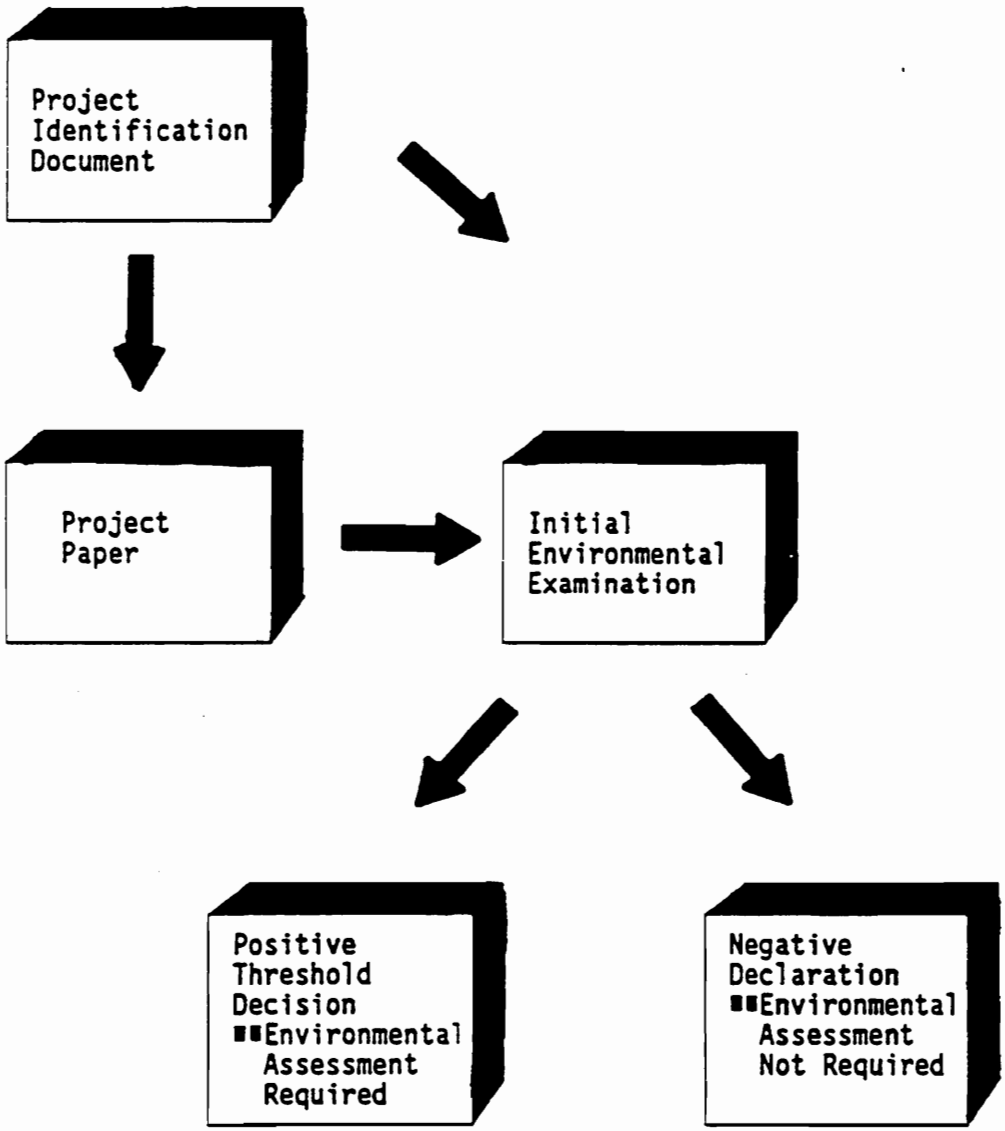

Table 1. Pesticides Classified According to Function

Pesticide	Pest group controlled or function of the pesticide
Acaricide	Mites, ticks, and spiders
Algicide	Algae
Attractant	Attracts pests (pheromones, baits, and miscellaneous chemicals)
Avicide	Birds
Bactericide	Bacteria
Defoliant	Removes plant foliage
Desiccant	Removes water from plants and arthropod pests
Fungicide	Fungi
Growth regulator	Regulates plant or animal growth
Herbicide	Weeds
Insecticide	Insects, mites, and related arthropods
Miticide	Mites
Molluscicide	Mollusks such as snails and slugs
Nematicide	Nematodes
Piscicide	Fish
Predacide	Vertebrate pests
Repellent	Repels animals
Rodenticide	Rodents
Silvicide	Trees and woody shrubs

WHAT IS NEEDED TO CONDUCT AN ASSESSMENT?

Conducting an Environmental Assessment of pesticide use requires access to a range of information appearing below. A check (√) appears by each of the essential documents.

A.I.D. Documents

- √ A.I.D. Environmental Procedures (22 CFR Part 216) (Source: A.I.D. Handbook No. 3, Appendix 2D). The Environmental Procedures appear in Annex 1 of this guide.

- √ The Project Identification Document, Project Paper, or other A.I.D. documents (Program Assistance Initial Proposal or Program Assistance Approval Document) that describe the proposed action (Source: A.I.D. Project Officer).

- √ The Initial Environmental Examination, if any (Source: A.I.D. Project Officer).

- √ Any earlier Environmental Assessments of the A.I.D. project (Source: A.I.D. Project Officer).

Table 2. Examples of Alternatives to Chemical Pesticides

Insects, mites, and other invertebrates	Plant diseases	Weeds	Vertebrate pests
Biological control Conservation, augmentation, inoculation, and habitat manipulation with parasites, predators, and pathogens Plant resistance Environmental manipulations Plant spacing Intercropping Timing of planting and harvesting Crop rotation Water management Fertilizer management Soil preparation Sanitation Trap crops Induced sexual sterility Physical and mechanical control Screens Traps Fly swatters Protective packaging Barriers Flaming and burning Hand picking Attraction and repellency Attractants Repellents Genetic manipulation of pest populations Lethal genes Male-producing genes Botanical insecticides	Disease resistance in host plants Reduction of losses by manipulations of plants and pathogens Control of plant pathogens by antagonists, hyperparasites, and natural enemies Disease- and nematode-free seed and propogating material Crop rotation and soil management Vector control Nematode attractants and repellents Sanitation Destruction of inoculum Roguing Intercropping Destruction of alternate hosts	Biological control Insects and other herbivores Diseases Environmental manipulation Choice of variety Seedbed preparation Method of seeding or planting Seeding rates and row spacing Fertilizer management Cultivation Irrigation and water management Erosion control Design of irrigation and drainage canals and ponds Managed grazing Sanitation Flaming and burning Natural stimulants and inhibitors Plant competition Revegetation of weed- and brush-infested grazing lands Breeding highly competitive forage species Oversowing Green manures and cover crops Crop rotations	Noise and physical repellents Chemical repellents Trapping and shooting Behavior Environmental manipulation Exclusion Visual repellents

Source: Modified from President's Science Advisory Committee. 1965. Restoring the quality of our environment. The White House. U.S. Government Printing Office, Washington, DC

- √ A.I.D.'s Endangered Species Act (Section 119 of the Foreign Assistance Act) (Source: A.I.D. Project Officer).

Technical References

- √ Local and international publications on pests, pesticides, alternative methods of control, and integrated pest management (Source: Libraries, universities, and host country ministries).

- √ Pesticide labels, container wrappers, or supplemental literature accompanying the proposed pesticides (Source: Pesticide manufacturers and dealers).

- √ Current Pesticide Chemical News Guide (updated periodically) (Source: Louis Rothschild, Jr., 1101 Pennsylvania Avenue, S.E., Washington, DC 20003, telephone: 202-544-1980).

- √ Title 40, Part 180 (pesticide tolerances for raw agricultural commodities) and Title 21, Part 193 (pesticide tolerances for processed foods) of the Code of Federal Regulations (updated periodically) (Source: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9371).

- √ Guide to Codex Maximum Limits for Pesticide Residues (updated periodically) (Source: Joint FAO/WHO Food Standards Programme, Codex Alimentarius Commission, Pesticide Residues, The Netherlands).

- √ Suspended, Cancelled, and Restricted Pesticides (updated periodically) (Source: Office of Pesticides and Toxic Substances, Office of Compliance Monitoring (EN-342), U.S. Environmental Protection Agency, Washington, DC 20460, telephone: 202-382-3807).

- √ Current Report on the Status of Chemicals in the Special Review Program and Registration Standards in the Reregistration Program (updated periodically) (Source: Public Information Branch, Field Operations Division, Office of Pesticide Programs [H7506C], U.S. Environmental Protection Agency, Washington, DC 20460, telephone: 703-557-2805).

- √ Recent publications and maps that describe the natural environment whe the proposed pesticides are to be used. A.I.D.'s environmental profiles of various developing countries are excellent references (Source: A.I.D. or host country).

- √ EPA Crop Groupings [40 CFR 180.34(f)(9)] (Source: Distribution [PM 215], U.S. Environmental Protection Agency, Washington, DC 20460, telephone: 202-382-2118).

- Current Farm Chemicals Handbook (updated annually) (Source: 37841 Euclid Ave., Willoughby, Ohio 44094, telephone: 216-942-2000, telex: 212556 MPCO, fax: 216-942-0662).

- Crop Protection Chemicals Reference (updated annually) (Source: MSDS Reference for Crop Protection Chemicals, c/o John Wiley & Sons, Inc., 605 Third Avenue, New York, New York 10157-0228).

- Recognition and Management of Pesticide Poisonings; 4th edition, March 1989 (Source: Public Information Branch, Field Operations Division, Office of Pesticide Programs [H7506C], U.S. Environmental Protection Agency, Washington, DC 20460, telephone: 703-557-2805).

Documents on Local Laws and Regulations

- √ Laws and regulations governing pesticide use in the host country (Source: Host country ministry of agriculture, ministry of natural

resources, or other ministry or office responsible for the laws and regulations).

- Laws and regulations on environmental protection, endangered species, or related environmental matters (Source: Host country ministry of natural resources or other ministry or office responsible for the laws and regulations).

- Lists of pesticides (by products) approved for use in country and (if available) quantities of pesticides imported to or produced in country for most recent year available (Source: Host country ministry of agriculture or other ministry or office responsible for compiling information on pesticides).

Other Sources

In addition, the following are useful and may be required to complete the assessment:

- Scientific publications on the impacts of pesticides on human health, environment, and socioeconomic factors (Source: Libraries).

- Residues in Foods (updated annually) (Source: U.S. Food & Drug Administration, Pesticide Program, 5600 Fishers Lane, Rockville, Maryland 20857, telephone: 301-443-1815).

- Health data on pesticide poisoning in country (Source: Host country ministry of health or other ministry or office responsible for health).

- PEST-BANK and CHEM-BANK databanks on CD-ROM (updated quarterly) (Source: SilverPlatter Information, Inc., One Newton Executive Park, Newton Lower Falls, Massachusetts 02162-1449, telephone: 800-343-0064, fax: 617-969-5554).

PEST-BANK and CHEM-BANK provide current information on pesticides registered by EPA. PEST-BANK provides information on residue tolerances for all EPA registered pesticides and is a good way to determine which pesticides are in EPA's restricted use category. CHEM-BANK provides toxicological data (human health and environmental effects) for some of the EPA-registered pesticides. The databanks are on CD-ROM disks accessed by computer.

Always Consult the Pesticide Label

The label includes all information printed on or attached to the pesticide container. The importance of the label cannot be stressed too often. If it is read and understood and all the directions are followed, the likelihood of misusing the material or of having an accident is greatly reduced. Unfortunately, many pesticides in developing countries are sold without labels, the labels are in a foreign language, or the labels are too difficult for applicators to understand. These problems are at the root of much of the pesticide misuse in developing countries.

Preparers of EAs must carefully assess all available label information. They must read and understand all directions on the label when developing the EA. They must determine if labels are understandable to farmers and other users.

A label for a pesticide registered by EPA includes the following information (see Glossary, page 28, for definition of terms):

- Brand name.
- Chemical name.
- Common name.
- Formulation.
- Ingredients.
- Contents.
- Manufacturer.
- Registration and establishment numbers.
- Signal word.
- Precautionary statements.
- Statement of practical treatment.
- Statement of use classification.
- Directions for use.
- Misuse statement.
- Reentry statement.
- Storage and disposal directions.
- Warranty.

GENERAL PROCEDURES

Briefing in Washington, DC

A briefing in Washington, DC is usually essential before beginning the EA. The briefing may be required to acquire critical A.I.D. documents. It is an opportunity to meet A.I.D. environmental officers, pest management advisors, and others who may be reviewing the EA. They will have made preliminary arrangements for the host country visit and usually can suggest useful contacts there.

Upon Arrival in Host Country

Upon arrival in the host country, contact the designated A.I.D. representative for briefing and instructions. The A.I.D. representative usually will identify host country counterparts or other collaborators. Give governmental and nongovernmental host country representatives ample opportunity to participate in developing the EA.

The Environmental Assessment's Content and Form

The Environmental Assessment should include the following:

1. Cover page: The cover shows the name of the A.I.D. project, mission, and country; name, professional discipline, and affiliation of each person responsible for conducting the EA; name and address of the contractor in charge of the EA; and date.

BEST AVAILABLE

2. Summary: The summary presents the major conclusions, areas of controversy, if any, and the issues to be resolved.

3. Introduction: This section describes why the Environmental Assessment was developed. The Initial Environmental Examination in the A.I.D. Project Identification Document or Project Paper describes why a positive Threshold Decision was reached and the EA is needed.

4. Pesticide Procedures: This section addresses the following factors, a. to l., in accordance with 22 CFR 216, §216.3(b)(1):

   a. The EPA registration status of the requested pesticide(s).

   b. The basis for selection of the requested pesticide(s).

   c. The extent to which the proposed pesticide use is part of an integrated pest management program.

   d. The proposed method or methods of pesticide application, including availability of appropriate application and safety equipment.

   e. Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed pesticide use and measures available to minimize such hazards.

   f. The effectiveness of the requested pesticide(s) for the proposed use.

   g. Compatibility of the proposed pesticide(s) with target and nontarget ecosystems.

   h. The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils.

   i. The availability and effectiveness of other pesticides or nonchemical control methods.

   j. The requesting country's ability to regulate or control the distribution, storage, use, and disposal of the requested pesticide(s).

   k. The provisions made for training of users and applicators.

   l. The provision made for monitoring the use and effectiveness of the pesticide(s).

5. Summary of mitigative measures and requirements: This section summarizes measures to reduce negative environmental impacts and may include a budget of costs to implement the measures. Practical needs (training, research directed at finding nonchemical alternatives, safety equipment, storage facilities, pesticide enforcement procedures, new publications, etc.) should be emphasized.

6. References cited: This section should list citations of technical articles and other documents used as sources for all significant assertions and scientific data presented.

7. Collaborators and Persons Contacted: This section should list the names, disciplines, affiliations, and contributions of host country representatives, A.I.D. staff, EPA staff, and any others who provided information or were contacted about the EA.

8. Recommended Distribution: This section should identify the names and addresses of key host country representatives and A.I.D. contractors who should receive the approved Environmental Assessment. The list of persons to receive the EA should be compiled in consultation with designated A.I.D. personnel.

9. Annexes: If host country pesticide laws and regulations exist, they should be presented as annexes. Annexes should also include copies of labels of the proposed pesticides and a list of pesticides approved for use in country, if available.

Before Departing Host Country

The last step before departing the host country is to debrief designated A.I.D. personnel in the overseas mission. If the Environmental Assessment is not completed, inform them when it will be available. Also, determine if they expect any follow-up assistance in revising the EA, etc.

Debriefing in Washington, DC

A debriefing at A.I.D. in Washington, DC may be necessary or helpful.

STEP-BY-STEP PROCEDURES

Writing Style

When writing an EA:

- Clearly define words or terms that a lay person may not understand.
- Explain the dual naming systems used for both living things (Latin name and common name) and pesticides (common and trade names) and be consistent in use of names.
- Give a reference for all significant assertions and scientific data presented. The EA should have a list of references cited.
- Beware of making unfounded or possibly mistaken assertions.
- Do not use sexist language. When referring to farmers, for instance, use "they" instead of "he" or "she."

Pesticide Procedures

The Pesticide Procedures section (see page 9) of the Environmental Assessment should take the following form:

a. The EPA Registration Status of the Requested Pesticide(s).

This section should indicate for each proposed pesticide: (1) if EPA has registered the pesticide for the proposed use(s), (2) the EPA classification category, and (3) if EPA is presently reviewing the pesticide because of suspected problems. Copies of sample labels of the pesticides, obtained in the country of proposed use, should be attached as an annex of the EA.

EPA Registration Status

EPA is responsible under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) for registering pesticides. FIFRA requires EPA to take into account economic, social, and environmental costs and benefits in making decisions. EPA may classify a product for "restricted use" if its toxicity warrants special handling. Use of one formulation of a pesticide may not be restricted but another formulation may be. EPA registers a pesticide according to its formulation and intended use.

In the U.S., only pesticide applicators who have been certified by law can purchase restricted pesticides. The restricted materials have a high potential for causing harm to humans and/or environment. They are too hazardous for general use in A.I.D. projects, but in exceptional circumstances they may be approved if their use is determined essential and the project includes a training component to minimize hazards.

The EPA registration status of all proposed pesticides must be determined, using one of the following sources:

- Pesticide labels. The labels of pesticides sold in the U.S. include the EPA registration number and indicate all uses for which registered. Foreign labels of the same pesticide chemicals may, but usually do not, include information on EPA registration.

- PEST-BANK. PEST-BANK (updated every 3 months) will provide all information needed on registration.

- Pesticide Chemical News Guide. This Guide (updated periodically) lists EPA tolerances (or exception from tolerances) for pesticides on specific crops. Inclusion of an EPA tolerance in the Guide indicates that the pesticide has been registered for that specific crop use.

- Crop Protection Chemicals Reference. This publication compiles information appearing on labels of EPA-registered pesticides. However, it does not include information for many EPA-registered pesticides and is only published once per year.

- Suspended, Cancelled, and Restricted Pesticides. This EPA publication lists those pesticides that EPA has suspended, cancelled, or restricted. The publication's limitation is that it is updated infrequently.

- EPA's Office of Pesticide Programs, Registration Division (telephone: 703-557-7700).

A.I.D. policy is to use unclassified (general use) pesticide chemicals that EPA has registered for the same or similar uses in the U.S. "Similar" refers to crops in related botanical categories (e.g., tuber crops). EPA Crop Groupings [40 CFR 180.34(f)(9)] provides guidelines on crop groupings.

Pesticides not registered by EPA or registered in EPA's restricted use category may be considered for approval on human and animal food crops in A.I.D. projects if the following provisions are met:

- For restricted use pesticides, there must be a training component in the project to assure proper use.

- For pesticide chemicals without EPA tolerances, the chemicals must have an acceptable daily intake (ADI) and maximum residue limit (MRL) established by the FAO/WHO Codex Alimentarius Commission for the crop(s) in question and use patterns must assure that those tolerances will not be exceeded (see discussion under Tolerance Requirements).

- For all pesticides, the chemicals must not have been cancelled, withdrawn, or suspended in the U.S. because of health or environmental concerns.

However, in these cases approval will depend on current information about the chemicals in question and whether they can be used properly under the particular circumstances.

Tolerance Requirements

The tolerance of a pesticide is the minute trace permitted to remain in or on raw agricultural commodities or processed foods. Some pesticides are sufficiently low in hazard to be exempt from tolerance requirements. Tolerances are set by EPA for each individual crop or food type. Some pesticides have no tolerances because EPA has not established them yet.

The following sources indicate if EPA has established tolerances for specific pesticides on specific crops or other commodities:

- The labels of EPA registered pesticides.

- Title 40, Part 180 (raw agricultural commodities) and Title 21, Part 193 (processed foods) of the Code of Federal Regulations.

- Pesticide Chemical News Guide.

- PEST-BANK.

Tolerances are assigned by crop. EPA has established crop groupings that link major crops with minor crops (including many tropical crops) having similar growth and consumption patterns. A tolerance that applies to one crop in a group can be extended to the others. The crop groupings are given in 40 CFR 180.34(f)(9).

The Food and Drug Administration is mandated by law to monitor foods imported into the United States. One objective of the monitoring is to insure that EPA tolerances for pesticide residues are not exceeded and that residues of pesticides not registered by EPA for use on a particular product are not present. It is therefore important that only EPA-registered products are used on crops for export to the U.S. and that the rates and frequency of application, together with the prescribed harvest intervals, do not result in residues exceeding such tolerances.

The FAO/WHO publication, Guide to Codex Maximum Limits for Pesticide Residues, recommends tolerances for specific pesticides on specific crops. The Guide includes tolerances for pesticides on crops for which EPA tolerances do not exist. Pesticides with FAO/WHO-recommended tolerances may be used in A.I.D. projects, but treated crops should not be exported to the U.S. unless the FAO/WHO tolerances have been approved by EPA. EPA's Office of International Activities, telephone: 202-382-4870, should be contacted if there is a question about EPA-approval of FAO/WHO-recommended tolerances.

EPA Special Review Program

EPA's Special Review program (formerly called Rebuttable Presumption Against Registration) studies pesticides to determine if their use presents unacceptable risks. The criteria for initiating a Special Review of pesticide uses include:

- Potential acute toxicity to humans or domestic animals.
- Potential adverse chronic effects in humans.
- Hazards to nontarget organisms.
- Separate criteria for hazards to threatened or endangered species.
- Other adverse effects that would permit EPA to initiate a Special Review in circumstances where potential risks may not be anticipated by specific criteria.

The Special Review study may take several years. At the end of the study, EPA may decide to cancel (ban) the pesticide or restrict its use, or may take no action if the Special Review fails to confirm substantial risks. The use in A.I.D. projects of pesticides under Special Review should be avoided if acceptable alternatives are available. They may be harmful, and if they are canceled or restricted during the life of a project, alternatives will have to be found and substituted quickly.

The following EPA publication lists the pesticides in the Special Review program and why the pesticides are being reviewed:

- Report on the Status of Chemicals in the Special Review Program and Registration Standards in the Reregistration Program (updated periodically).

EPA's Office of Pesticide Programs, Registration Division (telephone: 703-557-7700) should be contacted about questions concerning the Special Review status of a pesticide or recent changes in its registration.

The EA should indicate if any of the proposed pesticides are in the Special Review program and why EPA has put them in Special Review, as indicated in the EPA publication above. The EPA rationale for the review may include one or more of, but not necessarily be limited to, the factors in Table 3 (see Glossary, page 28, for unfamiliar terms).

Format

Much of the data for section a. of the Pesticide Procedures can be summarized in a table such as Table 4. If EPA has not established tolerances for a pesticide on a crop but FAO/WHO has established ADI/MRL levels, indicate so in a table footnote.

b. The Basis for Selection of the Requested Pesticide(s).

This section should briefly explain what criteria were used to select the proposed pesticide(s), for example:

- Because of local availability, effectiveness, and past experience.
- Because small plot experiments showed the pesticide(s) to be promising.
- Because there are no known chemical or nonchemical alternatives.
- Because of low mammalian toxicity.

c. The Extent to Which the Proposed Pesticide Use Is Part of an Integrated Pest Management Program.

A.I.D. policy is to promote integrated pest management to the extent possible. Pesticides normally will be approved only if the EA shows that the proposed pesticide use will be in accordance with IPM principles.

IPM is a pest control system that uses the "best mix" of two or more control methods based on criteria of crop yield, profit, and safety. Pesticides are used only when cost-benefit analyses show that use is truly justified and will produce beneficial results.

IPM can decrease pest losses, pesticide use, and costs and increase crop yield and stability. Successful IPM programs have been developed for insects and mites, plant diseases, weeds, vertebrates, and snails and slugs attacking various crops. Some IPM technology as conceived by research workers is too complex for farmers in developing countries. However, numerous IPM systems developed in close collaboration with farmers have been widely adopted in many of these countries.

Table 3. Examples of Criteria that EPA Considers When Initiating a Special Review of Pesticide Uses

Oncogenicity	Acute toxicity
Mutagenicity	Thyroid effects
Teratogenicity	Acute and chronic toxicity to nontarget organisms
Fetotoxicity	Reduction in nontarget organisms
Reproductive effects	Testicular effects
Hazards to wildlife	Avian hazard
Toxic effects in liver and kidney	Hazard to aquatic organisms
Ecological effects	Neurotoxicity
Ground water contamination	Reduction in endangered species
No antidote	Bioaccumulation
Carcinogenicity	Chronic effects
Emergency treatment	

Table 4. Example of a Table for Summarizing the EPA Registration Use Category, Tolerances, and Special Review Status of Each of the Proposed Pesticides

Pesticide names[1]	EPA registration category		Status of tolerances for crops for which requested:[2]			EPA Special Review status
	General use	Restricted use	Millet[3]	Beans	Cabbage	
Fungicides						
Copper oxychloride (Cupravit)	X			E	E	
Herbicides						
Bentazon (Basagran)[4]	X			T		5
2,4-D (Acme), emulsifiable concentrate	X			NT[6]		7
Insecticides						
Bacillus thuringiensis (Dipel)	X		E		E	
Chlorpyrifos (Counter)	X		T			

[1]Approved common name in the Pesticide Chemical News Guide and (in parenthesis) the trade name. A pesticide may have one or more trade names.

[2]T=EPA Tolerance established; NT=No EPA tolerance; E=Exempt from EPA tolerance. (Pesticide Chemical News Guide 1988).

[3]Millet is in cereal grains crop category of EPA's Crop Grouping [40 CFR 180.34(f)(9)], which includes the commodity corn. Status of tolerances for millet is based on tolerances established for corn.

[4]Bentazon will be used only in research demonstration plots under careful supervision by project supervisors.

[5]Bentazon is under Special Review because of suspected ground water contamination.

[6]No FAO/WHO recommended tolerances either. Treated beans will not be consumed; 2,4-D is to be included only as a reference treatment in farmer field trials.

[7]2,4-D is under Special Review because of suspected oncogenicity.

The EA should encourage the development and use of IPM. It should descril the existing use of IPM and indicate any requirements (including budget) for IPM training, research, etc. The requirements should be described in the EA's summary of mitigative measures and requirements.

Guidelines for IPM Programs

The EA should briefly describe the IPM program and how the proposed pesticide use will be integrated into it. Use of monitoring, nonpesticidal methods, and other features of the IPM program should be discussed along with pesticide use.

Specifics of an IPM program will depend on the crop, cropping system, pest complex, economic values, social conditions, availability of personnel, and other factors. The general steps for developing an IPM program appear in the boxes on the following pages.

d. The Proposed Method or Methods of Pesticide Application, Including Availability of Appropriate Application and Safety Equipment.

This section should describe the method or methods of application, availability of application equipment, and need for and availability of safety equipment. Before developing this section, the EA preparer should visit project sites to observe how the farmers apply pesticides and the safety practices they use, and to determine needs.

The equipment should be suited to local conditions. Large, powerful, or expensive equipment usually is impractical in developing countries where farmers commonly use small, hand-operated sprayers or dusters. Indicate all needs for equipment and spare parts in the EA's summary of mitigative measures and requirements.

This section should also describe availability and additional need for clothing and equipment to protect applicators, others, and environment. The pesticide label is an excellent information source: it includes a precautionary statement of the pesticide's hazards and describes clothing and equipment that should be used to reduce the hazards. Table 5 is a protective clothing and equipment guide developed by the California Department of Food and Agriculture for pesticides in EPA toxicity categories I-III. Note, however, that local climatic or economic conditions may preclude the use of protective clothing. Protective clothing recommended for temperate areas may be physically unbearable in tropical climates. If the necessary protective clothing is physically unbearable, then pesticides requiring this clothing should not be proposed.

The EA should clearly summarize precautions and safety information indicated on the pesticide labels, such as:

- How to avoid drift to nontarget areas.
- The need to avoid smoking or eating while using pesticides.

- The need to prevent unprotected persons and livestock from entering treated areas until enough time has passed for them to be safe. The pesticide label indicates how much time is required.
- How to clean contaminated clothing.
- How to clean up pesticide spills.
- How to maintain the pesticide application equipment.
- How to dispose of unused pesticide and pesticide containers.
- How to store and transport the pesticides.

e. Any Acute and Long-Term Toxicological Hazards, Either Human or Environmental, Associated With the Proposed Pesticide Use and Measures Available to Minimize Such Hazards.

The purpose of this section is to point out potentially harmful acute (short-term) and long-term effects of the proposed pesticides and outline measures to reduce the effects. A table (see Table 6 for example) showing the pesticides' acute oral LD_{50} values, EPA toxicity categories, and signal words and reasons for EPA Special Review, if any, should be included. If any pesticides are under EPA Special Review, the reasons for the review should be discussed thoroughly in relation to their proposed use.

Acute Toxicological Hazards

Examples of acute effects on humans include problems related to absorption through skin, inhalation, or eye contact. Examples of acute environmental hazards include problems of toxicity to honey bees, fish, birds, or other wildlife. Other potential acute effects would include chemical explosions during fires. The pesticide label, CHEM-BANK, and Crop Protection Chemicals Reference are sources for information on the short-term effects.

A pesticide's acute oral LD_{50} is the best indication of its potential short-term toxicity to humans. It is the amount of the chemical necessary to kill 50% of the test animal population (usually laboratory rats). The acute oral LD_{50} is based on unit weight of pesticide per unit body weight of the test animal (mg/kg) when swallowed. Pesticides with the lowest LD_{50} values are potentially the most toxic to humans (see Table 7). Ingestion of just a few drops to a teaspoon of a pesticide with an oral LD_{50} of less than 50 might be sufficient to kill an adult person. An adult may have to consume 16 tablespoons to 0.5 kilogram or more of a pesticide with an oral LD_{50} of 5000 before dying.

However, the pesticide's formulation and percentage active ingredient and other factors such as health of the person determine its actual hazard level. A pesticide formulation with 15% active ingredient would be potentially more hazardous than a formulation of the same pesticide chemical with 5% active ingredient.

STEPS TO IPM

STEP 1: IDENTIFY THE MAJOR PESTS AND ESTABLISH ECONOMIC INJURY LEVELS

Dozens of potentially harmful species may infest a crop. However, only a few serious pest species normally recur regularly. The serious pests--known as key, primary, or chronic pests --that recur regularly at intolerable levels are the focal organisms for IPM programs.

The criterion that determines whether taking action to control a harmful species is profitable is called the "economic injury level". The economic injury level may be expressed in different ways depending on the crop and the pests. For example:

- Numbers of insects per plant.
- Percentage of fruit damaged by a given pest.
- Numbers of weeds per square meter.

The economic injury level is the "break even point" in pest management. Below this level, the cost of control is not justified. Above this level, control may be profitable.

Several factors will influence the economic injury level for a specific pest: crop variety and stage of development, economic value of crop, presence of natural enemies, cost of the control measure, external costs to health and environment, etc. The economic injury level depends on the damage function (the relationship between pest intensity and yield loss) as well as the economics of reducing the damage. It therefore will change as these variables

(continued)

EPA has grouped pesticides into four toxicity categories according to their potential for causing injury to people and assigned them signal words ("Danger", "Warning", or "Caution") corresponding to their toxicity categories (see Table 7). Category I pesticides are most toxic or hazardous and their use is normally restricted. These are too toxic for general use in A.I.D. projects. Many Category II pesticides are also too toxic. They are acceptable only if the EA indicates that project use patterns will adequately mitigate hazards.

The following sources can be used to determine a pesticide's oral LD_{50}, EPA toxicity category, and EPA signal word:

- Oral LD_{50}: Farm Chemicals Handbook and CHEM-BANK.
- EPA toxicity category: The pesticide label, Crop Protection Chemicals Reference, Farm Chemicals Handbook, and PEST-BANK or CHEM-BANK.
- EPA signal word: The pesticide label, Crop Protection Chemicals Reference, Farm Chemicals Handbook, and PEST-BANK.

The EA should highlight special needs for avoiding short-term hazards. Some general suggestions appear on the pesticide label, under:

- Precautionary Statements.
- Statement of Practical Treatment.

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change. Economic injury levels developed in one area will not likely be appropriate for use in another area.

Research is needed to determine the initial economic injury levels. Then, before economic injury levels are recommended for wide-scale use, they should be tested on a few farmers' fields to verify their effectiveness. The levels can be refined as more information becomes available.

By inspecting fields regularly and basing pesticide applications on economic threshold criteria, pest control costs (and pesticide use) usually can be reduced and profits increased.

STEP 2: SELECT THE BEST MIX OF CONTROL TECHNIQUES

All methods and practices (see Table 2, page 5) should be considered for the IPM program. First consideration should be given to the use of preventive measures, namely:

- Resistant crop varieties.
- Biological control (conservation or augmentation of natural enemies already present or introduction of new natural enemies).
- Cultural control (cultivation, crop rotation, use of pest-free seed and planting stock, fertilizer management, intercropping, etc.).

(continued)

- Directions for Use.
- Reentry Statement (the amount of time that must elapse before a person enters an area treated with a pesticide).
- Storage and Disposal Directions (special instructions on storage and disposal).

Long-Term Toxicological Hazards

Examples of long-term (delayed) human health effects include oncogenicity, teratogenicity, carcinogenicity, and mutagenicity (see Glossary, page 28, for explanation). Examples of long-term ecological effects include decrease in biodiversity and ecological stability and contamination of aquifers. Years of continuous observation and complex research are often necessary before long-term effect on humans or ecosystems are known.

CHEM-BANK is a good source for information on long-term effects. The EPA Report on the Status of Chemicals in the Special Review Program and Registration Standards in the Reregistration Program identifies suspected long-term effects of those pesticides in EPA Special Review program.

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Farmers may already be using one or more of these preventive measures. It is therefore important to survey the farmers before determining which measures are needed.

Pesticides should be used only if no practical, effective, and economic nonchemical control methods are available. Then they should be applied only to keep the pests from reaching economic injury levels. The pesticides and application techniques selected should cause minimal harm to humans, livestock, honey bees, natural enemies, and the environment.

STEP 3: MONITOR THE FIELDS REGULARLY

The growth of pest populations usually is related closely to stage of crop growth and weather conditions. However, it is difficult to predict severity of pest problems accurately in advance. The crops must be inspected regularly to determine the levels of pests, natural enemies, and crop damage.

Extension and commodity organization personnel can assist with field inspections. They can train the farmers how to separate pests from non-pests and natural enemies and to determine when crop protection measures, perhaps including pesticides, are necessary. This approach has been very effective in many developing countries.

(continued)

f. The Effectiveness of the Requested Pesticide(s) for the Proposed Use.

The effectiveness of a pesticide is its ability to produce a desired effect on a target organism. Effectiveness is difficult to measure and expert opinions are often biased. Weather conditions, level of resistance in the pest, methods of application, and other factors will determine how effective a pesticide is.

What to Report on Effectiveness

The EA should include the following for the proposed pesticides:

- Why the pesticides are being proposed. Are efficacy data available? Are the pesticides superior to nonchemical control measures or other pesticides? If efficacy data are not available, have pest control experts or farmers had experience using the pesticides?

- How will pesticide efficacy be monitored?

- Is pest resistance to pesticides a problem? Pesticide resistance is one of the most serious factors affecting pesticide use. Worldwide, over 600 species of pests have developed resistance to one or more chemical pesticides. The problem is so serious in some areas that effective pesticides are no longer available for some major pests, such as the diamondback moth attacking cabbages and other plants of the mustard family. Malaria eradication programs in many countries are in disarray because vector mosquitoes are no longer adequately controlled with available insecticides. Combatting resistant strains is not easy, and there may not always be solutions. The best strategy is to avoid the

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STEP 4: USE ALL CONTROL METHODS CORRECTLY AND SAFELY

Each pest control method has both advantages and disadvantages. Extension personnel and others advising farmers should learn the advantages and disadvantages. They should develop educational programs to teach farmers how to use the control methods correctly and safely.

STEP 5: COMPLY WITH ALL LEGAL CONTROLS

Legal controls result from laws and regulations and include:

- Quarantines to prevent the entry and establishment of new pests.
- Local laws and regulations that govern pesticides.
- Pesticide restrictions and regulations in projects financed by outside donors.
- Laws relating to international transport and marketing of produce.

All local pesticide laws and regulations as well as A.I.D. regulations must be followed. The EA should determine what laws and regulations exist, assess enforcement, and recommend appropriate changes.

STEP 6: DEVELOP EDUCATIONAL, TRAINING, AND DEMONSTRATION PROGRAMS FOR FARMERS AND EXTENSION WORKERS

Implementation of IPM depends heavily on education, training, and demonstrations to help farmers and extension workers develop and evaluate the IPM methods. Practical hands-on training conducted in farmers' fields (as opposed to classroom) is a must. Special training for extension workers and educational programs for government officials and the public are also important.

problem of resistance by using pesticides sparingly and as a last resort in IPM systems.

g. Compatibility of the Proposed Pesticide(s) With Target and Nontarget Ecosystems.

This section should point to potentially harmful effects of pesticide use in the target (crop) ecosystem itself or surrounding crops or natural ecosystems.

This section requires site visit work to assess potential hazards to nontarget organisms, water, and other elements in the target crop and associated environment. Nontarget organisms such as natural enemies, honey bees, and other pollinators that inhabit target crops especially may be vulnerable. However, pesticides sometimes drift long distances. Highly volatile pesticides discharged from high pressure sprayers with small nozzles during windy conditions are the most prone to drift long distances.

The potential hazards in the treated area and in other areas where drift may be a problem should be described clearly.

Table 5. Protective Equipment and Clothing Guidelines For Pesticides in EPA Toxicity Categories I-III

Summarized label statement	Mixer-loader		Applicator	
	I-II	III	I-II	III*
Precautions should be taken to prevent exposure	A,B,C,F,G,H,R **	A,B,C,F,G,H	B,C,F,G,H,R **	C,F,H,R, **
Protective clothing or protective equipment is to be worn	A,B,C,F,G,H,R **	B,C,F,G,H,A **	B,C,F,G,H,R **	C,F,H,R **
Clean clothing is to be worn	C	C	C	C
Contact with clothing should be avoided	A,B,C	B,C	B,C	C
Contact with shoes should be avoided	B	B	B	B
Rubber boots or rubber foot coverings are to be worn	B	B	B	B
Contact with skin should be avoided	A,B,C,F,G,H	B,C,F,G,H	B,C,F,G,H	C,F,G,H **
A cap or hat is to be worn	H	H	H	H
An apron is to be worn	A	A		
Rubber gloves are to be worn	G	G	G	G
Contact with eyes should be avoided	F	F	F	F
Goggles or face shield are to be worn	F	F	F	F
Avoid inhalation	R	R	R **	R **
A respirator is to be worn	R	R	R **	R **

A Waterproof apron made from rubber or synthetic material. Use for mixing liquids.

B Waterproof boots or foot coverings made from rubber or synthetic material.

C A daily change of clean overalls or clean outer clothing. Wear waterproof pants and jacket if there is any chance of becoming wet with spray.

F Face shield, goggles, or full face respirator. Goggles with side shields or a full face respirator are required if handling or applying dusts, wettable powders, or granules or if being exposed to spray mist.

G Waterproof, unlined gloves made from rubber or synthetic material.

H Waterproof, wide-brimmed hat with nonabsorbent headband.

R Cartridge type respirator approved for pesticide vapors when label specifies another type of respirator such as a dust mask, canister type gas mask, or self-contained breathing apparatus.

* If the Category III pesticide application is being made in an enclosed area such as a greenhouse, or if the application consists of a concentrate spray of 100 gallons-per-acre or less in a grove, orchard, or vineyard, then use the guidelines for Category I-II pesticides.

** Use these guidelines when there is likelihood of exposure to spray mist, dust, or vapors.

Source: P. J. Marer (author), M. L. Flint (technical editor), M. W. Stimmann (Statewide Pesticide Coordinator, OPIC). The safe and effective use of pesticides. Pesticide Appl. Compendium 1. U. Calif. Statewide Integrated Pest Management Project, Div. Agr. Nat. Resources. Publ. 3324.

Table 6. Example of a Table for Summarizing Toxicities of the Proposed Pesticides

Pesticide names[1]	Acute oral LD_{50} (mg/kg)[2]	EPA Toxicity Category[3]	EPA Signal Word[3]	Reasons for EPA Special Review, if any
Fungicides				
Copper oxychloride (Cupravit)	ca. 1000	III	Caution	
Herbicides				—
Bentazon (Basagran)[4]	2063	II	Warning	Suspected ground water contamination
2,4-D (Acme), emulsifiable concentrate	1780	III	Caution	
Insecticides				
Bacillus thuringiensis (Dipel)	15000	III	Caution	

[1]Approved common name in the Pesticide Chemical News Guide and (in parentheses) the trade name. A pesticide may have one or more trade names. Only show trade names of products to be used.

[2]Based on toxicity to rats. LD_{50} values vary with formulation.

[3]See Table 7.

[4]Bentazon will be used only in research demonstration plots under careful supervision of the project supervisor.

Table 7. Criteria that EPA Uses to Establish Pesticide Toxicity Categories

Hazard indicators	Category I Danger	Category II Warning	Category III Caution	Category IV Caution
Oral LD_{50} of active ingredient	50 mg/kg or less	50-500 mg/kg	500-5000 mg/kg	>5000 mg/kg
Inhalation LD_{50}	0.2 mg/liter or less	0.2-2 mg/liter	2.0-20 mg/liter	>20 mg/liter
Dermal LD_{50}	200 mg/kg or less	200-2000 mg/kg	2000-20000 mg/kg	>20000 mg/kg
Eye Effects	Corrosive: corneal opacity not reversible within 7 days	Corneal opacity reversible within 7 days: irritation persisting for 7 days	No corneal opacity: irritation reversible within 7 days	No irritation
Skin Effects	Corrosive	Severe irritation at 72 hours	Moderate irritation at 72 hours	Mild or slight irritation at 72 hours

Special Requirements to Preserve Endangered Species and Biodiversity

The EA must give special attention to A.I.D. policy on endangered species and biodiversity. Section 119 of the Foreign Assistance Act requires that proposed actions by A.I.D. do not endanger wildlife species or habitats critical for them, harm protected areas, or adversely affect biodiversity (species richness). The EA should identify any species that may be endangered or threatened by the proposed pesticide use. It should also point to any potential harm to wildlife habitat, protected areas (wildlife preserves, parks, etc.), or biodiversity. The appropriate host country ministry or government office should be contacted for information and regulations on endangered species, protected areas, and biodiversity. Advice from local environmental organizations should be sought also.

h. The Conditions Under Which the Pesticide Is to Be Used, Including Climate, Flora, Fauna, Geography, Hydrology, and Soils.

This section should describe the environment where proposed pesticides will be used. The description can be rather general except when detailing hazard situations. A.I.D.'s environmental profiles, available for some of the A.I.D. countries, are good sources for preparing this section. Host country universities and ministries and environmental organizations are other sources.

It is important to include a description of any protected areas such as wildlife preserves and parks. Include maps to show the exact locations.

i. The Availability and Effectiveness of Other Pesticides or Nonchemical Control Methods.

This section should discuss the availability and effectiveness of nonchemical alternatives such as shown in Table 2 (page 5). Explain to what degree, how, and where nonchemical alternatives are presently being used and how effective they are. Availability, costs, and feasibility for use in the project should be described.

The section should also discuss the availability and effectiveness of other pesticides. The reason for doing this is to alert A.I.D. and host country officials to potential alternatives that could be considered if use of the proposed pesticides is not approved, if stocks of project pesticides run low, or if a change in regulations renders them unacceptable. Identify the alternatives by both common and brand names. Information on their effectiveness should be included. If effectiveness is suspected but not determined for the target crop or pest, recommend needed trials.

j. The Requesting Country's Ability to Regulate or Control the Distribution, Storage, Use, and Disposal of the Required Pesticide(s).

The purpose of this section is to describe the preparedness of the host country to enforce effective pesticide management. The discussion should address appropriate pesticide laws and regulations and the roles of relevant institutions associated with the project in regulating and controlling pesticide use.

Pesticide regulatory and enforcement procedures vary considerably among developing countries. Many countries have pesticide laws on the books, but few have the means for effective enforcement.

This section should briefly summarize provisions of the pesticide laws and regulations (e.g., authority for pesticide registration, importation, manufacture, storage, transportation, sale, and use of pesticides) and indicate the government offices in charge of enforcement. Also, state whether the country is presently capable of adequately enforcing the laws and regulations and complying with correct pesticide practices. Attach copies of the laws and regulations as an annex to the EA. Use of pesticides should not be proposed unless a country is capable of enforcing the laws and regulations or unless all aspects of their use will be closely supervised by trained project personnel.

If the country is not likely to enforce the pesticide law, indicate what is needed to achieve enforcement at project level. Personnel, other needs, and budgeting requirements should be included in the summary of mitigative measures and requirements.

k. The Provisions Made for Training of Users and Applicators.

This section should include a detailed training plan showing who should be trained (farmers, extension officers, etc.), specific type of training (pesticide safety, IPM, biological control, etc.), how the training is to be done (where, when, and who will do the training), and cost requirements. Such plans can be included in the EA as mitigative action. Personnel and other resources necessary to implement the training should be identified in the summary of mitigative measures and requirements.

How much impact the EA has in promoting safer and improved pest and pesticide practices will depend heavily on the A.I.D. project's training component. Pay particularly close attention to this section.

l. The Provisions Made for Monitoring the Use and Effectiveness of the Pesticide(s).

This section should identify the needs and provisions being made for monitoring of the following:

- Use patterns (frequency of and interval between applications) of the requested pesticide(s).
- Pesticide safety practices during transportation, storage, application, and disposal.
- Pesticide effectiveness.
- Environmental impacts.
- Public health impacts.

The monitoring plan should include a description of the specific kinds of monitoring, who will do it, and who will be responsible for correcting any unsafe pesticide practices or problems found during monitoring.

HOW TO SUMMARIZE THE MITIGATIVE MEASURES AND REQUIREMENTS

This section should briefly summarize all mitigative measures needed to reduce negative environmental impacts. A budget of costs should be included. This is a critical section of the EA and should be written carefully and clearly. The following example shows the form that this section might take:

1. Nonchemical methods of control and IPM systems will be emphasized.

Project training and demonstrations will emphasize nonchemical methods of control and IPM systems. All project personnel and farmers using pesticides in the project will receive training on use of nonchemical methods and IPM. IPM will be demonstrated and evaluated on selected farms.

2. Selection of pesticides.

The pesticides to be used in the A.I.D. project:

- Have no acceptable nonchemical alternatives.
- Are EPA registered for the same or similar use or have the requisite tolerances established.
- Have low human toxicities, present no unacceptable acute or long-term toxicological hazards, and have not been classified by EPA for restricted use.
- Are relatively non-persistent in the environment and present no unacceptable hazards to the environment or nontarget organisms.
- Have not been withdrawn, suspended, or canceled in the U.S. and are not under EPA Special Review.

3. Provide pesticide training and protection to project personnel and participating farmers.

All project personnel and farmers using pesticides in the project will receive training on correct transportation, storage, application, and disposal of pesticides, worker and applicator protection, how to recognize and treat pesticide poisoning, and environmental protection. The training will include instruction on local laws and regulations regarding pesticides, human protection, and environmental protection.

A.I.D. will provide safety equipment and protective clothing to all persons who use pesticides in the project. The equipment and clothing will comply with recommendations on pesticide manufacturers' labels and be feasible for use in the particular climate and social setting.

4. Monitor pesticide use.

Project personnel will regularly monitor project use of pesticides on farmer's fields and demonstration sites and enforce their proper use.

5. Comply with local laws and regulations.

Project supervisors will enforce compliance with all relevant laws and regulations on pesticides, human safety, and environmental protection.

6. Cost requirements.

Include a budget to show the cost for each mitigative measure.

GLOSSARY OF TERMS COMMONLY ENCOUNTERED IN ENVIRONMENTAL ASSESSMENTS[1/]

Acaricide. A pesticide used to control mites.

Acceptable daily intake (ADI). The level of pesticide residue that may be consumed each day over the course of an average human life span without appreciable risk.

Active ingredient (a.i.). The material in the pesticide formulation responsible for the toxic (or other desired) effects on a target pest.

Acute dermal LD_{50}. The dose of a pesticide absorbed through the skin that kills 50% of a population of test animals; usually expressed in milligrams of pesticide per kilogram of body weight of test animal.

Acute effects. The immediate effects (as opposed to delayed effects) of a pesticide.

Acute oral LD_{50}. The dose of a pesticide ingested by mouth that kills 50% of a population of test animals; usually expressed in milligrams of pesticide per kilogram of body weight of test animal.

Acute (short-term) toxicological hazards. The immediate hazards of a pesticide.

Agroecosystem. The ecological community and physical environment in an agricultural land unit.

A.I.D. mission. The A.I.D. representation in a foreign country.

A.I.D. Endangered Species Act. Section 119 of the Foreign Assistance Act.

A.I.D. Environmental Procedures. Procedures of Title 22 of the Code of Federal Regulations, Part 216, to ensure that environmental factors and values are integrated into the A.I.D. decision making process.

A.I.D. Handbook 3. Project Assistance. A.I.D.'s official manual on the requirements for analysis, authorization, development, implementation/monitoring, and evaluation of projects supported by A.I.D.

Application equipment. Equipment for applying pesticides (may range from hand-held sprayers to aircraft sprayers).

Applicator (of pesticides). Any person who applies pesticides.

Aquatic. Pertaining to water.

[1/]The glossary is based, in part, on terms in the publication by Marer, Flint, and Stimmann (1988) cited in Table 5 (page 22).

Attractant. A substance that attracts a specific species of animal to it. When manufactured to attract pests to traps or poisoned bait, attractants are considered to be pesticides.

Avian. Relating to birds.

Avicide. A pesticide used to control pest birds.

Bait. A food or foodlike substance that is used to attract and, often, to poison pest animals.

Beneficial. Helpful in some way to people, such as a beneficial plant or insect.

Bioaccumulation. The gradual buildup of certain pesticides within the tissues of living organisms after they feed on lower organisms containing smaller amounts of these pesticides. Animals higher up on the food chain accumulate greater amounts of these pesticides in their tissues.

Biodiversity. The richness or abundance of species of organisms or biotic life forms.

Biological control. The use of natural enemies (predators, parasites, or disease agents) to control pests.

Brand name. See Trade name.

Broad-spectrum pesticide. A pesticide that is capable of controlling many different species or types of pests.

Calibration. The process for measuring the output of pesticide equipment so that the proper amount of pesticide can be applied to a given area.

Carcinogenicity. The cancer-causing potential of a substance.

Caution. The signal word on labels of pesticides in EPA toxicity Category III or IV; these pesticides have an oral LD_{50} greater than 500 and a dermal LD_{50} greater than 2000.

CD-ROM. Compact disk-read only memory.

CHEM-BANK. A database of SilverPlatter Information Services that provides environmental and toxicological data for some of the EPA-registered pesticides.

Chemical name. Name of the chemical ingredients of a pesticide.

Chronic. Pertaining to long duration or frequent recurrence.

Chronic effects. Long-term or recurring effects.

Climate. The prevailing or average weather conditions of a place as determined by temperature and meteorology over a period of years.

Common name. An approved nontechnical name of a pesticide product. An approved nontechnical name of an organism.

Compatibility. In A.I.D. Environmental Assessments, refers to the degree of known hazards to the target ecosystem (crops to be treated) or nontarget ecosystems (surrounding noncropping environment or crops not to be treated).

Contents. All that is contained in a pesticide container.

Corneal opacity. The eye's imperviousness to rays of light.

Corrosive. Having the power to corrode or wear away by chemical action.

Cultural controls. Crop management and other practices that make the environment less favorable for pests, e.g., field sanitation, crop rotation, diversification, harvesting practices, time of planting, trap crops.

Danger. The signal word used on labels of pesticides in EPA toxicity Category I pesticides with an oral LD_{50} of 50 or less or a dermal LD_{50} less than 200 or having specific, serious health or environmental hazards.

Delayed effects. Effects of pesticides that occur later (sometimes years later) and not immediately.

Dermal. Pertaining to the skin. One of the major ways pesticides can enter the body.

Dermal LD_{50}. See acute dermal LD_{50}.

Disposal (of pesticides). Destruction of left-over pesticides or pesticide containers.

Distribution (of pesticides). The process by which pesticides get from their point of entry (into a country, for example) to their final destination.

Dose. The measured quantity of a pesticide.

Directions for use. Statements on the pesticide labels describing use.

Drift. The movement of pesticide dust, spray, or vapor away from the application site.

Ecological. Consideration of the interrelationship between living organisms and the environment.

Economic damage. Damage caused by pests to plants, animals, or other resources that results in loss of income or a reduction of value.

Economic injury level. The point at which the value of the damage caused by a pest exceeds the cost of controlling the pest.

Ecosystem. An ecological community together with its physical environment.

Effectiveness (of pesticides). See efficacy.

Efficacy. The ability of a pesticide to produce a desired effect on a target organism.

Endangered species. A species in danger of extinction.

Environment. All of the living organisms and nonliving features of a defined area.

Environmental Assessments. In A.I.D. projects a detailed study of the reasonably foreseeable significant effects, both beneficial and adverse, of a proposed action on the environment of a foreign country or countries.

Environmental Impact Statement. A detailed study of the reasonably foreseeable environmental impacts, both positive and negative, of a proposed A.I.D. action and its reasonable alternatives on the United States, the global environment, or areas outside the jurisdiction of any nation.

EPA Signal Word. See Signal Word.

EPA Toxicity Category. Four categories used to indicate the potential hazard of EPA-registered pesticides; Category I uses the signal words "Danger" and "Poison" to signify highly toxic compounds (acute oral LD_{50} mg/kg), Category II uses the word "Warning" to signify moderately toxic compounds (acute oral LD_{50} 50-500 mg/kg), Category III uses the word "Caution" to signify slightly toxic compounds (acute oral LD_{50} 500-5000 mg/kg), and Category IV uses the word "Caution" and must state "Keep Out Of The Reach Of Children" (acute oral LD_{50} >5000 mg/kg).

Exempt from tolerance. Indicates that EPA has determined that minute amounts of pesticide residue on foods will cause no adverse effects to humans.

Fauna. Animal life.

Fetotoxicity. Pesticide toxicity to the unborn fetus.

FIFRA. The Federal Insecticide, Fungicide, and Rodenticide Act of 1947. Governs the licensing, or registration, of pesticide products.

Flora. Plant life.

Formulation. A mixture of active ingredients combined during manufacture with inert materials. Inert materials are added to improve the mixing and handling qualities of a pesticide.

Fumigant. Vapor or gas form of a pesticide used to penetrate porous surfaces for control of soil dwelling pests or pests in enclosed areas or storage.

Fungicide. A pesticide used for control of fungi.

General use (unclassified) pesticide. A pesticides that has been designated by EPA for use by the general public as well as by licensed or certified applicators.

Geography. The physical features (especially the surface features) of a region, area, or place.

Groundwater. Fresh water trapped in aquifers beneath the surface of the soil and used for drinking, irrigation, and manufacturing.

Habitat. The place where an organism lives.

Herbicide. A pesticide used to control weeds.

Host. A plant or animal species that provides sustenance for another organism.

Host country. The country hosting an A.I.D. project.

Host resistance. The ability of a host plant or animal to ward off or resist attack by pests or to be able to tolerate damage caused by pests.

Hydrology. The science dealing with water, its distribution, and the evaporation and precipitation cycle.

Inert ingredient. A substance (such as a solvent) contained in a pesticide formulation, which by itself does not add materially to the pesticide's effect on a pest.

Ingredients. The chemical composition of the pesticide. See Active ingredient and Inert ingredient.

Inhalation. Entering the body through breathing. One of the routes of entry of pesticides into the body.

Initial Environmental Examination. The first review of the reasonably foreseeable effects of a proposed action (in an A.I.D. project) on the environment.

Insecticide. A pesticide used to control insects. Some insecticides are also labeled for control of ticks, mites, spiders, and other arthropods.

Integrated pest management (IPM). Use of a variety of biological, cultural, and chemical control methods in a cohesive management scheme designed to maintain pest populations at levels below those causing economic injury.

Interval. The legal period of time that must elapse between the application of a pesticide and worker reentry into the treated field or the harvesting of produce. See Preharvest interval and Reentry interval.

Invertebrate. An animal that has no backbone (e.g., insect).

IPM. Integrated pest management.

Irreversible. An effect that is not reversible or cannot be repealed or annulled.

Knapsack sprayer. A small portable sprayer carried on the back of the person making a pesticide application. Some knapsack sprayers are hand-operated and others are powered by small gasoline engines.

Label signal words. See signal word.

LC_{50}. The lethal concentration of a pesticide in the air or in a body of water that will kill half of a test population. LC_{50} values are given in micrograms per milliliter of air or water.

LD_{50}. Abbreviation of median lethal dose, MLD. A dose of a pesticide that kills 50% of a population of test animals; usually expressed in milligrams of pesticide per kilograms of test animal body weight.

Lethal. Capable of causing death.

Long-term (delayed) toxicological hazards. Hazards occurring over or involving a relatively long period of time.

Manufacturer. The company manufacturing the pesticide product.

Maximum residue limit (MRL). The maximum residue level likely to arise when a pesticide is used according to recommendations reflecting good agricultural practices.

Misuse statement. Statement on a pesticide label that indicates when the pesticide is used incorrectly and the potential consequences.

Mites. Tiny, sometimes microscopic, relatives of insects that belong to the order Acari of the arthropod phylum.

Mitigative measure. Action taken to avoid, reduce, minimize, repair, or compensate for an adverse environmental impact.

MLD. Median lethal dose. See LD_{50}.

Mode of action. The way a pesticide reacts with a pest organism to destroy it.

Monitoring. Sampling or observations of pesticide use, pesticide residue, natural enemies, etc.

Mutagenic. A chemical that is capable of causing mutations in the cells of living organisms.

Mutagenicity. The degree to which a compound can cause a biological mutation.

Natural enemies. Predators, parasites, and microorganisms that cause the death of pests; biological control agents.

Negative Declaration. A finding that the proposed A.I.D. action will not have a significant effect on the environment.

Nematicide. A pesticide used to control nematodes.

Nematode. Elongated, cylindrical, nonsegmented worms. Nematodes are commonly microscopic; some are parasites of plants or animals.

Nonchemical method. Any method other than a chemical pesticide used to prevent or control a pest. Same as Nonpesticidal method.

Nonpesticidal method. Same as Nonchemical method.

Nontarget ecosystem. An ecosystem not intentionally receiving a pesticide application.

Nontarget organism. Animals or plants within or outside a pesticide treated area that are not intended to be killed or injured by the pesticide application.

Nozzle. A short tube at the end of a sprayer hose that breaks up a pesticide spray into small droplets and directs it toward the target area.

Oncogenicity. A measure of the tendency of a compound to cause tumors.

Oral. Through the mouth. One of the routes of entry of pesticides into the body.

Organism. Any living thing.

Parasite (parasitoid). An organism that grows and feeds in or on a host; often used in biological control programs to suppress pest populations.

Pathogen. A microorganism that causes a disease.

PEST-BANK. A database of SilverPlatter Information Services that allows access to information (registration status, residue tolerances, etc.) on EPA-registered pesticides.

Pest control practice. An action taken (such as plowing, rotating crops, etc.) to reduce a pest problem. Sometimes used interchangeably with Tactic.

Pest control tactic. See Tactic.

Pest management. Any deliberative action to prevent or reduce the density or harmful effects of a pest population.

Pesticide. Any substance or mixture of substances intended for harming, destroying, repelling, or mitigating the effects of pests (insects, rodents, nematodes, fungi, weeds, or any other forms of life declared to be pests); and any other substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

Pesticide formulation. The pesticide as it comes from its original container, consisting of the active ingredient blended with inert materials.

Pesticide label. Information on a pesticide container required by EPA.

Pesticide management. Deliberate actions to reduce the harmful effects of pesticides; includes legislation and regulations as well as safe application, storage, and disposal.

Pesticide resistance. Genetic qualities of a pest population that enable individuals to resist the effects of certain types of pesticides that are toxic to other members of that species.

Pheromone. A chemical substance given off by one individual that causes a specific reaction by other individuals of the same species, such as sex attractants.

Phytotoxic. Injurious to plants.

Positive Threshold Decision. A finding that the proposed A.I.D. action may have a significant effect on the environment.

Practice. See Pest control practice.

Precautionary statements. Statements on a pesticide label that give precautions for using the product.

Predator. An organism that lives by preying on animals (prey); often used in biological control programs to suppress pest populations.

Preharvest interval. A period of time set by law that must elapse between pesticide application to an edible crop and harvesting of the crop. Pesticide labels provide information on preharvest intervals.

Prey. Animals that serve as food for predators.

Product. A commercial formulation of a pesticide.

Project Identification Document. An internal A.I.D. document that initially identifies and describes a proposed project.

Project Paper. An internal A.I.D. document that provides the definitive description and appraisal of a project, particularly the implementation plan.

Rate. The quantity or volume of pesticide that is applied to an area over a specified period of time.

Reentry interval. The period of time specified by law that must elapse after a pesticide is applied before people can resume work in the treated area.

Reentry statement. Statement on the pesticide label concerning the time between application of the material and safe entry into the treated area.

Registration and establishment numbers. The registration number assigned to the product by EPA. For regular registrations, the number preceding the hyphen represents the registering company (establishment).

Reproductive effects. Effects of a pesticide on reproduction in animals.

Residue. Traces of pesticide that remain on treated surfaces after a period of time.

Resistance. See Pesticide resistance and Host resistance.

Respirator. A device worn over the nose and mouth to prevent inhalation of toxic substances.

Restricted-use pesticide. A pesticide, usually in EPA toxicity Category I, that is available for purchase and use only by applicators who have a valid Certified Pesticide Applicator license, or by persons under their direct supervision.

Reversible. Opposite of irreversible.

Rodenticide. A pesticide used to control rats and other rodents.

Rope wick applicator. A device used to apply contact herbicides onto target weed foliage with a saturated rope or cloth pad.

Safety equipment. Face masks, goggles, respirators, etc. to reduce exposure to and risks from pesticides.

Safety apparel. Clothing (coveralls, hat, boots, gloves, etc.) to reduce exposure to and risks from pesticides.

Selective pesticide. A pesticide that has a mode of action against only a single or small number of pest species.

Signal Word. The word "Danger", "Warning", or "Caution" that appears on the label of an EPA-registered pesticide to signify how toxic the pesticide is and what toxicity category it belongs to.

Significant effect. Significant harm to the environment.

Slugs. Any of the gastropod land mollusks with rudimentary internal shells in their mantles.

Snails. Gastroped mollusks living on land or in water and having a spiral protective shell.

Special Review. A process to determine if certain EPA risk criteria are exceeded by a particular registered pesticide. If the Review determines that a pesticide exceeds the risk criteria, the pesticide is presumed unsuitable for registration unless that presumption is rebutted.

Statement of practical treatments. Statement on a pesticide label of acceptable procedures for treating people poisoned by or contaminated with the material.

Statement of use classification. Statement on a pesticide label to make proper use of the material understandable.

Storage (of pesticides). The way pesticides are kept when not being used.

Tactic. Any method (pesticide, biological control agent, etc.) used to reduce a pest problem.

Target. Either the pest that is being controlled or surfaces within an area that the pest will contact.

Target ecosystem. An ecosystem intentionally receiving a pesticide application such as crop ecosystem.

Target pest. A harmful organism at which a pesticide or other pest control tactic or practice is directed.

Teratogenicity. A measure of a compound's tendency to cause physical birth defects in the offspring of exposed parents (male or female).

Testicular effects. Effects of a pesticide on male testes.

Threatened species. Any species of fish, wildlife, or plant listed as having its existance threatened.

Threshold Decision. A decision to determine if a proposed A.I.D. action will or will not have a significant impact on the environment.

Thyroid effects. Effects of a pesticide on the thyroid gland.

Tolerance. The pesticide residue level permitted in or on raw agricultural commodities or processed foods.

Toxicity Category. See EPA Toxicity Category.

Trade name. Trademark (brand) name of a pesticide, formulation, or other product.

Toxicity. A pesticide's potential for causing harm.

U. S. Environmental Protection Agency (EPA). The federal agency responsible for regulating pesticide use in the United States.

Ultra-low-volume (ULV). A pesticide application technique in which very small amounts of liquid spray are applied over a unit of area; usually 2 liters or less of spray per acre in row crops to about 20 liters of spray per acre in orchards and vineyards.

Unclassified (general use) pesticide. See General use pesticide.

User (of pesticides). Any person using (storing, mixing, applying, transporting, or disposing of) a pesticide.

Vertebrates. The group of animals that have an internal skeleton and segmented spine, such as fish, birds, reptiles, and mammals.

Virus. A very small organism that multiplies in living cells and is capable of producing disease symptoms in some plants and animals.

Volatile. Readily vaporizable at a relatively low temperature.

Warranty. The manufacturer's guarantee of the integrity of a pesticide product.

Warning. The signal word used on labels of pesticides in EPA toxicity Category II, having an oral LD_{50} between 50 and 500 and a dermal LD_{50} between 200 to 2000.

20. Working Group: Analysis of Participants' Activities or Projects

Description/Objectives

Bring any material you may have brought describing activities or projects you are working on. This working group is designed as a round table for each participant to discuss issues in the environmental review of their activities or projects.

21. USAID and New Directions in Environmental Procedures and Natural Resource Management

Description/Objectives

To increase your familiarity with new approaches to sustainable management of the environment and natural resource base, nationally, regionally and globally.

This session covers USAID's new directions in environment and natural resource management in Africa, including: strategies in community-based natural resource management; regional NRM initiatives; the relationship of National Environmental Action Planning (NEAPs) to donor coordination and financing; and use of endowments or trust fund mechanisms to support sustainable environmental/natural resource management. This module may be complemented by a discussion led by other host-country presenters on future directions and needs in environmental/natural resource policy, legislation and management at the national and/or regional level.

Readings

Module Backgrounder: "USAID and New Directions in Environmental Procedures and Natural Resource Management"

MODULE BACKGROUNDER
USAID Africa Bureau - New Directions in Environmental Procedures and Natural Resource Management

1. Introduction

The objective of this module is to increase your familiarity with new approaches to sustainable management of the environment and natural resource base, nationally, regionally and globally.

This module covers USAID's new directions in environment and natural resource management in Africa, including: strategies in community-based natural resource management; regional NRM initiatives; the relationship of National Environmental Action Planning (NEAPs) to donor coordination and financing; and use of endowments or trust fund mechanisms to support sustainable environmental/natural resource management. Module 9 on USAID Environmental Procedures also discusses recent USAID responsibilities and initiatives related to tropical forests and biodiversity; country environmental and natural resource threats assessments (See Sections 3.1 to 3.3).

2. Tools To Promote Sustainable Environmental Management and Development

2.1 Building multi-sectoral environmental management capacity for NGOs, PVOs and other development partners in Africa[1]

Background. USAID/AFR has been steadily increasing its funding to private voluntary organizations (PVOs) and non-governmental organizations (NGOs) over the past several years. Generally this support occurs through "umbrella" projects which may result in considerable numbers of subgrants, usually with a variety of NGO/PVO grantees. Increased association with the PVO and NGO community has stimulated an interest in providing environmental management capacity building opportunities and guidelines to ensure that such activities are consistent with USAID's Environmental Procedures.

USAID/AFR has developed *Environmental Guidelines for Small-Scale Activities in Africa* which over the past three years have been used and tested in draft and provisional versions, and have now been finalized. They will be used in building multi-sectoral capacity related to environmental management. The purpose of the guidelines is to promote environmentally sound development activities that build on principles of sustainable natural resource management. The

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1. For more information on this activity contact: AFR/SD/PSGE

guidelines provide PVOs and NGOs with a tool for design, implementation and monitoring of field activities. While intended primarily for use by staff of PVOs and NGOs who engage in development and humanitarian activities in Africa, the guidelines may also prove a useful reference for USAID field staff, consultants, and other developments partners in the host countries.

2.2 Africa Bureau Development Activities and the Environment

The goal of the Development Fund for Africa (DFA) has been to promote broad-based and sustainable economic growth (USAID, 1993) and that goal remains paramount. Its achievement requires that adverse environmental impacts be kept to a minimum. Among other things, Africa Bureau development activities support partnerships among USAID and PVOs/NGOs, program and activity flexibility and willingness to learn, and a long-term development agenda. Programs and activities designed and monitored from afar often depend only on analysis obtained during the design phase. But the most valuable experience comes during implementation, when uncertainties and unforeseen difficulties must be dealt with. The Bureau supports grass-roots development—working through PVOs/NGOs to improve USAID's ability to monitor activities and mitigate those environmental problems which may arise. Also, through improved monitoring and accountability, Africa Bureau activities are designed to improve the capacity of African institutions and individuals to become more self-reliant.

There are many examples of USAID-funded activities working through PVOs and NGOs. Many are umbrella projects where an international PVO has the nominal lead in managing activities, and in exchange passes on technical and managerial expertise to NGO partners. The NGOs also perform much of the grass-roots work. In other program activities, USAID may fund the creation of an African NGO to implement and manage development activities. For example, in the Rwenzori Mountains of Uganda, USAID funded a activity supporting ecotourism development. The Rwenzori Mountain Service (RMS), an NGO, was formed by members of villages near the mountains' national park to provide guide and porter services to tourists. The RMS also maintains trails and the hut system in the park. Funds generated from tourist revenue are used to finance community development activities (Erdmann, 1992).

2.3 Linkage with National Environmental Action Plans

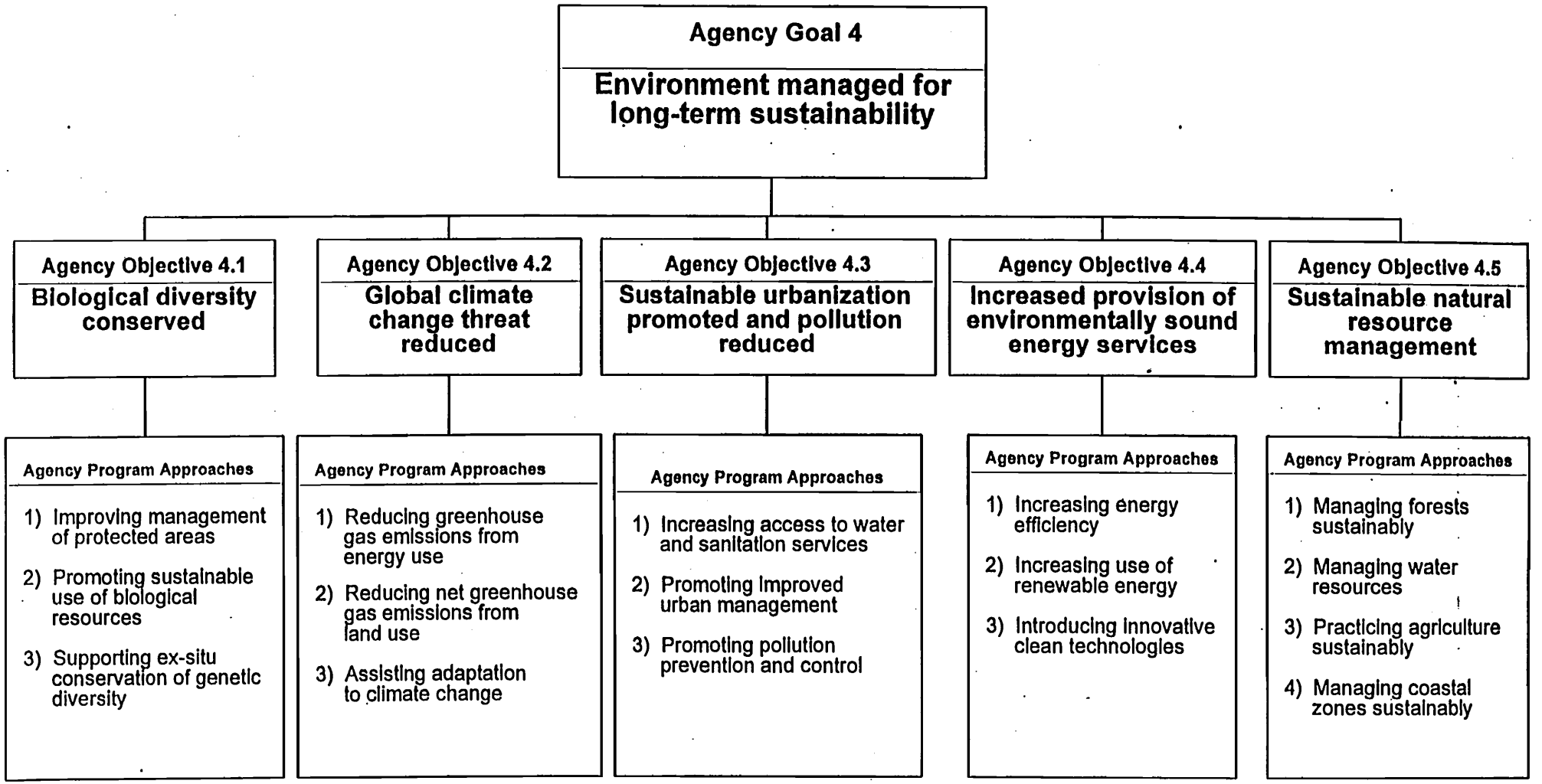
A National Environmental Action Plan (NEAP) is an action-oriented strategy created by a developing country to integrate environmental protection into the development process. The development of these long-term plans involves coordination among host governments, donors, PVOs/NGOs, and local communities. NEAPs emphasize consensus building and local participation, and serve as important tools in planning and evaluating development activities. NEAP development is considered to be a continuing collaborative process in which local institutions and PVOs/NGOs gain more say and experience in the design and implementation of programs and activities, and become better prepared to monitor, evaluate and mitigate activities.

2.4 Endowments for PVO/NGO Sustainability

Recently, USAID has begun using endowments of US dollars or local currencies to promote the long-term sustainability of certain kinds of development programs and activities. This support allows PVOs/NGOs to focus greater attention on their development activities by providing greater financial sustainability, and helps to assure USAID and other donors that the implementing agency will survive to see a program activity through to completion.

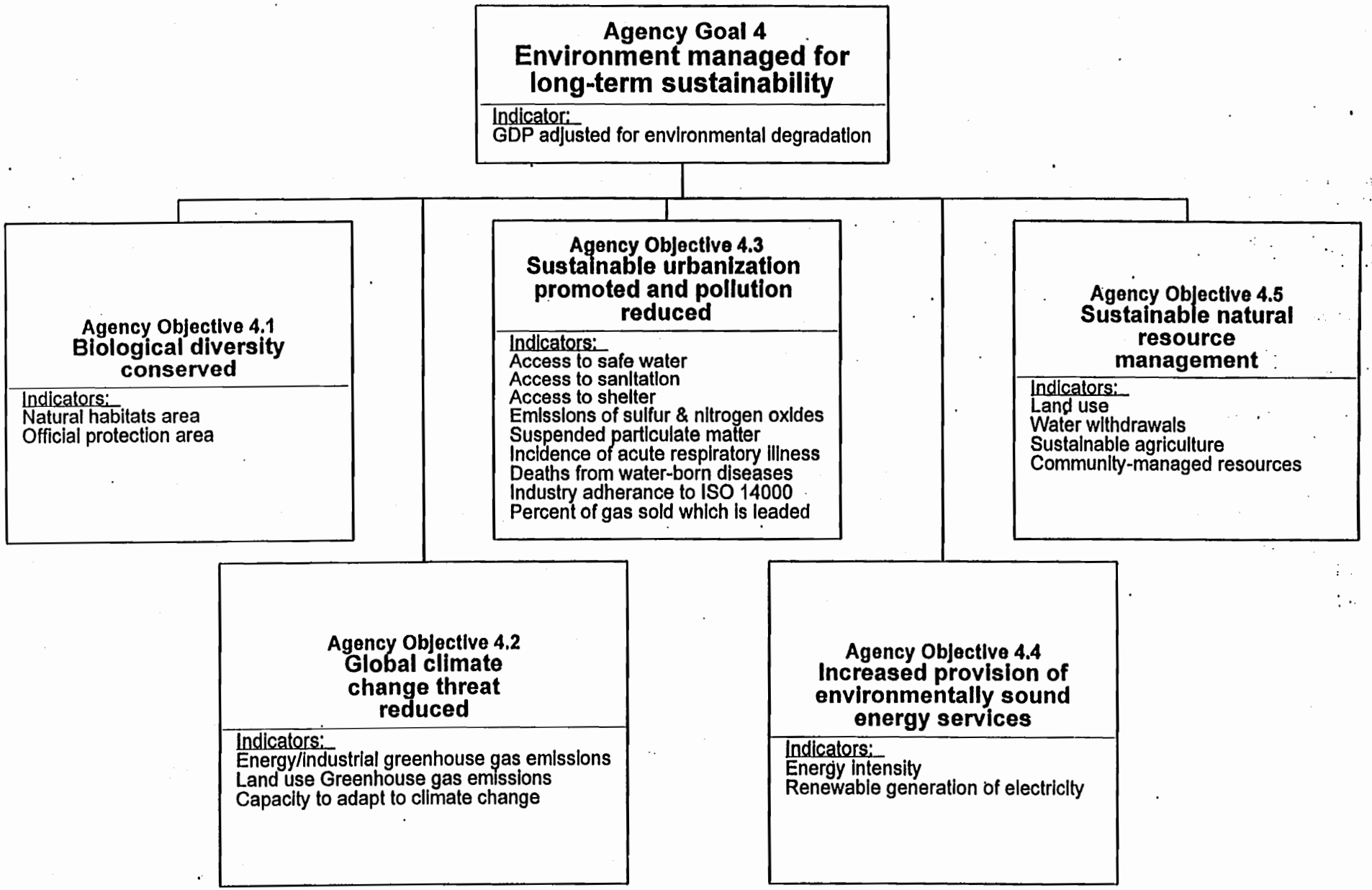
USAID is using this authority to support endowments for institutions and PVOs/NGOs through two means: debt-for-nature swaps and direct grants. The debt-for-nature swap endowment has been around for several years. However, the direct grant is newly created, beginning in 1994. Together, they provide a continuing and stable source of long-term funding to institutions involved in sustainable natural resource management, environmental conservation, maintenance of biodiversity and protection of endangered species. One of the key criteria for selecting institutions and PVOs/NGOs to receive endowment funds of this kind is their familiarity with environmentally sound design and implementation.

Figure 6a: Environment Strategic Framework 1995/96



PPC/CDIE/PME, 9/18/95

Figure 6b: Agency Environment Goal and Objective 1995/96, with Indicators



PPC/CDIE/PME, 9/18/95

Annex 1

Background Reading (Module 21)

World Bank National Environmental Action Plans (A Case Study of USAID Cooperation with the World Bank and Other Donors)

I. Background

National Environmental Action Plans (NEAPs) are being designed and implemented by the World Bank in cooperation with several donors. Approximately 50 NEAPs are now in existence throughout the world, with about 28 in Africa. The Africa Bureau of USAID has played a significant role in the NEAP process since its inception in 1987. USAID has maintained several grants with the World Bank to support design and implementation, donor coordination, networking, and information and analysis activities.

A. The NEAP Process

The NEAP is an important tool for organizing donor and host country resources to reverse the degradation of the African environment. Two notable features of the NEAPs are that they are demand-driven and action-oriented. The demand comes from the nature of the **problem**, i.e., the need to "do something about the environment", and the attraction to donors. The action orientation has evolved from the nature of the **solution**, i.e., "it won't work unless there is grassroots involvement", and the fact that the billions of dollars invested in the 70s and 80s in Africa to reverse desertification were not very successful.

The NEAP process is also unusual in that it involves participation at many different levels within a country. In several countries the head of state as well as the ministries of finance and planning participate in the NEAP process. Because the high political profile of the topic demands a high level of interest, top ranks of government are more likely to get involved. NEAPs not only address community-based issues, but affect sectors that generate foreign exchange, such as tourism. In addition, the World Bank has tied structural adjustment conditionality to the NEAP.

Another important feature of the NEAP is that it encourages broad-based and open participation, especially by the NGO/PVO organizations. The process provides a vehicle for the public to express their opinion on issues of concrete and vital interest for the nation. Furthermore, the ongoing, long-term nature of the process results in the involvement of a large number of people. In Madagascar, for example, approximately 150 Malagasy were involved when the NEAP started; more than one thousand people participated during the process.

B. USAID Involvement in the NEAP Process

USAID continues to be a leader in the NEAP process. In **Madagascar,** USAID has participated in numerous NEAP missions and analyses, and has funded a major biodiversity conservation and development project (SAVEM) under the World Bank's Environment I Program. A second policy-oriented program (KEPEM) is now in the final stage of design. USAID assistance will contribute approximately $60 million over five years to the national environment program.

In **Lesotho,** USAID has developed a Community Management of Natural Resources Project as a complementary activity to the World Bank NEAP. This project addresses rangeland management. In **Guinea, the Gambia, Senegal** and **Uganda,** USAID has participated in NEAP missions and has taken the lead in designing NRM programs to address priority areas identified by the NEAPs.

To support and help carry out these activities, USAID is working with host country individuals, as well as other donors, the World Bank and the NGO/PVO community to further improve the process in other African

countries that are about to design NEAPs. This work has been done through a combination of field-based staff and technical staff from Washington and a series of grants to the World Bank through the Policy, Analysis and Technical Support Project (698-0478). This effort also involves non-governmental organizations like the World Resources Institute, as well as a variety of consultative groups.

USAID has also provided direct support to several organizations located in the World Bank, especially the MultiDonor Secretariat (MDS) and the Network for Environmentally Sustainable Development in Africa (NESDA). This support, which is detailed below, has helped to develop an analytical base for those countries that are likely to participate in the NEAP process.

II. USAID/Africa - World Bank Effort with NEAPs

Realizing that little could be achieved to change the course of environmental degradation without the support of the donor community, the World Bank held a series of workshops between 1987-89 that encouraged donors to participate both analytically and financially in NEAPs. Between 1989-1994, USAID has funded five grants totalling $1.4 million that supported NEAP development in a multi-donor effort (other donors included: Norway, Germany, France, Sweden and the World Bank itself). The donors involved the host country governments, which ensured that mechanisms would be implemented to carry activities well into the 1990s.

The grants involved were facilitated by the fact that the World Bank established a management system under its trust funds for such multi-donor activities. In addition to the grants, USAID has funded analytical assessment and documentation of both process and progress, and has encouraged and employed private groups such as the World Resource Institute to conduct evaluations of NEAP activities. These assessments, both donor and private, have provided valuable lessons for future NEAP programs and they have resulted in several country review documents and a 1992 World Bank publication entitled "Lessons for the Africa Environmental Plans ".

One of the key issues to emerge from these assessments is whether and how Africans pursue the effort once the Action Plan process is put in motion. The Africans themselves must be responsible for the sustainability of NEAP activities. The early momentum, because of the high political profile, must be translated into a realistic, long-term in-country approach with appropriate measures built in to ensure that recurrent costs are met and that NEAP components are designed to be self-supporting.

Environmental sustainability can only occur if the general public are directly concerned and supportive. They will expect the NEAP process to bring an end to the continued degradation of their standard and quality of life. The other aspect of sustainability is the survival of organizations like the Network for Environmentally Sustainable Development in Africa (NESDA) once USAID (and other donor) funding comes to an end. USAID/AFR, working through WRI, has recently assisted NESDA to start the process of becoming a legally endowed NGO in Abidjan. Several major donors are very interested in this development as it would allow NESDA to plan its future on a sustainable basis, using funds derived from the endowment.

III. Advantages and Impact

All donors involved have recognized that USAID grant money, sectoral expertise and capacity for operational research and analysis have provided important leverage. USAID is also the only bilateral donor with a strong field presence and an interest in environment/NRM policy reform. Often, USAID project officers and mission directors have substantial influence over the direction and development of NEAPs, frequently more so than the World Bank which does not fund environmentally-specific reform efforts. In several countries, USAID's work in the design and early implementation phases of the NEAP established the framework used by the World Bank in its broader design of the country's environmental sector program. Most of USAID's environmental/NRM funds are used for community based interventions in biodiversity and sustainable agriculture, whereas the World Bank tends to focus on public sector interventions.

The Congressionally mandated Development Fund for Africa requires extensive impact analysis of USAID programs. Consequently, in the case of Madagascar, USAID included specific environmental impact indicators to the recently designed KEAPEM non-project assistance program that are tied directly to the strategic objectives of the program. Recently at workshops on environmental programs and assessments, several of the participants expressed interest in the USAID indicators and commented on how they could be applied more broadly in multi-donor environmental activities. USAID has agreed to provide more information on these indicators and their use.

USAID has also been instrumental in encouraging broader participation of Africans in order to guarantee the sustainability of NEAPs. NESDA workshops have identified the need for networking within and between African countries regarding the NEAP process. One way of achieving this is to ensure that Africans experienced with the process, be included on future NEAP teams. In addition, the World Bank will be organizing a NEAP Electronic Bulletin to provide up to date information on NEAP activities. Also, it has been recommended that future workshops be organized every six months.

IV. Summary of The NEAP Process

a.) The NEAP process is going forward in many African countries, and appears to be on its way to becoming a major tool in organizing donor and in-country resources to reverse the degradation of the African environment, illustrating a successful cooperative effort between the World Bank and other donors;

b.) The latest workshops and briefing sessions indicate there is much to learn from an analytical review of the NEAP process;

c.) Several issues have yet to be addressed by the NEAP process in a serious way, these are: sustainability, indicators of success and networking;

d.) USAID is seriously involved in the NEAP process in Madagascar, Rwanda, the Gambia, Senegal, Guinea and Uganda and will be looked upon to help other African countries to develop sound, realistic Environmental Action Plans. In this we will be looking to WRI and the World Bank to assist in the development of a series of guidelines based on our past experience.

22. Course Evaluation, Synthesis, and Recommendations for Follow-up Activities

Description/Objectives

This module is designed to solicit your comments and opinions on the course, which are essential for further development and improvement of the course design and materials. The course contains up to three components: 1) the completion and collection of evaluation forms; 2) the delivery of a synthesis presentation by course participants; and 3) a discussion of recommended follow-up activities. You are requested to fill out the attached course evaluation form on a daily basis (if possible). If sufficient time is available, approximately 20 minutes should be set aside during this session to complete the forms.

Course Evaluation Form

Appendix A: Text of Regulation 22 CFR Part 216 ("Reg 16")

22 CFR Part 216
Effective Date: October 9, 1980
ENVIRONMENTAL PROCEDURES

INTERNATIONAL DEVELOPMENT COOPERATION AGENCY
Agency for International Development

22 CFR Part 216
Environmental Procedures

§ 216.1 Introduction
(a) Purpose. In accordance with sections 118(b) and 621 of the Foreign Assistance Act of 1961, amended, (the FAA) the following general procedures shall be used by A.I.D. to ensure that environmental factors and values are integrated into the A.I.D. decision making process. These procedures also assign responsibility within the Agency for assessing the environmental effects of A.I.D.'s actions. These procedures are consistent with Executive Order 12114, issued January 4, 1979, entitled Environmental Effects Abroad of Major Federal Actions, and the purposes of the National Environmental Policy Act of 1970, as amended (42 U.S.C. 4371 et seq.) (NEPA). They are intended to implement the requirements of NEPA as they effect the A.I.D. program.
(b) Environmental Policy. In the conduct of its mandate to help upgrade the quality of life of the poor in developing countries, A.I.D. conducts a broad range of activities. These activities address such basis problems as hunger, malnutrition, overpopulation, disease, disaster, deterioration of the environment and the natural resources base, illiteracy as well as the lack of adequate housing and transportation. Pursuant to the F.A.A., A.I.D. provides development assistance in the form of technical advisory services, research, training, construction and commodity support. In addition, A.I.D. conducts programs under the Agricultural Trade Development and Assistance Act of 1954 (Pub. L.480) that are designed to combat hunger, malnutrition and to facilitate economic development assistance programs are carried out under the foreign policy guidance of the Secretary of State and in cooperation with the governments of sovereign states. Within this framework, it is A.I.D. policy to:
(1) Ensure that the environmental consequences of A.I.D.-financed activities are identified and considered by A.I.D. and the host country prior to a final decision to proceed and that appropriate environmental safeguards are adopted;
(2) Assist developing countries to strengthen their capabilities to appreciate and effectively evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement and manage effective environmental programs:
(3) Identify impacts resulting from A.I.D.'s actions upon the environment, including those aspects of the biosphere which are the common and cultural heritage of all mankind; and
(4) Define environmental limiting factors that constrain development and identify and carry out activities that assist in restoring the renewable resource base on which sustained development depends.
© Definitions.-- (1) CEQ Regulations.
Regulations promulgated by the President's Council on Environmental Quality (CEQ) (Federal Register, Volume 43, Number 230, November 29, 1978) under the authority of NEPA and Executive Order 11514, entitled Protection and Enhancement of Environmental Quality (March 5, 1970) as amended by Executive Order 11991) May 24, 1977).
(2) Initial Environmental Examination. An Initial Environmental Examination is the first review of the reasonably foreseeable effects of a proposed action on the environment. Its function is to provide a brief

statement of the factual basis for a Threshold Decision as to whether an Environmental Assessment or an Environmental Impact Statement will be required.

(3) Threshold Decision. A formal Agency decision which determines, based on an Initial Environmental Examination, whether a proposed Agency action is a major action significantly affecting the environment.

(4) Environmental Assessment.
A detailed study of the reasonably foreseeable significant effects, both beneficial and adverse, of a proposed action on the environment of a foreign country or countries.

(5) Environmental Impact Statement.
A detailed study of the reasonably foreseeable environmental impacts, both positive and negative, of a proposed A.I.D. action and its reasonable alternatives on the United States, the global environment or areas outside the jurisdiction of any nation as described in § 216.7 of these procedures. It is a specific document having a definite format and content as provided in NEPA and the CEQ Regulations. The required form and content of an Environmental Impact Statement is further described in § 216.7 infra.

(6) Project Identification Document (PID). An internal A.I.D. document which initially identifies and describes a proposed project.

(7) Program Assistance Initial Proposal (PAIP). An internal A.I.D. document used to initiate and identify proposed non-project assistance, including commodity import programs. It is analogous to the PID.

(8) Project Paper (PP). An internal A.I.D. document which provides a definitive description and appraisal of the project and particularly the plan or implementation.

(9) Program Assistance Approval Document (PAAD). An internal A.I.D. document approving non-project assistance. It is analogous to the PP.

(10) Environment. The term environment, as used in these procedures with respect to effects occurring outside the United States, means the natural and physical environment. With respect to effects occurring within the United States see § 216.7(b).

(11) Significant Effect. With respect to effects on the environment outside the United States, a proposed action has a significant effect on the environment if it does significant harm to the environment.

(12) Minor Donor. For purposes of these procedures, A.I.D. is a minor donor to a multi-donor project when A.I.D. does not control the planning or design of the multi-donor project and either (I) A.I.D.'s total contribution to the project is both less than $1,000,000 and less than 25 percent of the estimated project cost, or (ii) A.I.D.'s total contribution is more than $1,000,000 but less than 25 percent of the estimated project cost and the environmental procedures of the donor in control of the planning of design of the project are followed, but only if the A.I.D. Environmental Coordinator determines that such procedures are adequate.

§ 216.2 Applicability of procedures.

(a) Scope. Except as provided in §216.2(b), these procedures apply to all new projects, programs or activities authorized or approved by A.I.D. and to substantive amendments or extensions of ongoing projects, programs, or activities.

(b) Exemptions. (1) Projects, programs or activities involving the following are exempt from these procedures:

(I) International disaster assistance;

(ii) Other emergency circumstances; and

(iii) Circumstances involving exceptional foreign policy sensitivities.

(2) A formal written determination, including a statement of the justification therefore, is required for each project, program or activity for which an exception is made under paragraphs (b) (1) (ii) and (iii) of this section, but is not required for projects, programs or activities under paragraph (b) (1) (I) of this section. The determination shall be made either by the Assistant Administrator having responsibility for the program, project or activity, or by the Administrator, where authority to approve financing has been reserved by the

Administrator. The determination shall be made after consultation with CEQ regarding the environmental consequences of the proposed program, project or activity.

© **Categorical Exclusions.**

(1) The following criteria have been applied in determining the classes of actions included in § 216.2(c)(2) for which an Initial Environmental Examination, Environmental Assessment and Environmental Impact Statement generally are not required;

(I) The action does not have an effect on the natural or physical environment;

(ii) A.I.D. does not have knowledge of or control over, and the objective of A.I.D. in furnishing assistance does not require, either prior to approval of financing or prior to implementation of specific activities, knowledge of or the specific activities that have an effect on the physical and natural environment for which financing is provided by A.I.D.;

(iii) Research activities which may have an affect on the physical and natural environment but will not have a significant effect as a result of limited scope, carefully controlled nature and effective monitoring.

(2) The following classes of actions are not subject to the procedures set forth in § 216.3, except to the extent provided herein;

(I) Education, technical assistance, or training programs except to the extent such programs include activities directly affecting the environment (such as construction of facilities, etc.);

(ii) Controlled experimentation exclusively for the purpose of research and field evaluation which are confined to small areas and carefully monitored;

(iii) Analyses, studies, academic or research workshops and meetings;

(iv) Projects in which A.I.D. is a minor donor to a multidonor project and there is no potential significant effects upon the environment of the United States, areas outside any nation's jurisdiction or endangered or threatened species or their critical habitat.

(v) Document and information transfers;

(vi) Contributions to international, regional or national organizations by the United States which are not for the purpose of carrying out a specifically identifiable project or projects;

(vii) Institution building grants to research and educational institutions in the United States such as those provided for under Section 122(d) and Title XII of Chapter 2 or Part I of the FAA (22 USCA § § 2151 p.(b) 2220s. (1979));

(viii) Programs involving nutrition, health care or population and family planning services except to the extent designed to include activities directly affecting the environment (such as construction of facilities, water supply systems waster water treatment, etc.)

(ix) Assistance provided under a Commodity Import Program when, prior to approval A.I.D. does not have knowledge of the specific commodities to be financed and when the objective in furnishing such assistance requires neither knowledge, at the time the assistance is authorized, nor control, during implementation, of the commodities or their use in the host country.

(x) Support for intermediate credit institutions when the objective is to assisting the capitalization of the institution or part thereof and when such support does not involve reservation of the right to review and approve individual loans made by the institution;

(xi) Programs of maternal or child feeding conducted under Title II of Pub. I.480;

(xii) Food for development programs conducted by food recipient countries under Title III of Pub. L. 480. when achieving A.I.D.'s objectives in such programs does not require knowledge of or control over the details of the specific activities conducted by the foreign country under such program:

(xiii) Matching, general support and institutional support grants provided to private voluntary organizations (PVOs) to assist in financing programs where A.I.D.'s objective in providing such financing does not require knowledge of or control over the details of the specific activities conducted by the PVO;

(xiv) Studies, projects or programs intended to develop the capability of recipient countries to engage in development planning, except to the extent designed to result in activities directly affecting the environment

(such as construction of facilities, etc.); and
(xv) Activities which involve the application of design criteria or standards developed and approved by A.I.D.
(3) The originator of a project, program or activity shall determine the extent to which it is within the classes of actions described in paragraph © (2) of this section. This determination shall be made in writing and be submitted with the PID, PAIP or comparable document. This determination, which must include a brief statement supporting application of the exclusion shall be reviewed by the bureau Environmental Officer in the same manner as a Threshold Decision under § 216.3(a)(2) of these procedures. Notwithstanding paragraph (c)(2) of this section, the procedures set forth in § 216.3 shall apply to any project, program or activity included in the classes of actions listed in paragraph (c)(2) of this section, or any aspect or component thereof, if at any time in the design, review or approval of the activity it is determined that the project, program or activity, or aspect or component thereof, if subject to the control of A.I.D. and may have a significant effect on the environment.
(d) Classes of Actions Normally Having a Significant Effect on the Environment. (1) The following classes of actions have been determined generally to have a significant effect on the environment and an Environmental Assessment or Environmental Impact Statement, as appropriate, will be required:
(I) Programs of river basin development
(ii) Irrigation or water management projects, including dams and impoundments;
(iii) Agricultural land leveling;
(iv) Drainage projects;
(v) Large scale agricultural mechanization;
(vi) New lands development;
(vii) Resettlement projects;
(viii) Penetration road building or road improvement projects;
(ix) Powerplants;
(x) Industrial plants;
(xi) Portable water and sewerage projects other than those that are small-scale.
(2) An Initial Environmental Examination normally will not be necessary for activities with the classes described in § 216.2(d), except when the originator of the project believes that the project will not have a significant effect on the environment. In such cases, the activity may be subjected to the procedures set forth in § 216.3.
(e) Pesticides. The exemptions of § 216.2(b)(1) and the categorical exclusions of § 216.2(c)(2) are not applicable to assistance for the procurement or use of pesticides.

§ 216.3 Procedures.
(a) General Procedures -

(1) Preparation of the Initial Environmental Examination. Except as otherwise provided, an Initial Environmental Examination is not required for activities identified in § 216.2(b)(1), © (2), and (d). For all other A.I.D. activities described in § 216.2(a) an Initial Environmental Examination will be prepared by the originator of an action. Except as indicated in this section, it should be prepared with the PID or PAIP. For projects including the procurement or use of pesticides, the procedures set forth in § 216.3(b) will be followed, in addition to the procedures in this paragraph. Activities which cannot be identified in sufficient detail to permit the completion of an Initial Environmental Examination PID or PAIP, shall be described by including with the PID or PAIP: (I) an explanation indicating why the Initial Environmental Examination cannot be completed; (ii) an estimate of the amount of time required to complete the Initial Environmental Examination; and
(iii) a recommendation that a Threshold Decision be deferred until the Initial Environmental Examination is

completed. The responsible Assistant Administrator will act on the request for deferral concurrently with action on the PID or PAIP and will designate a time for completion of the Initial Environmental Examination. In all instances, except as provided in §216.3(a)(7), this completion date will be in sufficient time to allow for the completion of an Environmental Assessment or Environmental Impact Statement, if required, before a final decision is made to provide A.I.D. funding for the action.

(2) Threshold decision. (I) The Initial Environmental Examination will include a Threshold Decision made by the officer in the originating office who signs the PID or PAIP. If the Initial Environmental Examination is completed prior to or at the same time as the PID or PAIP, the Threshold Decision will be reviewed by the Bureau Environmental Officer concurrently with approval of the PID or PAIP. The Bureau Environmental Officer will either concur in the Threshold Decision or request reconsideration by the officer who made the Threshold Decision, stating the reasons for the request. Differences of opinion between these officers shall be submitted for resolution to the Assistant Administrator at the same time that the PID is submitted for approval.

(ii) An Initial Environmental Examination, completed subsequent to approval of the PID or PAIP, will be forwarded immediately together with the Threshold Determination to the Bureau Environmental Officer for action as described above.

(iii) A Positive Threshold Decision shall result from a finding that the proposed action will have a significant effect on the environment. An Environmental Impact Statement shall be prepared if required pursuant to § 216.7. If an impact statement is not required, an Environmental Assessment will be prepared in accordance with § 216.6. The cognizant Bureau or Office will record a Negative Determination if the proposed action will not have a significant effect on the environment.

(3) Negative Declaration. The Assistant Administrator, or the Administrator in actions for which the approval of the Administrator, or the Administrator in actions for which the approval of the Administrator is required for the authorization of financing, may make a Negative Declaration in writing, that the Agency will not develop an Environmental Assessment or an Environmental Impact Statement regarding an action found to have a significant effect on the environment when (I) a substantial number of Environmental Assessments or Environmental Impact Statements relating to similar activities have been prepared in the past, if relevant to the proposed action, (ii) the Agency has previously prepared a programmatic Statement or Assessment covering the activity in question which has been considered in the development of such activity, or (iii) the Agency has developed design criteria for such an action which, if applied in the design of the action, will avoid a significant effect on the environment.

(4) Scope of Environmental Assessment or Impact Statement--(I) Procedure and Content. After a Positive Threshold Decision has been made, or a determination is made under the pesticide procedures set forth in § 216.3(b) that an Environmental Assessment or Environmental Impact Statement is required, the originator of the action shall commence the process of identifying the significant issues relating to the proposed action and of the issues to be addressed in the Environmental Assessment or Environmental Impact Statement. The originator of an action within the classes of actions described in §216.2(d) shall commence this scoping process as soon as practicable. Persons having expertise relevant to the environmental aspects of the proposed action shall also participate in this scoping process. (Participants may include but are not limited to representatives of host governments, public and private institutions, the A.I.D. Mission staff and contractors.) This process shall result in a written statement which shall include the following matters:

(a) A determination of the scope and significance of issues to be analyzed in the Environmental Assessment or Impact Statement, including direct and indirect effects of the project on the environment.

(b) Identification and elimination from detailed study of the issues that are not significant or have been covered by earlier environmental review, or approved design considerations, narrowing the discussion of these issues to a brief presentation of why they will not have significant effect on the environment.

© A description of (1) the timing of the preparation of environmental analyses, including phasing if appropriate, (2) variations required in the format of the Environmental Assessment, and (3) the tentative

planning and decision making schedule; and,

(d) A description of how the analysis will be conducted and the disciplines that will participate in the analysis.

(ii) These written statements shall be reviewed and approved by the Bureau Environmental Officer.

(iii) Circulation of Scoping Statement.

To assist in the preparation of an Environmental Assessment, the Bureau Environmental Office may circulate copies of the written statement, together with a request for written comments, within thirty days, to selected federal agencies if that Officer believes comments by such federal agencies will be useful in the preparation of an Environmental Assessment. Comments received from reviewing federal agencies will be considered in the preparation of the Environmental Assessment and in the formulation of the design and implementation of the project, and will, together with the scoping statement, will be included in the project file.

(iv) Change in Threshold Decision. If it becomes evident that the action will not have a significant effect on the environment (i.e., will not cause significant harm to the environment), the Positive Threshold Decision may be withdrawn with the concurrence of the Bureau Environmental Officer. In the case of an action included in §216.2(d)(2), the request for withdrawal shall be made to the Bureau Environmental Officer.

(5) Preparation of Environmental Assessments and Environmental Impact Statement. If the PID or PAIP is approved, and the Threshold Decision is positive, or the action is included in § 216.2(d), the originator of the action will be responsible for the preparation of an Environmental Assessment or Environmental Impact Statement as required. Draft Environmental Impact Statements will be circulated for review and comment as part of the review of Project Papers and as outlined further in § 216.7 of those procedures. Except as provided in §216.3(a)(7), final approval of the PP or PAAD and the method of implementation will include consideration of the Environmental Assessment of final Environmental Impact Statement.

(6) Processing and Review Within A.I.D. (I) Initial Environmental Examinations, Environmental Assessments and final Environmental Impact Statements will be processed pursuant to standard A.I.D. procedures for project approval documents. Except as provided in §216.3(a)(7), Environmental Assessments and final Environmental Impact Statements will be reviewed as an integral part of the Project Paper or equivalent document. In addition to these procedures. Environmental Assessments will be reviewed and cleared by the Bureau Environmental Officer. They may also be reviewed by the Agency's Environmental Coordinator who will monitor the Environmental Assessment process.

(ii) When project approval authority is delegated to field posts, Environmental Assessments shall be reviewed and cleared by the Bureau Environmental Officer prior to the approval of such actions.

(iii) Draft and final Environmental Impact Statements will be reviewed and cleared by the Environmental Coordinator and the Office of the General Counsel.

(7) **Environmental Review After Authorization of Financing.** (I) Environmental review may be performed after authorization of a project program or activity only with respect to subprojects or significant aspects of the project, program or activity that are unidentified at the time of authorization. Environmental review shall be completed prior to authorization for all subprojects and aspects of a project, program or activity that are identified.

(ii) Environmental review should occur at the earliest time in design or implementation at which a meaningful review can be undertaken, but in no event later than when previously unidentified subprojects or aspects of projects, programs or activities are identified and planned. To the extent possible, adequate information to undertake deferred environmental review should be obtained before funds are obligated for unidentified subprojects or aspects of projects, programs or activities (Funds may be obligated for the other aspects for which environmental review has been completed). To avoid irreversible commitment of resources prior to the conclusion of environmental review, the obligation of funds can be made incrementally as subprojects or aspects of projects, programs or activities are identified: or if necessary while planning continues, including environmental review, the agreement or other document obligating funds may contain

appropriate covenants or conditions precedent to disbursement for unidentified subprojects or aspects of projects, programs or activities.

(iii) When environmental review must be deferred beyond the time some of the funds are to be disbursed (e.g. long lead times for the delivery of good or services), the project agreement or other document obligating funds shall contain a covenant or covenants requiring environmental review, including an Environmental Assessment or Environmental Impact Statement, when appropriate, to be completed and taken into account prior to implementation of those subprojects or aspects of the project, program or activity for which environmental review is deferred. Such covenants shall ensure that implementation plans will be modified in accordance with environmental review if the parties decide that modifications are necessary.

(iv) When environmental review will not be completed for an entire project, program or activity prior to authorization, the Initial Environmental Examination and Threshold Decision required under §216.3(a)(1) and (2) shall identify those aspects of the project, program or activity for which environmental review will be completed prior to the time financing is authorized. It shall also include those subprojects or aspects for which environmental review will be deferred, stating the reasons for deferral and the time when environmental review will be completed. Further, it shall state how an irreversible commitment of funds will be avoided until environmental review is completed. The A.I.D. officer responsible for making environmental decisions for such projects, programs or activities shall also be identified (the same officer who has decision making authority for the other aspects of implementation). This deferral shall be reviewed and approved by the officer making the Threshold Decision and the officer who authorizes the project, program or activity. Such approval may be made only after consultation with the Office of General Counsel for the purpose of establishing the manner in which conditions precedent to disbursement or covenants in project and other agreements will avoid an irreversible commitment of resources before environmental review is completed.

(8) Monitoring. To the extent feasible and relevant, projects and programs for which Environmental Impact Statements or Environmental Assessments have been prepared should be designed to include measurement of any changes in environmental quality, positive or negative, during their implementation. This will require recording of baseline data at the start. To the extent that available data permit, originating offices of A.I.D. will formulate systems in collaboration with recipient nations, to monitor such impacts during the life of A.I.D's involvement. Monitoring implementation of projects, programs and activities shall take into account environmental impacts to the same extent as other aspects of such projects, programs and activities. If during implementation of any project, program or activity, whether or not an Environmental Assessment or Environmental Impact Statement was originally required, it appears to the Mission Director, or officer responsible for the project, program or activity, that it is having or will have a significant effect on the environment that was not previously studied in an Environmental Assessment or Environmental Impact Statement, the procedures contained in this part shall be followed including, as appropriate, a Threshold Decision. Scoping and an Environmental Assessment or Environmental Impact Statement.

(9) Revisions. If, after a Threshold Decision is made resulting in a Negative Determination, a project is revised or new information becomes available which indicates that a proposed action might be "major" and its effects "significant", the Negative Determination will be reviewed and revised by the cognizant Bureau and an Environmental Assessment or Environmental Impact Statement will be prepared, if appropriate. Environmental Assessments and Environmental Impact Statements will be amended and processed appropriately if there are major changes in the project or program, or if significant new information becomes available which relates to the impact of the project, program or activity on the environment that was not considered at the time the Environmental Assessment or Environmental Impact Statement was approved. When on-going programs are revised to incorporate a change in scope or nature, determination will be made as to whether such change may have an environmental impact not previously assessed. If so, the procedures outlined in this part will be followed.

(10) Other Approval Documents.

These procedures refer to certain A.I.D documents such as PIDs, PAIPs, PPs and PAADs as the A.I.D.

internal instruments for approval of projects, programs or activities. From time to time, certain special procedures, such as those in §216.4, may not require the use of the aforementioned documents. In these situations, these environmental procedures shall apply to those special approval procedures, unless otherwise exempt, at approval times and levels comparable to projects, programs and activities in which the aforementioned documents are use.

(b) Pesticide Procedures

(1) Project Assistance. Except as provided in § 216.3(b)(2), all proposed projects involving assistance for the procurement or use, or both, of pesticides shall be subject to the procedures prescribed in § 216.3(b)(1) (I) through (v) below. These procedures shall also apply, to the extent permitted by agreements entered into by A.I.D. before the effective date of these pesticide procedures, to such projects that have been authorized but for which pesticides have not been procured as of the effective date of these pesticide procedures.
(I) When a project includes assistance for procurement or use, or both of pesticides registered for the same or similar uses by USEPA without restriction, the Initial Environmental Examination for the project shall include a separate section evaluating the economic, social and environmental risks and benefits of the planned pesticide use to determine whether the use may result in significant environmental impact. Factors to be considered in such an evaluation shall include, but not be limited to the following:

(a) The USEPA registration status of the requested pesticide;
(b) The basis for selection of the requested pesticide;
© The extent to which the proposed pesticide use is part of an integrated pest management program;
(d) The proposed method or methods of application, including availability of appropriate application and safety equipment;
(e) Any acute and long-term toxicological hazards, either human or environmental, associated with the proposed use and measures available to minimize such hazards;
(f) The effectiveness of the requested pesticide for the proposed use;
(g) Compatibility of the proposed pesticide with target and non-target ecosystems;
(h) The conditions under which the pesticide is to be used, including climate, flora, fauna, geography, hydrology, and soils;
(I) The availability and effectiveness of other pesticides or non-chemical control methods;
(j) The requesting country's ability to regulate or control the distribution, storage, use and disposal of the requested pesticide;
(k) The provisions made for training of users and applicators; and,
(l) The provisions made for monitoring the use and effectiveness of the pesticide.

In those cases where the evaluation of the proposed pesticide use in the Initial Environmental Examination indicates that the use will significantly affect the human environment, the Threshold Decision will include a recommendation for the preparation of an Environmental Assessment or Environmental Impact Statement, as appropriate. In the event a decision is made to approve the planned pesticide use, the Project Paper shall include to the extent practicable, provisions designed to mitigate potential adverse effects of the pesticide. When pesticide evaluation section of the Initial Environmental Examination does not indicate a potentially unreasonable risk arising from the pesticide use, an Environmental Assessment or Environmental Impact Statement shall nevertheless be prepared if the environmental effects of the project otherwise require further assessment.
(ii) When a project includes assistance for the procurement or use, or both, of any pesticide registered for the same or similar uses in the United States but the proposed use is restricted by the USEPA on the basis of user hazard, the procedures set forth in §216.3(b)(1)(I) above will be followed. In addition, the Initial

Environmental Examination will include an evaluation of the user hazards associated with the proposed USEPA restricted uses to ensure that the implementation plan which is contained in the Project Paper incorporates provisions for making the recipient government aware of these risks and providing, if necessary, such technical assistance as may be required to mitigate these risks. If the proposed pesticide use is also restricted on a basis other than user hazard, the procedures in § 216.3(b)(1)(iii) shall be followed in lieu of the procedures in this section.

(iii) If the project includes assistance for the procurement or use, or both of:

(a) Any pesticide other than one registered for the same or similar uses by USEPA without restriction or for restricted use on the basis of user hazard: or

(b) Any pesticide for which a notice of rebuttable presumption against registration, notice of intent to cancel, or notice of intent to suspend has been issued by USEPA.

The Threshold Decision will provide for the preparation of an Environmental Assessment or Environmental Impact Statement, as appropriate (§ 216.6(a). The EA or EIS shall include, but not be limited to, an analysis of the factors identified in §216.3(b)(1)(I) above.

(iv) Notwithstanding the provisions of § 216.3(b)(1) through (iii) above, if the project includes assistance for the procurement or use, or both, of a pesticide against which USEPA has initiated a regulatory action for cause, or for which it has issued a notice of rebuttable presumption against registration, the nature of the action or notice, including the relevant technical and scientific factors will be discussed with the requesting government and considered in the IEE and, if prepared, in the EA or EIS. If USEPA initiates any of the regulatory action above against a pesticide subsequent to its evaluation in an IEE, EA or EIS, the nature of the action will be discussed with the recipient government and considered in an amended IEE or amended EA or EIS, as appropriate.

(v) If the project includes assistance for the procurement or use, or both of pesticides but the specific pesticides to be procured or used cannot be identified at the time the IEE is prepared, the procedures outlined in § 216.3(b) (I) through (iv) will be followed when the specific pesticides are identified and before procurement or use is authorized. Where identification of the pesticides to be procured or used does not occur until after Project Paper approval neither the procurement nor the use of the pesticides shall be undertaken unless approved, in writing, by the Assistant Administrator (or in the case of projects authorized at the Mission level, the Mission Director) who approved the Project Paper.

(2) Exceptions to Pesticide Procedures. The procedures set forth in § 216.3(b)(1) above shall not apply to the following projects including assistance for the procurement or use, or both of pesticides.

(I) Projects under emergency conditions.

Emergency conditions shall be deemed to exist when it is determined by the Administrator, A.I.D., in writing that:

(a) A pest outbreak has occurred or is imminent; and

(b) Significant health problems (either human or animal) or significant economic problems will occur without the prompt use of the proposed pesticide; and

© Insufficient time is available before the pesticide must be used to evaluate the proposed use in accordance with the provisions of this regulation.

(ii) Projects where A.I.D. is a minor donor, as defined in §216.1(c)(12) above, to a multi-donor project.

(iii) Projects including assistance for procurement or use, or both, of pesticides for research or limited field evaluation purposes by or under the supervision of project personnel. In such instances, however, A.I.D. will ensure that the manufacturers of the pesticides provide toxicological and environmental data necessary to safeguard the health or research personnel and the quality of the local environment in which the pesticides will be used. Furthermore, treated crops will not be used for human or animal consumption unless appropriate tolerances have been established by EPA or recommended by FAO/WHO, and the rates and frequency of application, together with the prescribed preharvest intervals, do not result in residues exceeding

such tolerances. This prohibition does not apply to the feeding of such crops to animals for research purposes.

(3) Non-Project Assistance. In a very few limited number of circumstances A.I.D. may provide non-project assistance for the procurement and use of pesticides. Assistance in such cases shall be provided if the A.I.D. Administrator determines in writing that (I) emergency conditions, as defined in §216.3(b)(2)(I) above exists; or (ii) that compelling circumstances exist such that failure to provide the proposed assistance would seriously impede the attainment of U.S. foreign policy objectives or the objectives of the foreign assistance program. In the latter case, a decision to provide the assistance will be based to the maximum extent practicable, upon a consideration of the factors set forth in § 216.3(b)(1)(I) and, to the extent available, the history of efficacy and safety covering the past use of the pesticide in the recipient country.

§ 216.4 Private applicants.

Programs, projects or activities for which financing from A.I.D. is sought by private applicants, such as PVOs and educational and research institutions, are subject to these procedures. Except as provided in §216.2(b),(c) or (d), preliminary proposals for financing submitted by private applicants shall be accompanied by an Initial Environmental Examination or adequate information to permit preparation of an Initial Environmental Examination. The Threshold Decision shall be made by the Mission Director for the country to which the proposal relates, if the preliminary proposal is submitted to the A.I.D Mission, or shall be made by the officer in A.I.D. who approves the preliminary proposal. In either case, the concurrence of the Bureau Environmental Officer is required in the same manner as in § 216.3(a)(2), except for PVO projects approved in A.I.D. Missions with total life of project costs less than $500,000. Thereafter, the same procedures set forth in § 216.3 including as appropriate scoping and Environmental Assessments or Environment Impact Statements, shall be applicable to programs, projects or activities submitted by private applicants. The final proposal submitted for financing shall be treated, for purposes of these procedures, as a Project Paper. The Bureau Environmental Officer shall advise private applicants of studies or other information foreseeably required for action by A.I.D.

§ 216.5 Endangered species.

It is A.I.D. policy to conduct its assistance programs in a manner that is sensitive to the protection of endangered or threatened species and their critical habitats. The Initial Environmental Examination for each project, program or activity having an effect on the environment shall specifically determine whether the project, program or activity will have an effect on an endangered or threatened species, or critical habitat. If the proposed project, program or activity will have the effect of jeopardizing an endangered or threatened species or of adversely modifying its critical habitat, the Threshold Decision shall be a Positive Determination and an Environmental Assessment or Environmental Impact Statement completed as appropriate, which shall discuss alternatives or modifications to avoid or mitigate such impact on the species or its habitat.

§ 216.6 Environmental assessments.

(a) General Purpose. The purpose of the Environmental Assessment is to provide Agency and host country decision makers with a full discussion of significant environmental effects of a propose action. It includes alternatives which would avoid or minimize adverse effects or enhance the quality of the environment so that the expected benefits of development objectives can be weighed against any adverse impacts upon the human environmental or irretrievable commitment of resources.

(b) Collaboration with Affected Nation on Preparation. Collaboration in obtaining data, conducting analyses and considering alternatives will help build an awareness of development associated environmental

problems in less developed countries as well as assist in building an indigenous institutional capability to deal nationally with such problems. Missions, Bureaus and Offices will collaborate with affected countries to the maximum extent possible, in the development of any Environmental Assessments and consideration of environmental consequences as set forth therein.

© **Content and Form.** The Environmental Assessment shall be based upon the scoping statement and shall address the following elements, as appropriate:

(1) Summary. The summary shall stress the major conclusions, areas of controversy. If any, and the issues to be resolved.

(2) Purpose. The Environmental Assessment shall briefly specify the underlying purpose and need to which the Agency is responding in proposing the alternatives including the proposed action.

(3) Alternatives Including the Proposed Action. This section should present the environmental impacts of the proposal and its alternatives in comparative form, thereby sharpening the issues and providing a clear basis for choice among options by the decision maker. This section should explore and evaluate reasonable alternatives and briefly discuss the reasons for eliminating those alternatives which were not included in the detailed study, devote substantial treatment to each alternatives considered in detail including the proposed action so that reviewers may evaluate their comparative merits; include the alternative of no action; identify the Agency's preferred alternative or alternatives, if one or more exists; include appropriate mitigation measures not already included in the proposed action or alternatives.

(4) Affected Environment. The Environmental Assessment shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives. Data and analyses in the Environmental Assessment shall be commensurate with the significance of the impact with important material summarized, consolidated or simply referenced.

(5) Environmental Consequences. This section forms the analytic basis for the comparisons under paragraph(c)(3) of this section. It will include the environmental impacts of the alternatives including the proposed action; any adverse effects that cannot be avoided should the proposed action be implemented; the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity; and any irreversible or irretrievable commitments of resources which would be involved in the proposal should it be implemented. It should not duplicate discussions in paragraph (c)(3) of this section. This section of the Environmental Assessment should include discussion of direct effects and their significance; possible conflicts between the proposed action and land use plans, policies and controls for the areas concerned; energy requirements and conservation potential of various alternatives and mitigation measures; natural or depletable resource requirements and conservation potential of various requirements and mitigation measures; urban quality; historic and cultural resources and the design of the built environment, including the re-use and conservation potential of various alternatives and mitigation measures; and means to mitigate adverse environmental impacts.

(6) List of Preparers. The Environmental Assessment shall list the names and qualifications (expertise, experience, professional discipline) of the persons primarily responsible for preparing the Environmental Assessment or significant background papers.

(7) Appendix. An Appendix may be prepared.

(d) Program Assessment. Program Assessments may be appropriate in order to assess the environmental effects of a number of individual actions and their cumulative environmental impact in a given country or geographic area, or the environmental impacts that are generic of common to a class of agency actions, or other activities which are not country-specific. In these cases, a single, programmatic assessment will be prepared in A.I.D./Washington and circulated to appropriate overseas Mission, host governments, and to interested parties within the United States. To the extent practicable, the form and content of the programmatic Environmental Assessment will be the same as for project Assessments. Subsequent Environmental will be the same as for project Assessments. Subsequent Environmental Assessments on

major individual actions will only be necessary where such follow-on or subsequent activities may have significant environmental impacts on specific countries where such impacts have not been adequately evaluated in the programmatic Environmental Assessment. Other programmatic evaluations of classes of actions may be conducted in an effort to establish additional categorical exclusions or design standards or criteria for such classes that will eliminate or minimize adverse effects of such actions, enhance the environmental effect of such action or reduce the amount of paperwork or time involved in these procedures. Programmatic evaluations conducted for the purpose of establishing additional categorical exclusions under §216.2© or design considerations that will eliminate significant effects for classes of actions shall be made available for public comment before the categorical exclusions or design standards or criteria are adapted by A.I.D. Notice of the availability of such document shall be published in the Federal Register. Additional categorical exclusions or design standard or criteria are adopted by A.I.D. Notice of the availability of such document shall be published in the Federal Register. Additional categorical exclusions shall be adopted by A.I.D. upon the approval of the Administrator, and design consideration in accordance with usual agency procedures.

(e) Consultation and Review. (1) When Environmental Assessments are prepared on activities carried out within or focused on specific developing countries, consultation will be held between A.I.D. staff and the host government both in the early stages of preparation and on the results and significance of the completed Assessment before the project is authorized.

(2) Missions will encourage the host government to make the Environmental Assessment available to the general public of the recipient country. If Environmental Assessments are prepared on activities which are not country-specific, the Assessment will be circulated by the Environmental Coordinator to A.I.D.'s Overseas Missions and interested governments for information, guidance and comment and will be made available in the U.S. to interested parties.

(f) Effect in Other Countries. In a situation where an analysis indicates that potential effects may extend beyond the national boundaries of a recipient country and adjacent foreign nations may be affected. A.I.D. will urge the recipient country and adjacent foreign nations may be affect. A.I.D. will urge the recipient country to consult with such countries in advance of project approval and to negotiate mutually acceptable accommodations.

(g) Classified Material. Environmental Assessments will not normally include classified or administratively controlled material. However, there may be situations where environmental aspects cannot be adequately discussed without the inclusion of such material. The handling and disclosure of classified or administratively controlled will be made available to persons outside the Agency as provided for in 22 CFR Part 212.

§ 216.7 Environmental Impact Statements.

(a) Applicability. An Environmental Impact Statement shall be prepared when agency actions significantly affect:

(1) The global environment or areas outside the jurisdiction on any nation (e.g. the oceans);

(2) The environment of the United States; or

(3) Other aspects of the environment at the discretion of the Administrator.

(b) Effects on the United States:

Content and Form. An Environmental Impact Statement relating to paragraph (a)(2) of this section shall with the CEO Regulations. With respect to effects on the United States, the terms environment and significant effect whenever used in these procedures have the same meaning as in the CEQ Regulations rather than as defined in §216.1(c)(12) and (13) of these procedures.

(c) Other Effects: Content and Form.

An Environmental Impact Statement relating to paragraphs (a(1) and (a) (3) of this section will generally follow the CEQ Regulations, but will take into account the special considerations and concerns of A.I.D

Circulation of such Environmental Impact Statements in draft form will precede approval of a Project Paper or equivalent and comments from such circulation will be considered before final project authorization as outlined in § 216.3 of these procedures. The draft Environmental Impact Statement will also be circulated by the Missions to effected foreign governments for information and comment. Draft Environmental Impact Statements generally will be made available for comment to Federal agencies with jurisdiction by law or special expertise with respect to any environmental impact involved, and to public and private organizations and individuals for not less than forty-five (45) days. Notice of availability of the draft Environmental Impact Statements will be published in the Federal Register. Cognizant Bureaus and Offices will submit these drafts for circulation through the Environmental Coordinator who will have the responsibility for coordinating all such communications with persons outside A.I.D. Any comments received by the Environmental Coordinator will be forwarded to the originating Bureau or Office for consideration in final policy decisions and the preparation of a final Environmental Impact Statement. All such comments will be attached to the final Statement, and those relevant comments not adequately discussed in the draft Environmental Impact Statement will be appropriately dealt with in the final Environmental Impact Statement. Copies of the final Environmental Impact Statement, with comments attached, will be sent by the Environmental Coordinator to CEQ and to all other Federal, state, and local agencies and private organizations that made substantive comments on the draft, including effected foreign governments. Where emergency circumstances or considerations of foreign policy make it necessary to take an action without observing the provisions of § 1506.10 of the CEQ Regulations, or when there are overriding considerations of expense to the United States or foreign governments, the originating Office will advise the Environmental Coordinator who will consult with Department of State and CEQ concerning appropriate modification of review procedures.

§ 216.8 Public hearings.

(a) In most instances AID will be able to gain the benefit of public participation in the impact statement process through circulation of draft statements and notice of public availability in CEQ publications. However, in some cases the Administrator may wish to hold public hearings on draft Environmental Impact Statements. In deciding whether or not a public hearing is appropriate, Bureaus in conjunction with the Environmental Coordinator should consider:

(1) The magnitude of the proposal in terms of economic costs, the geographic area involved, and the uniqueness or size of commitment of the resources involved:

(2) The degree of interest in the proposal as evidenced by requests from the public and from Federal, state and local authorities, and private organizations and individuals, that a hearing be held:

(3) The complexity of the issue and likelihood that information will be presented at the hearing which will be of assistance to the Agency, and

(4) The extent to which public involvement already has been achieved through other means, such as earlier public hearings, meetings with citizen representatives, and/or written comments on the proposed action.

(b) If public hearings are held, draft Environmental Impact Statements to be discussed should be made available to the public at least fifteen (15) days prior to the time of the public hearings, and notice will be placed in the FEDERAL REGISTER giving the subject, time and place of the proposed hearings.

§ 216.9 Bilateral and multilateral studies and concise reviews of environmental issues.

Notwithstanding anything to the contrary in these procedures, the Administrator may approve the use of either of the following documents as a substitute for an Environmental Assessment (but not a substitute for an Environmental Impact Statement) required under these procedures.

(a) Bilateral or multilateral environmental studies, relevant or related to the proposed action, prepared by the United States and one or more foreign countries or by an international body or organization in which the

United States is a member or participant; or
(b) Concise reviews of the environmental issues involved including summary environmental analyses or other appropriate documents.

§ 216.10 Records and reports.

Each Agency Bureau will maintain a current list of activities for which Environmental Assessments and Environmental Impact Statements are being prepared and for which Negative Determinations and Declarations have been made. Copies of final Initial Environmental Examinations, scoping statements, Assessments and Impact Statements will be available to interested Federal agencies upon request. The cognizant Bureau will maintain a permanent file (which may be part of its normal project files) of Environmental Impact Statements, Environmental Assessments, final Initial Environmental Examinations, scoping statements, Determinations and declarations which will be available to the public under the Freedom of Information Act. Interested persons can obtain information or status reports regarding Environmental Assessments and Environmental Impact Statements through the A.I.D. Environmental Coordinator.

(22) U.S.C. 2381: 42 U.S.C. 4332) - Dated October 9, 1980. - Joseph C. Wheeler, Acting Administrator.

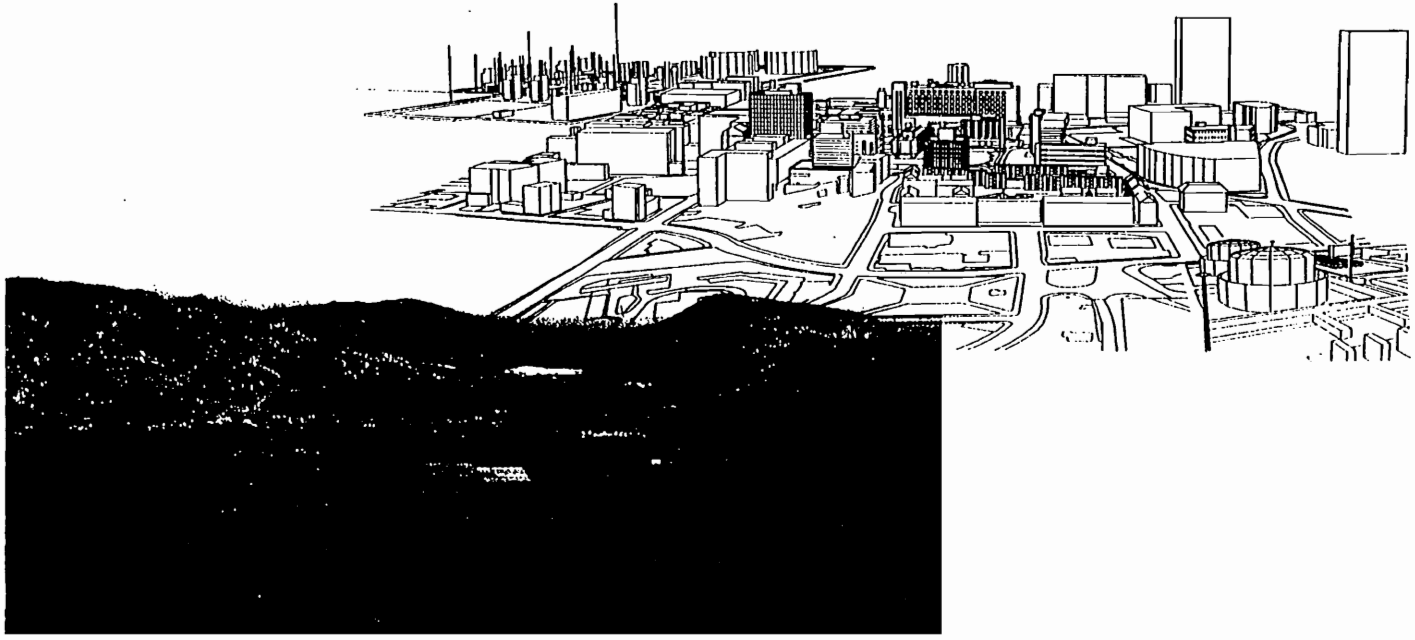
Appendix B

Appendix B: Background Readings on Environmental Assessment

UNITED NATIONS
ENVIRONMENT PROGRAMME

Environmental Impact Assessment

Basic procedures for developing countries



What is Environmental Impact Assessment?

Environmental Impact Assessment, or 'EIA' for short, is a formal study process used to predict the environmental consequences of a proposed major development project. Such projects may include, for example, building a hydroelectric dam or a factory, irrigating a large valley, or developing a harbour.

An EIA concentrates on problems, conflicts or natural resource constraints that could affect the viability of a project. It also examines how the project might cause harm to people, their homeland or their livelihoods, or to other nearby developments. After predicting potential problems, the EIA identifies measures to minimise the problems and outlines ways to improve the project's suitability for its proposed environment.

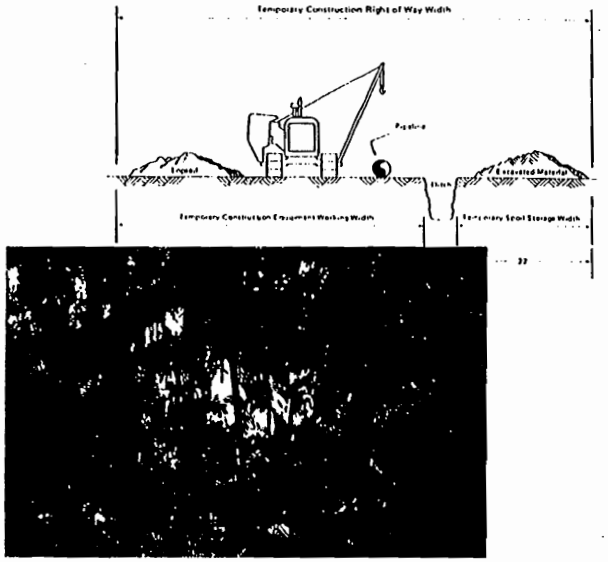
The aim of an EIA is to ensure that potential problems are foreseen and addressed at an early stage in the project's planning and design. To achieve this aim, the assessment's findings are communicated to all the various groups who will make decisions about the proposed project: the project developers and their investors, as well as regulators, planners and politicians. (In some countries, a report – called an Environmental Impact Statement – is prepared at the end of the EIA study, and this is submitted to a Government department as part of a permit application for the project.) Having read the conclusions of an Environmental Impact Assessment, project planners and engineers can shape the project so that its benefits can be achieved and sustained without causing inadvertent problems.

The EIA is an important phase in the process of deciding about the final shape of a proposed project. It helps officials make decisions about a project and it helps the project's proponents achieve their aims more successfully:

- A project that has been designed to suit the local environment is more likely to be completed on time and within budget, and is more likely to avoid difficulties along the way.
- A project that conserves the natural resources it relies upon will continue to be sustained by the environment for years to come.
- A project that yields its benefits without causing serious problems is more likely to bring credit and recognition to its proponents.

In summary, an Environmental Impact Assessment:

- Predicts the likely environmental impacts of projects
- Finds ways to reduce unacceptable impacts and to shape the project so that it suits the local environment
- Presents these predictions and options to decision-makers.



EIA is a management tool

Like economic analysis and engineering feasibility studies, EIA is a management tool for officials and managers who must make important decisions about major development projects.

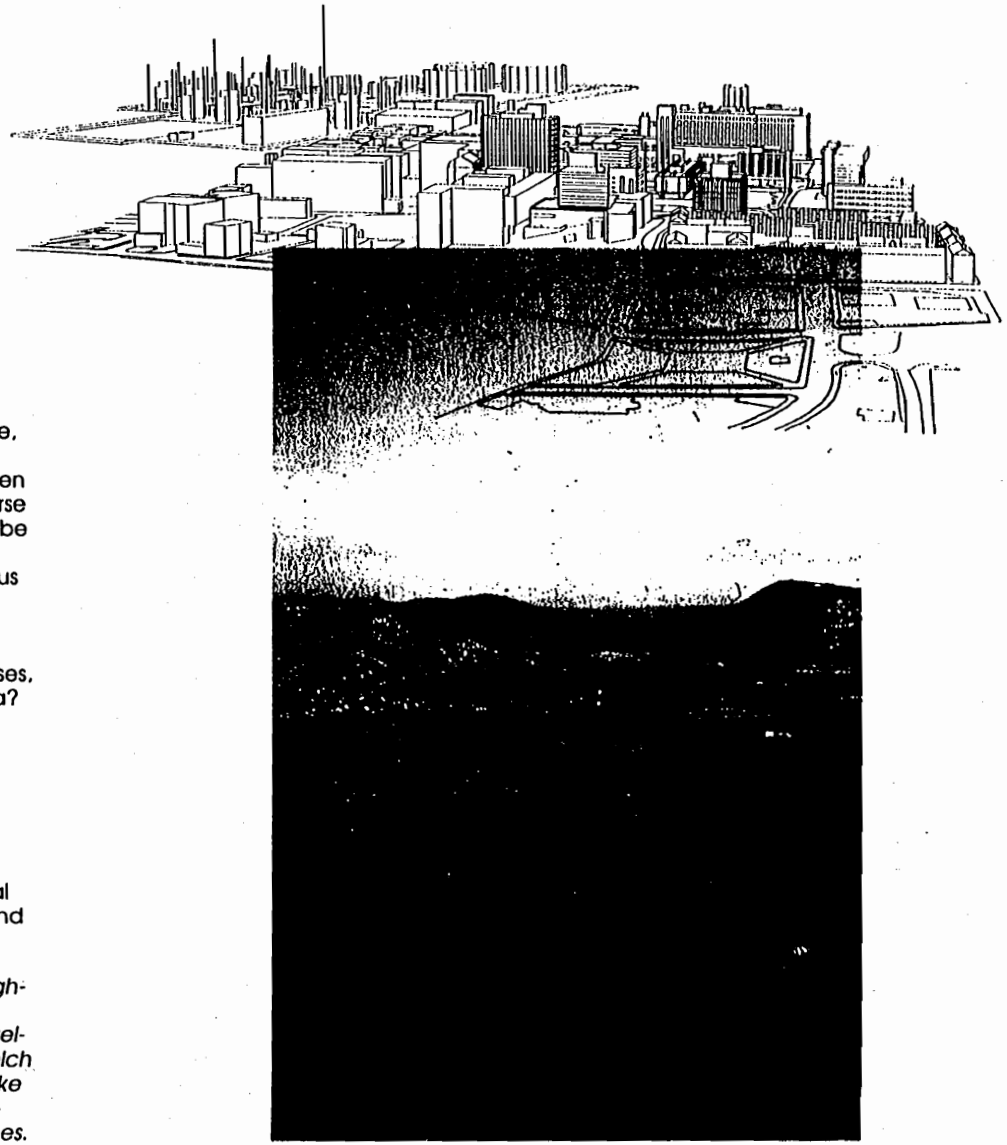
All developers are familiar with economic and engineering studies. These tools provide the basis for designing robust, economically-viable projects. EIA is now seen as an equally important tool in designing a viable project.

In recent years, major projects have encountered serious difficulties because insufficient account has been taken of their relationship with the surrounding environment. Some projects have been found to be unsustainable because of resource depletion. Others have been abandoned because of public opposition, financially encumbered by unforeseen costs, held liable for damages to natural resources and even been the cause of disastrous accidents.

Given this experience, it is clearly very risky to undertake, finance, or approve a major project without first taking into account its environmental consequences – and then siting and designing the project so as to minimise adverse impacts. For instance, the following questions need to be asked about any major project:

- Can it operate safely, without serious risk of dangerous accidents or long-term health effects?
- Can the local environment cope with the additional waste and pollution it will produce?
- Will its proposed location conflict with nearby land uses, or preclude later developments in the surrounding area?
- How will it affect local fisheries, farms or industry?
- Is there sufficient infrastructure, such as roads and sewers, to support it?
- How much water, energy and other resources will it consume, and are these in adequate supply?
- What human resources will it require or replace, and what social effects may this have on the community?
- What damage may it inadvertently cause to national assets such as virgin forest, tourism areas, or historical and cultural sites?

The illustration to the right, and similar illustrations throughout this booklet, visually represent the relationship between an existing environment and a proposed development plan. This particular plan is for a new town, which is to include gas works and storage. These images evoke questions like the ones above about the project's compatibility with its surroundings and the available resources.



Who is involved in the EIA process?

An EIA review is normally undertaken by those responsible for the development – the 'developer'. In some cases, the developer is a private company; in other cases, the developer is the government authority responsible for the relevant sector (eg, transportation or agriculture).

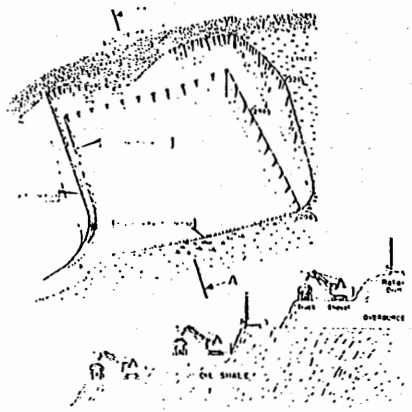
Increasingly, governments and international agencies are adopting regulations that legally require developers to undertake EIAs. In such cases, the EIA report may need to be submitted as part of the application to a permit-granting government department – the 'competent authority'. But many developers, on their own initiative, are incorporating the EIA process into their routine project cycle. They recognise that environmental problems not only lead to risks and costly liabilities, but that they also cause concern about the developer's effectiveness across the full range of its responsibilities. A prudent developer uses all the management tools available to ensure a project's success in advance.

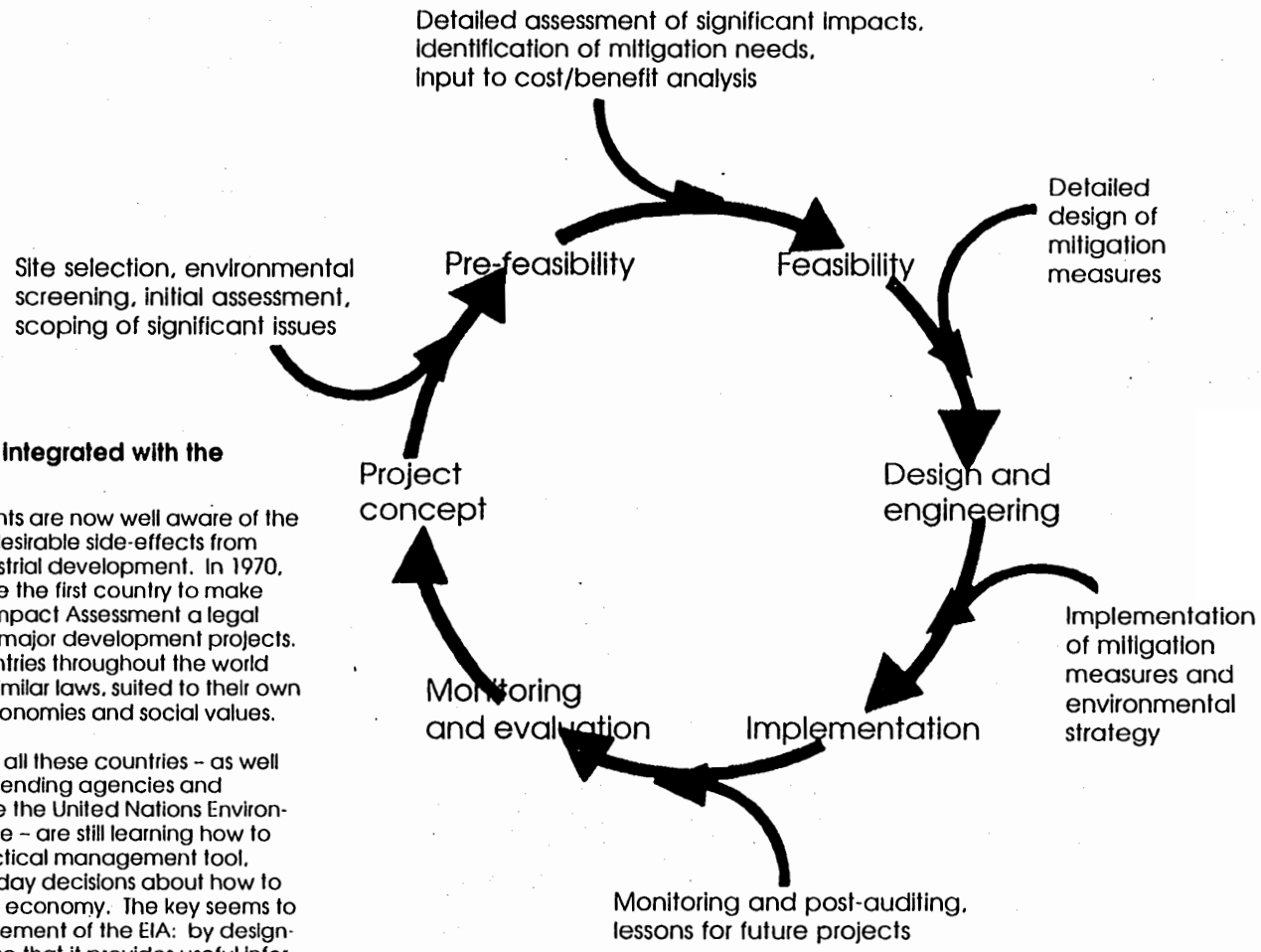
Although the developer is usually responsible for undertaking the EIA, the 'competent authority' also has a role to play:

- By providing general guidance, past EIA formats or examples to follow
- After the EIA is done, using its results to reach a decision on the project, and later ensuring that all the mitigation measures are implemented.

The concerns and points-of-view of all the various groups interested in and affected by the project should be taken into account throughout the EIA process. Each of these participants will have a different use for the results of the EIA:

- The *developer* needs to know where to site a project and how to reduce adverse environmental impacts
- The *investor* needs to know how the impacts will affect the viability of the project, and what liabilities are incurred
- The *competent authority* uses the EIA's results to decide on a response to the permit application
- Other *government authorities* will want to know the implications of the project's adverse impacts for other projects they may wish to promote
- The *regulator* needs to know the extent of environmental impacts and whether they are acceptable
- The *regional planner* needs to know how the impacts will interfere with adjacent developments and land uses
- The *local community* or its representatives will need to know how the project's impacts will affect their quality of life
- The *politician* needs to know who is affected and in what way, and what issues should be of concern.



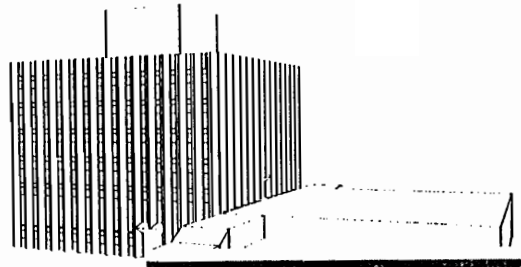


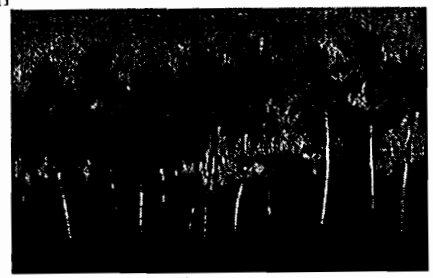
EIA should be integrated with the project cycle

Most governments are now well aware of the possibility of undesirable side-effects from large scale industrial development. In 1970, the USA became the first country to make Environmental Impact Assessment a legal requirement for major development projects. Since then, countries throughout the world have enacted similar laws, suited to their own constitutions, economies and social values.

Governments of all these countries – as well as international lending agencies and organisations like the United Nations Environment Programme – are still learning how to make EIA a practical management tool, useful in day-to-day decisions about how to build a country's economy. The key seems to lie in the management of the EIA: by designing the process so that it provides useful information to decision-makers at just the right time in the project cycle, EIA can have a real effect on projects. In other words, EIA should enhance and augment the project planning process. Only by actually shaping projects can EIA become an important instrument for protecting the environment and ensuring sustainable economic success.

Illustrated here is a generalised project cycle, showing when and how an Environmental Impact Assessment can contribute positively to the cycle's progress.





Important principles in managing an EIA

Principle 1
Focus on the main issues.
It is important that an Environmental Impact Assessment does not try to cover too many topics in too much detail.

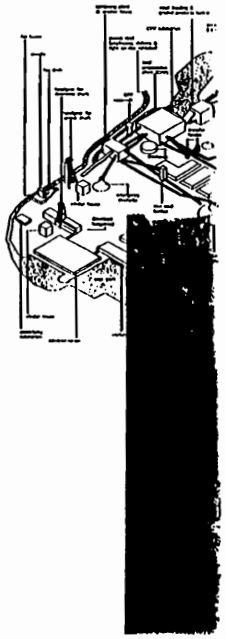
At an early stage, the scope of the EIA should be limited to only the most likely and most serious of the possible environmental impacts. Some EIAs have resulted in large and complex reports running to several thousand pages. Such extensive work is unnecessary, and can be counter-productive, because the EIA's findings must be readily accessible and immediately useful to decision-makers and project planners.

When mitigation measures are being suggested, it is again important to focus the study only on workable, acceptable solutions to the problems. It is easy for the study to waste time considering measures that are impractical or totally unacceptable to the developer or to the Government.

When it is time to communicate the conclusions, the EIA should provide a summary of information relevant to the needs of each group for making its decision. Supporting data should be provided separately.

Principle 2
Involve the appropriate persons and groups.
Just as it is important not to waste time and effort on irrelevant issues, it is also important to be selective when involving people in the EIA process. Generally, three categories of participants are needed to carry out an EIA:
- Those appointed to manage and undertake the EIA process (usually a co-ordinator and a staff of experts)
- Those who can contribute facts, ideas or concerns to the study, including scientists, economists, engineers, policy makers, and representatives of interested or affected groups
- Those who have direct authority to permit, control or alter the project – that is, the decision-makers – including for example the developer, aid agency or investors, competent authorities, regulators and politicians.

Principle 3
Link information to decisions about the project.
An EIA should be organised so that it directly supports the many decisions that need to be taken about the proposed project. It should start early enough to provide information to improve basic designs, and should progress through the several stages of project planning. In a typical sequence:
- When the developer and investors first broach the project concept, they consider likely environmental issues
- When the developer is looking for sites or routes, environmental considerations are used to aid the selection process
- When the developer and investors are assessing the project's feasibility,



an EIA is in progress, helping them to anticipate problems
- When engineers are creating the project design, the EIA identifies certain standards for the design to meet
- When a permit is requested, a completed EIA report is submitted, and also published for general comment
- When the developer implements the project, monitoring or other measures provided for in the EIA are undertaken.

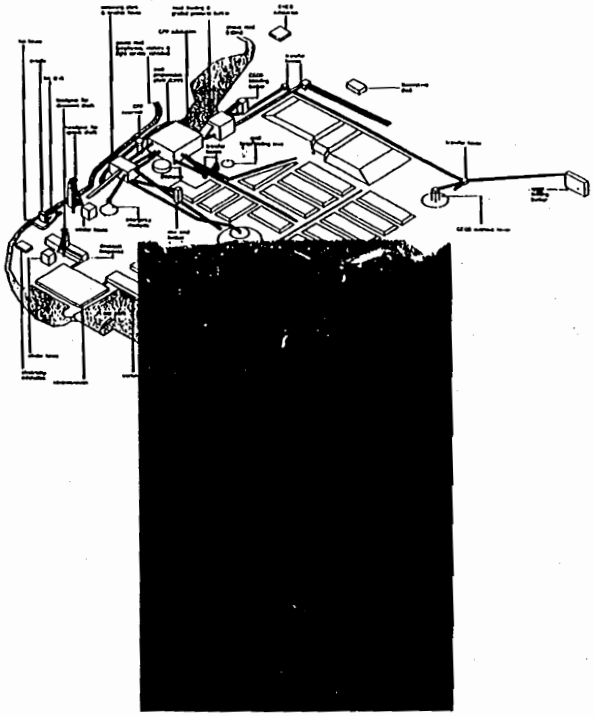
Principle 4

Present clear options for the mitigation of impacts and for sound environmental management.

To help decision-makers, the EIA must be designed so as to present clear choices on the planning and implementation of the project, and it should make clear the likely results of each option. For instance, to mitigate adverse impacts, the EIA could propose:
- Pollution control technology or design features
- The reduction, treatment or disposal of wastes
- Compensation or concessions to affected groups.

To enhance environmental compatibility, the EIA could suggest:
- Several alternative sites
- Changes to the project's design and operation
- Limitations to its initial size or growth
- Separate programmes which contribute in a positive way to local resources or to the quality of the environment.

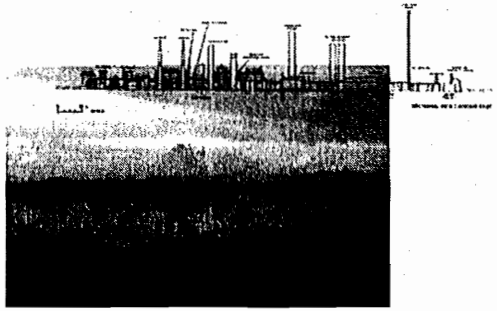
And to ensure that the implementation of an approved project is environmentally sound, the EIA may prescribe:
- Monitoring programmes or periodic impact reviews
- Contingency plans for regulatory action
- The involvement of the local community in later decisions.



Principle 5

Provide information in a form useful to the decision-makers.

The objective of an EIA is to ensure that environmental problems are foreseen and addressed by decision-makers. To achieve this, decision-makers must fully understand the EIA's conclusions. Most decision-makers are unlikely to use information, no matter how important it is, unless it is presented in terms and formats immediately meaningful:
- Briefly present 'hard' facts and predictions about impacts, comment on the reliability of this information, and summarise the consequences of each of the proposed options
- Write in the terminology and vocabulary that is used by the decision-makers and the community affected by the project
- Present the essential findings in a concise document, supported by separate background materials where necessary
- Make the document easy to use, providing visuals whenever possible.



The Environmental Impact Assessment process

Before starting the EIA

Despite its usefulness in finding ways to make projects more successful, the full EIA process is not necessary for every kind of development project. For a major project, an EIA may use considerable resources and expertise. If a detailed EIA is not really needed, these resources can be put to better use elsewhere.

There are two 'tiers' of assessment which should be applied to the project before proceeding with a full EIA: *screening* and *preliminary assessment*. Where these first tiers of assessment are a regulatory requirement, the developer normally does the work and submits the results to the regulatory agency. The agency may then decide:

- There is nothing to be concerned about, or
- The evaluation should proceed to the next tier.

The advantage of a tier approach is that the extent of the inquiry expands with the advancing development of the project plans. 'Screening' is appropriate when the project is only a rough concept. Later, when the project is under more general discussion, a 'preliminary assessment' can look deeper into possible sites and potential impacts. Then, just before the preliminary stages of feasibility and design work get underway, a full 'EIA study' can commence, so that it can influence the detailed decisions to ' come. This tier approach also ensures that impacts are examined at a very early stage in the project planning, and not later when sites or designs are already decided by other factors.

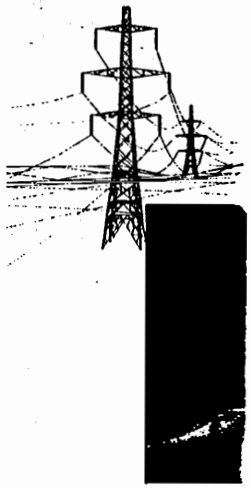
Screening

Screening is the first and simplest tier of project evaluation. Screening helps to clear types of projects which in past experience are not likely to cause serious environmental problems. The exercise may take one of several forms:

- Measuring against simple criteria such as size or location
- Comparing the proposal with lists of project types rarely needing an EIA (eg. schools) or definitely needing one (eg. coal mines)
- Estimating general impacts (eg. increased infrastructure needed) and comparing these impacts against set thresholds
- Doing complex analyses, but using readily available data.

Preliminary Assessment

If screening does not automatically clear a project, the developer may be asked to undertake a *Preliminary Assessment*. This involves sufficient



research and expert advice to:

- Identify the project's key impacts on the local environment
- Generally describe and predict the extent of the impacts
- Briefly evaluate their importance to decision-makers.

The preliminary assessment can be used to assist early project planning – for instance, to narrow the discussion of possible sites – and it can serve as an early warning that the project may have serious environmental difficulties. It is in the developer's interest to do a preliminary assessment, since in practice, this step can clear projects of the need for a full EIA.

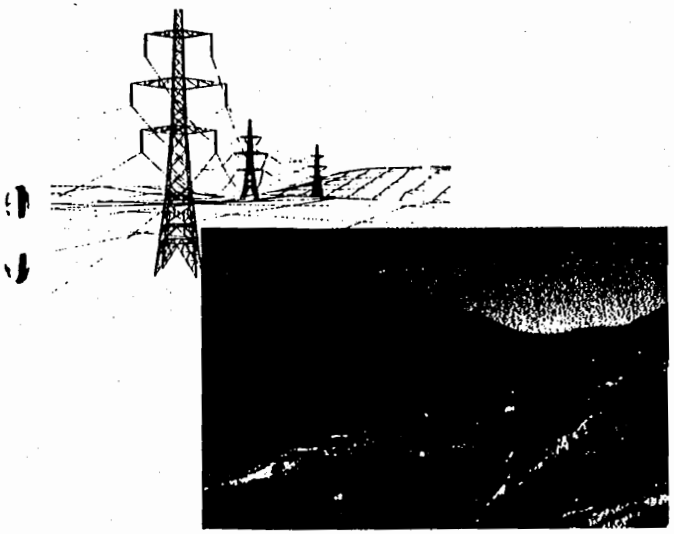
Organisation

If after reviewing a preliminary assessment the competent authority deems that a full EIA is needed, the next step for the project developer is the *Organisation* of the EIA study. This entails:

- Commissioning and briefing an independent co-ordinator and expert study team (the disciplines that will be represented are decided after the 'scoping' stage, but the team always includes a communications expert)
- Identifying the key decision-makers who will plan, finance, permit and control the proposed project, so as to characterise the audience for the EIA
- Researching laws and regulations that will affect these decisions
- Making contact with each of the various decision-makers
- Determining how and when the EIA's findings will be communicated.

Scoping

The first task of the EIA study team is '*Scoping*' the EIA. The aim of scoping is to ensure that the study addresses all the issues of importance to the decision-makers. First the study team's outlook is broadened – by discussions with the project developers, decision-makers, the regulatory agency, scientific institutions, local community leaders, and others – to include all the possible issues and concerns raised by these various groups. Then the study team selects primary impacts for the EIA to focus on, choosing on the basis of magnitude, geographical extent, significance to decision-makers, or because of special local sensitivities (eg, soil erosion, the presence of an endangered species, or a nearby historical site).



The EIA study

After 'scoping', the EIA study itself begins. Simply put, the EIA study attempts to answer five questions:

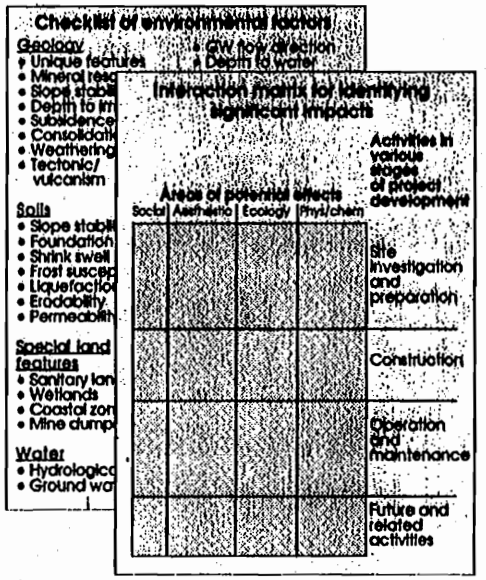
i) What will happen as a result of the project?
ii) What will be the extent of the changes?
iii) Do the changes matter?
iv) What can be done about them?
v) How can decision-makers be informed of what needs to be done?

After controls on the project's impacts are proposed in answer to question *(iv)*, the study team may again ask: 'What will happen as a result of the (now revised) project?' Thus the EIA often becomes a cyclical process of asking and re-asking the first four questions, until decision-makers can be offered workable solutions.

Identification

The answer to the first question – *'What will happen as a result of the project?'* – has already been partly addressed, but only in general terms: if a 'preliminary assessment' has been done, it will have broadly reviewed the project's effects; also, 'scoping' will have focused the study on the most important issues for decision-makers. Taking these findings into account, the full EIA study now formally identifies those impacts which should be assessed in detail. This *Identification* phase of the study may use these or other methods:

- Compile a candidate list of key impacts – such as changes in air quality, noise levels, wildlife habitats, species diversity, landscape views, social and cultural systems, settlement patterns and employment levels – from other EIAs for similar projects. This should draw on as many examples of similar projects as possible.
- Name all the project's 'sources' of impacts (eg, smoke emissions, water consumption, construction jobs) using checklists or questionnaires; then list possible 'receptors' in the environment (eg, crops, communities using the same water for drinking, migrant labourers) by surveying the existing environment and consulting with interested parties. Where the 'sources' may affect the 'receptors', a potential impact is suspected.
- Identify impacts themselves through the use of checklists, matrices, networks, overlays, models and simulations.

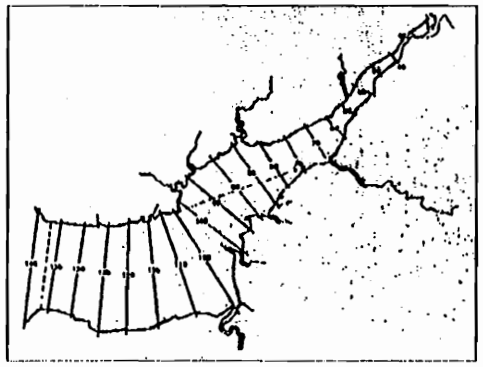


Checklist and matrix as used for impact identification.

Prediction

The next step, called *Prediction*, answers the EIA's second question: *'What will be the extent of the changes?'* As far as is practicable, prediction scientifically characterises the impact's causes and effects, and its secondary and synergistic consequences for the environment and the local community. Prediction follows an impact within a single environmental parameter (eg, a toxic liquid effluent) into its subsequent effects in many disciplines (eg, reduced water quality, adverse impacts on fisheries, economic effects on fishing villages, and resulting socio-cultural changes). Prediction draws on physical, biological, socio-economic, and anthropological data and techniques. In quantifying impacts, it may employ mathematical models, photomontages, physical models, socio-cultural models, economic models, experiments or expert judgements.

To prevent unnecessary expense, the sophistication of the prediction methods used should be kept in proportion to the 'scope' of the EIA. For instance, a complex mathematical model of atmospheric dispersion should



Water quality model, based on a one-dimensional segmenting of a river system.

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Examples of standards used in the evaluation of predicted impacts.

National ambient air quality standards

Sulfur dioxide	80 µg/m³ annual arithmetic mean 365 µg/m³ max 24 hr concen
Particulate matter	75 µg/m³ annual geometric mean
Hydrocarbons	160 µg/m³ (0.24 ppm) max 3 hr concen
Nitrogen dioxide	100 µg/m³ annual arithmetic mean
Ozone	235 µg/m³ (0.12 ppm) concen
	³ (9ppm) concen
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Quality required for shellfish waters

pH: between 7-9	Qtity by electrometry
Temperature: discharges must not cause rise > 2 °C	Qtity by thermometry measures in situ at the time of sampling
Coloration (after filtration) mg Pt/l: discharges must not cause deviation > 10 mg Pt/l	Qtity, filter through 0.45 µm membrane, photometric method using platinum/ cobalt scale
Suspended solids (mg/l): discharges must not cause solid content to increase more than 30%	Qtity, filter through 0.45 µm membrane, dry at 105 °C, and weigh; centrifuge, dry, weigh

not be used if only a small amount of relatively harmless pollutant is emitted. Simpler models are available and are sufficient for the purpose. Also, it is unnecessary to undertake expensive analyses if they're not required by the decision-makers for whom the EIA is being done.

All prediction techniques, by their nature, involve some degree of uncertainty. So along with each attempt to quantify an impact, the study team should also quantify the prediction's uncertainty in terms of probabilities or 'margins of error'.

It has been a shortcoming of many EIAs that social and cultural impacts are not given the prominence they deserve in describing the extent of changes expected to result from a major development project. This has probably been due to the bias of physical and biological scientists against the comparatively younger disciplines of cultural anthropology and sociology. This is an unfortunate bias, since socio-cultural impacts are the ones that the local community will feel most acutely in their everyday lives. A consideration of socio-cultural impacts should be integrated, wherever possible, into every discussion of physical/biological change, and not just treated separately in a minor chapter or appendix.

Evaluation

The third question addressed by the EIA – *'Do the changes matter?'* – is answered in the next step, *Evaluation*, so called because it evaluates the predicted adverse impacts to determine whether they are significant enough to warrant mitigation. This judgement of significance can be based on one or more of the following:

- Comparison with laws, regulations or accepted standards
- Consultation with the relevant decision-makers
- Reference to pre-set criteria such as protected sites, features or species
- Consistency with government policy objectives
- Acceptability to the local community or the general public.

Mitigation

If the answer to the third question is 'Yes, the changes do matter', then the EIA proceeds to answer the fourth question – *'What can be done about them?'* In this phase, the study team formally analyses *Mitigation*. A wide range of measures are proposed to prevent, reduce, remedy or compensate for each of the adverse impacts 'evaluated' as significant. Possible mitigation measures include:

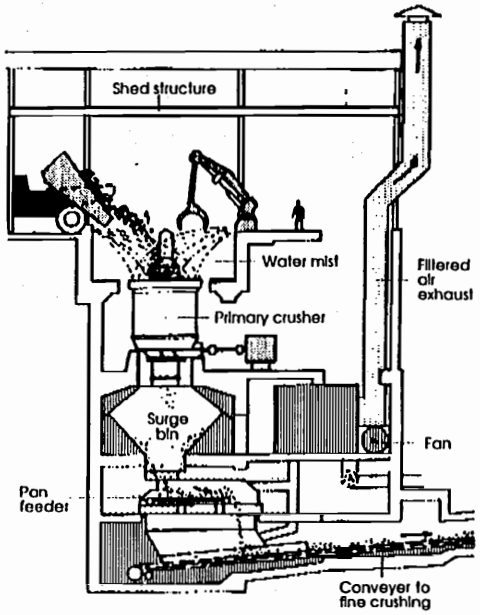
- Changing project sites, routes, processes, raw materials, operating methods, disposal routes or locations, timing, or engineering designs
- Introducing pollution controls, waste treatment, monitoring, phased implementation, landscaping, personnel training, special social services or public education
- Offering (as compensation) restoration of damaged resources, money to affected persons, concessions on other issues, or off-site programmes to

enhance some other aspect of the environment or quality of life for the community.

All mitigation measures cost something, and this cost must be quantified too.

These various measures are then compared, trade-offs between alternative measures are weighed, and the EIA study team proposes one or more 'action plans', usually combining a number of measures. The action plan may include technical control measures, an integrated management scheme (for a major project), monitoring, contingency plans, operating practices, project scheduling, or even joint-management (with affected groups). The study team should explicitly analyse the implications of adopting different alternatives, to help make the choices clearer for decision-makers. Several analytical techniques are available for this purpose:

- Cost/benefit analysis, in which all quantifiable factors are converted to monetary values, and actions are assessed for their effect on project costs and benefits (Be cautioned, however, that the unquantifiable and qualitative aspects can be equally important, and often need to be taken into account in the decision-making process.)
- Explaining what course of action would follow from various broad 'value judgements' (eg, that social impacts are more important than resources)
- A simple matrix of environmental parameters versus mitigation measures, containing brief descriptions of the effects of each measure
- Pairwise comparisons, whereby the effects of an action are briefly compared with the effects of each of the alternative actions, one pair at a time.

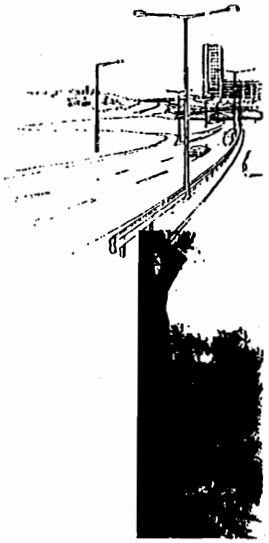


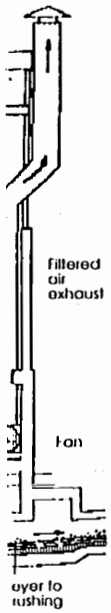
Example of mitigation technology: designs for dust control in a primary crusher, used in mining industries.

Documentation

The last step in the EIA process, which responds the last question – '*How can decision-makers be informed of what needs to be done?*' – is the *Documentation* of the process and the conclusions. Recall that the purpose of an EIA is to ensure that potential problems are foreseen and addressed in the project's design. Many technically first-rate EIA studies fail to exert their importance and usefulness because of poor documentation. The EIA can achieve its purpose only if its findings are well communicated to decision-makers.

Generally, to produce effective communications, one must identify the target audience or audiences, and then shape and style the publication to meet their specific needs. In documenting an EIA, this means identifying the key decision-makers, perceiving the questions they will be asking, and providing them with straightforward answers, formatted for easy interpretation in relation to their decision-making (eg, tables, graphs, summary points). Successful EIA documentation is more readily produced if the audience and their needs are established at the start of the EIA, and then made to affect how the research is focused and reported. It is the job of the study team's communications expert to make this happen.





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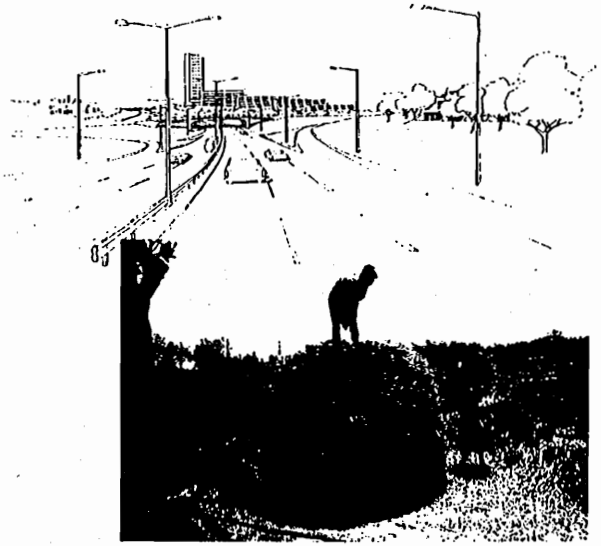
So that decision-makers can look more deeply into particular issues, the EIA report should also include a record of the EIA process and the judgements made by the study team. An EIA report typically contains:

- An executive summary of the EIA findings
- A description of the proposed development project
- The major environmental and natural resource issues that needed clarification and elaboration
- The project's impacts on the environment (in comparison with a baseline environment as it would be without the project), and how these impacts were identified and predicted
- A discussion of options for mitigating adverse impacts and for shaping the project to suit its proposed environment, and an analysis of the trade-offs involved in choosing between alternative actions
- An overview of gaps or uncertainties in the information
- A summary of the EIA for the general public.

All of this should be contained in a very concise, easy-to-read document, with cross references to background documentation, which is provided in an appendix. (The short document is sometimes called an 'Environmental Impact Statement', especially when it is submitted as part of a permit application.)

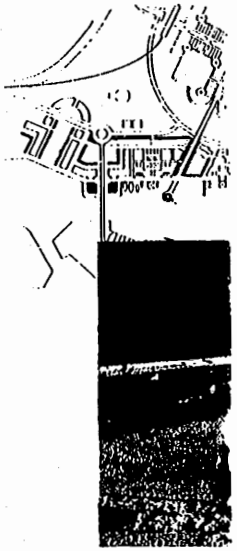


Using the results

Decisions based on the EIA are usually made by persons who have not been closely involved with the day-to-day progress of the EIA study. Their first consideration of the project may well be the moment they pick up and skim through the EIA report. The EIA will hopefully tell them all they need to know about 'what will happen as a result of the project', 'the extent of the changes', 'whether the changes matter', and 'what can be done about them'. But the decision-makers themselves must also consider political realities when selecting a course of action. Only decision-makers are in a position to balance the project's needs and problems with the other needs and problems over which they have jurisdiction. They must take into account not only the facts of the situation, but also people's perceptions.

If the project is accepted, perhaps with recommended modifications, then the decision-maker may need to take two further actions:

- Prepare a plan for reducing conflicts about the project; this may include public participation in planning, public education, and actions to compensate affected groups
- Allocate institutional responsibilities for overseeing the developer's adherence to its environmental requirements, for incorporating environmental management into further planning, and for enforcing any restrictions or carrying out any monitoring.

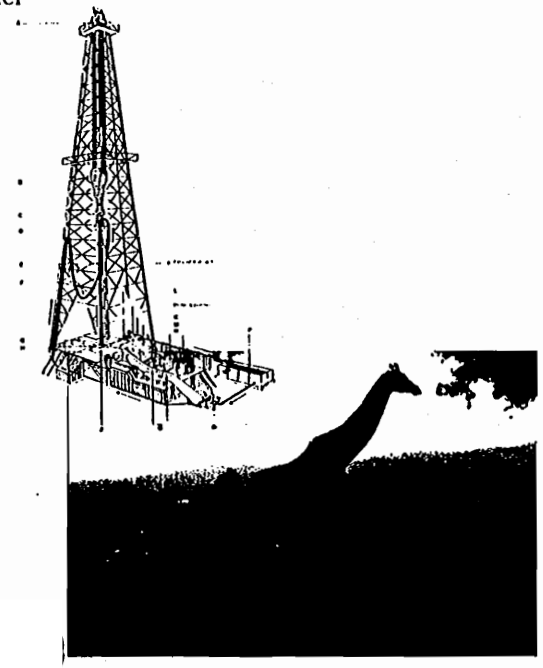


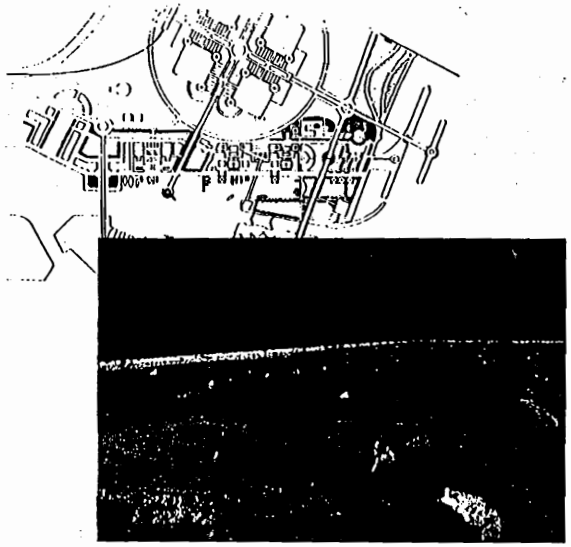
Sometimes, the competent authority sends the EIA to a review panel for comment on its adequacy and quality, before reaching its decision. The decision-maker may call for further study to answer additional questions about the project. The decision-maker may also ask that an opportunity be provided for public review and involvement. The competent authority simply places copies of the report on public display, and invites the public to comment. The EIA team may then be asked to re-draft the EIA to take account of the comments made, before a decision is taken. In cases where the decision-maker chooses to reject the proposed project altogether, there should be an appeal process open to the project developers.

The EIA's usefulness does not end with the decision on a course of action about the project. It still has several further contributions to make to the project's success:

- If the project goes ahead with recommended changes, the EIA's findings should be used to help shape the project to suit the environment, by influencing engineering designs
- Decisions that need to be made in the latter phases of project planning, such as precisely where to route supporting road or rail links, should be based on the EIA
- The EIA's precautions on environmental impacts can be part of the brief for tendering on contracts, and should be re-drafted as environmental safety guidance for workers.

Lastly, after the project is completed, a 'post audit' can be done to determine how close the EIA's predictions were to the project's real impacts. This forms a valuable record for others doing EIAs on similar projects in the future.



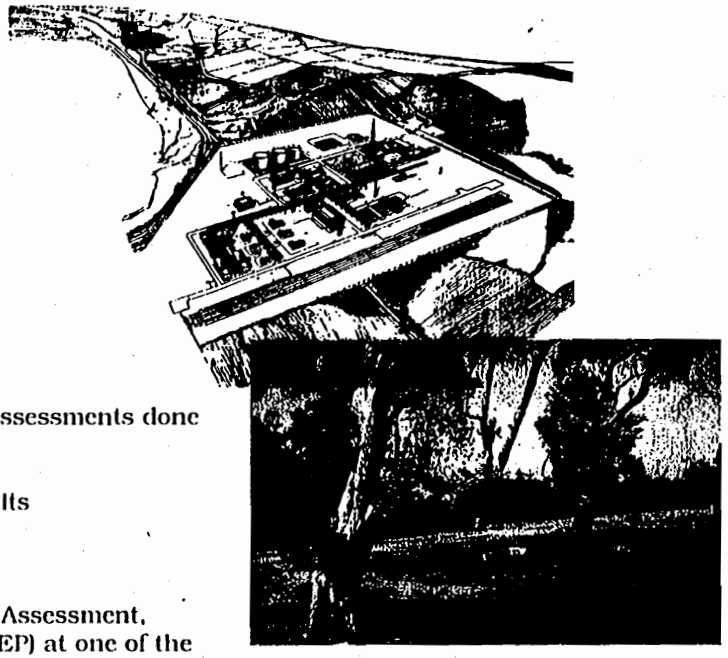


Resources needed for an EIA

Because of the EIA's acknowledged importance in planning a country's sustainable economic growth, EIAs are now undertaken throughout the world, even in places with very few resources to give to planning initiatives. There are, however, certain minimum resources needed to perform EIAs that can successfully shape major projects:

- **Qualified multi-disciplinary staff.** This includes a skilled manager (to co-ordinate the activities, communicate with decision-makers, and motivate the study team), trained specialists (in fields such as environmental science, rural and urban planning, economics, waste and pollution control, process engineering, landscape design, sociology and cultural anthropology), and a communications expert.
- **Technical guidelines, agreed with the competent authority,** for carrying out the various phases of the EIA process, especially screening, scoping, prediction, evaluation and mitigation.
- **Information about the environment** (especially relating to the impacts being considered after 'scoping') which can be sorted and evaluated.
- **Analytical capabilities** for doing field work, laboratory testing, library research, data processing, photomontage, surveys and predictive modelling.
- **Administrative resources** for the day-to-day running of the EIA process, including office staff, meeting rooms and support, communications facilities and records management.
- **Institutional arrangements,** including a formal procedure for consultation with the decision-makers and other interested groups, the authority to obtain the necessary information of the proposed project, and a formal process for integrating the EIA into decision-making about projects.
- **Review, monitoring and enforcement powers,** to ensure that accepted mitigation measures are included in the development.

Among the resources needed to perform an EIA, not least are **money** and **time**. As concerns time, the following are averages for a sampling of recent EIAs: preliminary assessments take between 2 and 10 weeks to complete; full EIAs may last between 3 months and 2 years. Regarding costs, officials often balk at some of the figures they hear, but developers and investors will realise that they represent but a very small percentage of the costs of any major development project – nearly always less than 1%. Indeed, it is a relatively small price to pay to prevent costly unforeseen problems, to promote development that can be sustained, to help prevent potentially ruinous environmental catastrophes, and to obtain approval and acceptance. EIAs mean better, more successful projects; they are a good investment in the future, for both the developer and the economy as a whole.



What to do next

If you want to know more about Environmental Impact Assessments done in your own country, consult these likely sources:

- The Ministry in charge of environmental protection
- Authorities empowered to grant building or other permits
- Environmental research centres
- Universities and related research establishments.

To find out more about how to do Environmental Impact Assessment, contact the United Nations Environment Programme (UNEP) at one of the following addresses:

- **United Nations Environment Programme**
  Regional Office for Asia and the Pacific
  The United Nations Building, Rajadamnern Avenue
  Bangkok 10200, Thailand
- **United Nations Environment Programme**
  Industry and Environment Office
  Tour Mirabeau
  39-43, Quai Andre Citroen
  75739 Paris Cedex 15, France
- **United Nations Environment Programme Headquarters**
  PO Box 30552, Nairobi, Kenya

UNEP can provide guidelines on the EIA process, examples of EIAs done throughout the world, reference materials on EIA techniques, and assistance finding the necessary resources, including expert advice.

The Governing Council of UNEP has adopted 'Goals and Principles of Environmental Impact Assessment'. In brief, the goals are:

- To take environmental effects into account in decisions by competent authorities
- To promote beneficial EIA procedures in all countries
- To encourage consultation between States on projects involving impacts across national boundaries.

First among UNEP's principles for EIA is that environmental effects should be considered before doing any project, and that EIAs should be done when significant effects are expected. The other principles cover many of the points about the EIA process which are discussed in this booklet: who to involve, how to focus the process, and how to integrate it with decision-making about the proposed project.

Environmental Impact Assessment
Basic procedures for developing countries
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Appendix C

Appendix C: Background Readings on Global and Regional Environmental Issues

[Reproduced with permission from "Agenda for Change", Keating, M., 1993, Center for Our Common Future]

Foreword

The United Nations Conference on Environment and Development (UNCED), which took place in Rio de Janeiro in June 1992, was a milestone event which brought together Heads of State and government officials from around the globe together with delegates from United Nations agencies, international organizations and many representatives from non-governmental organizations.

The Conference made it plain that we can no longer think of environment and economic and social development as isolated fields. The Declaration of Rio contains fundamental principles on which States must base their future decisions and policies, considering the environmental implications of socio-economic development.

Agenda 21, a vast work programme for the 21st century, represents the consensus reached by 179 States in Rio. It is a blueprint for a global partnership aimed at reconciling the twin requirements of a high quality environment and a healthy economy for all peoples of the world.

This historic document is 700 pages long and embraces all areas of sustainable development. Because this document concerns each and every one of us, it is essential that it is accessible to all.

This effort by the Centre for Our Common Future to transform this mammoth document into a plain language version is aimed at facilitating access to the very important material contained in Agenda 21. We hope that this plain language version can contribute to enhancing public interest in the future of our planet and encourage individuals to become an active part of the search for sustainable development.

Philippe Roch
Director
Swiss Federal Office of Environment, Forests and Landscape

The Road to Rio

During the last two decades, people began to realize that we cannot have a healthy society or economy in a world with so much poverty and environmental degradation. Economic development cannot stop, but it must change course to become less ecologically destructive. The challenge of the 1990s is to put this understanding into action, and make the transition to sustainable forms of development and lifestyles. From the farm field to the boardroom, from the shopping cart to the national budget, we will have to make major changes.

A road map to sustainable development is now taking shape. Agenda 21 is a guide for business and government policies and for personal choices into the next century. It was endorsed by the 1992 Earth Summit in Rio de Janeiro, Brazil, the largest-ever meeting of world leaders. This meeting took place during the United Nations Conference on Environment and Development which brought together the heads or senior officials of 179 governments. They were joined by hundreds of officials from United Nations organizations, municipal governments, business, scientific, non-government and other groups. Nearby, the '92 Global Forum held a series of meetings, lectures, seminars and exhibits on environment and development issues for the public. This drew 18,000 participants from 166 countries, as well as 400,000 visitors. There were 8,000 journalists covering the Rio meetings, and the results were seen, heard and read about around the world.

The foundations for the Rio process were laid in 1972, when 113 nations gathered for the Stockholm Conference on the Human Environment, the first global environmental meeting. In 1983, the United Nations created the World Commission on Environment and Development. Four years later its landmark report, *Our Common Future*, warned that people had to change many of the ways in which they did business and lived or the world would face unacceptable levels of human suffering and environmental damage.

The Commission said that the global economy had to meet people's needs and legitimate desires, but growth had to fit within the planet's ecological limits. The Commission, known as the Brundtland Commission after its chairman, called for "a new era of environmentally sound economic development". It said that: "Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs."

In 1989, the United Nations began planning a Conference on Environment and Development to spell out how to achieve sustainable development. For two years, experts from around the world hammered out difficult agreements along the road to Rio. The international negotiating system was opened up as never before. Thousands of people from non-governmental organizations, businesses, education, women's groups, indigenous groups and others contributed to the Rio process.

The Five Rio Documents

Rio produced two international agreements, two statements of principles and a major action agenda on world-wide sustainable development. The five are:

- The Rio Declaration on Environment and Development. Its 27 principles define the rights and responsibilities of nations as they pursue human development and well-being.
- Agenda 21, a blueprint on how to make development socially, economically and environmentally sustainable.
- A statement of principles to guide the management, conservation and sustainable development of all types of forests, which are essential to economic development and the maintenance of all forms of life.

Two major international Conventions were negotiated separately from but in parallel with preparations for the Earth Summit and were signed by most governments meeting at Rio.

- The aim of the United Nations Framework Convention on Climate Change is to stabilize greenhouse gases in the atmosphere at levels that will not dangerously upset the global climate system. This will require a reduction in our emissions of such gases as carbon dioxide, a by-product of the use of burning fuels for energy.
- The Convention on Biological Diversity requires that countries adopt ways and means to conserve the variety of living species, and ensure that the benefits from using biological diversity are equitably shared.

Agenda 21 explains that population, consumption and technology are the primary driving forces of environmental change. It lays out what needs to be done to reduce wasteful and inefficient consumption patterns in some parts of the world, while encouraging increased but sustainable development in others. It offers policies and programmes to achieve a sustainable balance between consumption, population and the Earth's life-supporting capacity. It describes some of the technologies and techniques that need to be developed to provide for human needs while carefully managing natural resources.

Agenda 21 provides options for combating degradation of the land, air and water, conserving forests and the diversity of species of life. It deals with poverty and excessive consumption, health and education, cities and farmers. There are roles for everyone: governments, business people, trade unions, scientists, teachers, indigenous people, women, youth and children. Agenda 21 does not shun business. It says that sustainable development is the way to reverse both poverty and environmental destruction.

We currently gauge the success of economic development mainly by the amount of money it produces. Accounting systems that measure the wealth of nations also need to count the full value of natural resources and the full cost of environmental degradation. The polluter should, in principle, bear the cost of pollution. To reduce the risk of causing damage, environmental assessment should be carried out before starting projects that carry the risk of adverse impacts. Governments should reduce or eliminate subsidies that are not consistent with sustainable development.

A major theme of Agenda 21 is the need to eradicate poverty by giving poor people more access to the resources they need to live sustainably. By adopting Agenda 21, industrialized countries recognized that they have a greater role in cleaning up the environment than poor nations, who produce relatively less pollution. The richer nations also promised more funding to help other nations develop in ways that have lower environmental impacts. Beyond funding, nations need help in building the expertise – the capacity – to plan and carry out sustainable development decisions. This will require the transfer of information and skills.

Agenda 21 calls on governments to adopt national strategies for sustainable development. These should be developed with wide participation, including non-governmental organizations and the public. Agenda 21 puts most of the responsibility for leading change on national governments but says that they need to work in a broad series of partnerships with international organizations, business, regional, state, provincial and local governments and non-governmental and citizens' groups.

As Agenda 21 says, only a global partnership will ensure that all nations will have a safer and more prosperous future.

Background Information

Developing Countries

The phrase "developing countries" is used throughout the Rio documents. There is no single definition for this term, but it generally refers to economic income. Depending on whose definition you use, the term can include more than 140 countries

Further Reading

The *Earth Summit's Agenda for Change* condenses nearly 180,000 words from the five Rio documents into a form that allows you to understand the key points.

The full text of Agenda 21 is available as *Agenda 21: The United Nations Programme of Action from Rio*. This 310 page UN Publications document also contains the Rio Declaration on Environment and Development and the Statement of Principles on Forests. It can be obtained from: UN Publications, Sales Section, Room DC2-0853, United Nations, New York, NY 10017, USA.

The texts of the climate and biodiversity Conventions can be obtained from: Project Manager for Sustainable Development, Department of Public Information, Room S-894, United Nations, New York, NY 10017, USA.

Based on the final text of Agenda 21, *The Global Partnership for Environment and Development: A Guide to Agenda 21*, provides a comprehensive understanding of the issues underlying Agenda 21. It can be obtained from: UN Publications, Sales Section, Room DC2-0853, United Nations, New York, NY 10017, USA.

Rio Declaration on Environment and Development

Recognizing the integral and interdependent nature of the Earth, our home, the nations meeting at the Earth Summit in Rio de Janeiro adopted a set of principles to guide future development. These principles define the rights of people to development, and their responsibilities to safeguard the common environment. They build on ideas from the Stockholm Declaration at the 1972 United Nations Conference on the Human Environment.

The Rio Declaration states that the only way to have long-term economic progress is to link it with environmental protection. This will only happen if nations establish a new and equitable global partnership involving governments, their people and key sectors of societies. They must build international agreements that protect the integrity of the global environment and the development system.

The Rio principles include the following ideas:

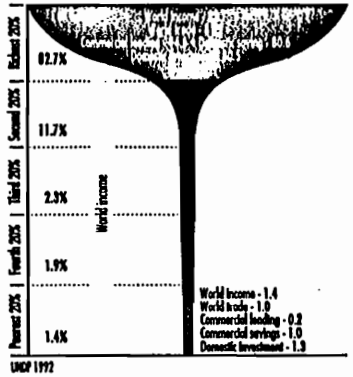
- People are entitled to a healthy and productive life in harmony with nature.
- Development today must not undermine the development and environment needs of present and future generations.
- Nations have the sovereign right to exploit their own resources, but without causing environmental damage beyond their borders.
- Nations shall develop international laws to provide compensation for damage that activities under their control cause to areas beyond their borders.
- Nations shall use the precautionary approach to protect the environment. Where there are threats of serious or irreversible damage, scientific uncertainty shall not be used to postpone cost-effective measures to prevent environmental degradation.
- In order to achieve sustainable development, environmental protection shall constitute an integral part of the development process, and cannot be considered in isolation from it.
- Eradicating poverty and reducing disparities in living standards in different parts of the world are essential to achieve sustainable development and meet the needs of the majority of people.
- Nations shall cooperate to conserve, protect and restore the health and integrity of the Earth's ecosystem. The developed countries acknowledge the responsibility that they bear in the international pursuit of sustainable development in view of the pressures their societies place on the global environment and of the technologies and financial resources they command.
- Nations should reduce and eliminate unsustainable patterns of production and consumption, and promote appropriate demographic policies.
- Environmental issues are best handled with the participation of all concerned citizens. Nations shall facilitate and encourage public awareness and participation by making environmental information widely available.
- Nations shall enact effective environmental laws, and develop national law regarding liability for the victims of pollution and other environmental damage. Where they have authority, nations shall assess the environmental impact of proposed activities that are likely to have a significant adverse impact.
- Nations should cooperate to promote an open international economic system that will lead to economic growth and sustainable development in all countries. Environmental policies should not be used as an unjustifiable means of restricting international trade.
- The polluter should, in principle, bear the cost of pollution.
- Nations shall warn one another of natural disasters or activities that may have harmful transboundary impacts.
- Sustainable development requires better scientific understanding of the problems. Nations should share knowledge and innovative technologies to achieve the goal of sustainability.
- The full participation of women is essential to achieve sustainable development. The creativity, ideals and courage of youth and the knowledge of indigenous people are needed too. Nations should recognize and support the identity, culture and interests of indigenous people.
- Warfare is inherently destructive of sustainable development, and Nations shall respect international laws protecting the environment in times of armed conflict, and shall cooperate in their further establishment.
- Peace, development and environmental protection are interdependent and indivisible.

Preamble to Agenda 21

Humanity stands at a defining moment in history. The world is confronted with worsening poverty, hunger, ill health, illiteracy, and the continuing deterioration of the ecosystems on which we depend for our well-being. The disparities between the rich and poor continue.

The only way to assure ourselves of a safer, more prosperous future is to deal with environment and development issues together in a balanced manner. We must fulfil basic human needs, improve living standards for all and better protect and manage ecosystems. No nation can secure its future alone; but together we can — in a global partnership for sustainable development.

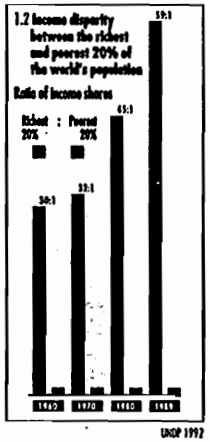
Agenda 21, adopted at the Earth Summit in Rio de Janeiro, reflects a global consensus and political commitment at the highest level on development and environment cooperation. The Agenda deals with both the pressing problems of today and the need to prepare for the challenges of the next century.



1.1 **Global income and economic disparities**

Distribution of world income and economic activity, 1989 - percentage of world total (Quintiles of population ranked by income)

It recognizes that sustainable development is primarily the responsibility of governments, and this will require national strategies, plans and policies. The efforts of nations need to be linked by international cooperation through such organizations as the United Nations. The broadest public participation, and the active involvement of the non-governmental organizations and other groups should also be encouraged.



1.2 **Income disparity between the richest and poorest 20% of the world's population**

Ratio of income shares

The objectives of Agenda 21 require substantial new financial assistance for developing countries. They need this additional support to cover the incremental costs of actions to deal with global environmental problems, and to accelerate sustainable development. Money is also needed to allow international bodies to implement the recommendations of Agenda 21.

Special attention should be given to nations whose economies are in transition, including eastern Europe and the former Soviet Union, where countries are transforming economies, sometimes in the midst of considerable social and political tension.

2

International Cooperation

A partnership of the world's nations is essential for an efficient and equitable global economy that can help all countries to achieve sustainable development.

A trading system that favours the optimal distribution of global production can contribute to sustainable development, as long as this is done under sound environmental policies.

The world trading system should allow efficient producers, especially those in developing countries, to market their products successfully. If poorer nations could earn more from exports, they would have more resources to invest in sustainable forms of development.

The export earnings of many developing countries dropped substantially during the 1980s, due to very low and declining prices for most commodities on international markets. In some cases, competition came from subsidized products. There is a need for agreement between producers and consumers that establishes fair prices for commodities, including those such as cocoa, coffee, sugar and tropical timber.

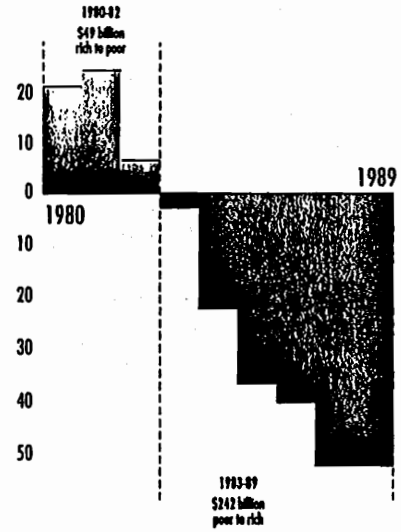
This drop in revenues, combined with heavy foreign debts, left many developing nations with little to invest in sustainable development.

Developing countries critically need investments to stimulate economic growth and meet the basic needs of their people in a sustainable manner. They should diversify exports and cooperate more among themselves in economic development plans.

During the past decade, many developing countries paid out more in debt repayments to

2.1

Debt-related net transfers



UNDP 1991

developed nations than the total amount they received from exports and development assistance. These developing nations had to reduce imports, investment and consumption, and they were less able to fight poverty at home. In some cases, the financial drain resulted in cuts in health care, education and environmental

protection. As a result, some developing countries are in a state of economic stalemate, and face increasing social and environmental problems.

An international strategy is needed to reverse these trends. Countries need to:

- Halt and reverse protectionism, including unilateral trade barriers that harm developing nations, and promote trade liberalization.
- Reduce subsidies that lead to unequal forms of competition.
- Ensure that environment and trade policies support sustainable types of development.
- See that environmental regulations, including those related to health and safety standards, do not constitute a means of arbitrary or unjustifiable discrimination, or a disguised restriction on trade.
- Ensure public input in the formation, negotiation and implementation of trade policies.

The strategy should involve both additional investment from abroad, the return of flight capital that left poor nations, and efficient utilization of resources. The world needs to provide financial assistance and find ways of reducing the foreign debt of many developing nations, particularly of the poorest countries.

The world also needs to offer assistance to developing nations in managing and diversifying their economies, and in managing natural resources for sustainability. Market forces such as interest and foreign exchange rates need to be stable. The prices of commodities in all nations need to reflect the environmental and social costs of their production.

In order to encourage investment, nations need to eradicate corruption and ensure effective, efficient, honest, equitable and accountable public administrations, along with individual rights and opportunities. They need to provide price stability, realistic foreign-exchange rates and efficient tax systems, and to foster the development of private business.

☛ *For more information on this subject, please see Chapter 33: Financing Sustainable Development.*

UNDP 1992

2.2

Widening economic gaps between regions
Percentage of global economic activity

	Global GNP		Global trade		Global commercial bank lending		Foreign private investment	
	1960	1989	1970	1989	1970	1989	1970	1989
Sub-Saharan Africa	1.9	1.2	3.8	1.0	0.3	0.3	24.8	15.0
South Asia	3.1	2.8	1.3	0.9	0.1	0.1	1.5	3.1
East and South-East Asia (excl. China)	1.7	2.9	4.1	8.1	5.7	12.8	11.7	33.3
China	3.0	2.0	0.8	1.9	0.4	0.2	11.8	7.0
Arab States	1.5	2.5	3.3	4.1	1.5	2.4	9.8	13.2
Latin America and the Caribbean	4.7	4.4	5.6	3.3	0.8	6.4	40.4	28.4
Developing countries	15.9	15.8	18.9	19.3	8.8	22.2	100.0	100.0
Least developed countries	1.0	0.5	0.8	0.4	0.2	0.1	1.7	2.2
Industrial countries	84.1	84.2	81.1	80.7	91.2	77.8		

BEST AVAILABLE

3

Combating Poverty

Poverty has so many causes that no one solution will solve all the problems in every country.

Each nation needs its own programme to eradicate such root causes of poverty as hunger, illiteracy, inadequate medical and child care, lack of employment and population pressures. The actions of individual governments must receive support, including financial assistance, because the struggle against poverty is the shared responsibility of all countries.

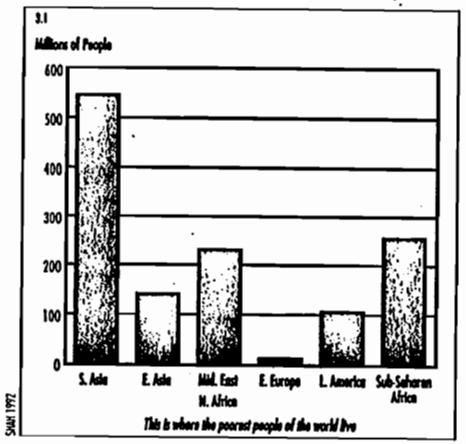
The United Nations and its member nations should make the reduction of poverty a major priority.

The aim of anti-poverty programmes is to make people better able to earn a living in a sustainable way. The poor need to become more self-sufficient, rather than having to depend on foreign aid and food shipments. Economic development is needed in poor nations to provide jobs for today's unemployed and under-employed and for the growing work forces.

To be sustainable over the long term, development plans must deal with the conservation and protection of resources. A development policy that focuses mainly on increasing the production of goods without ensuring the sustainability of the resources on which production is based will sooner or later run into declining productivity. This could increase poverty.

One way that national governments can encourage development is to give more responsibility and resources to local groups and to women. Peoples' organizations, women's groups and non-governmental organizations are

Measured in terms of dollars, the world has 157 billionaires, some 2 million millionaires and more than 1.1 billion people with an income of less than US$ 1 per day.

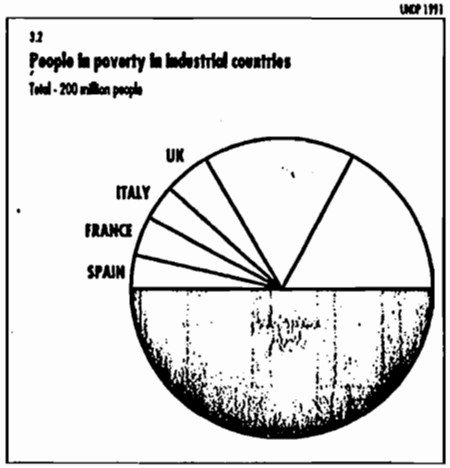


important sources of innovation and action at the local level. They have a proven ability to promote sustainable livelihoods.

Local people need to participate in the protection and sustainable management of natural resources. They need access to land, natural resources and enough money to become productive. They also need to share in the benefits of natural resources from their regions. Many people need more education and training in order to become more productive. This can be

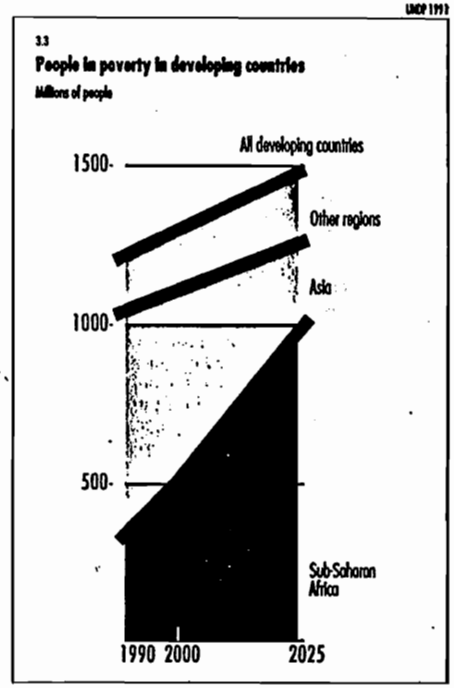
achieved through community-based learning centres for sustainable development. These need to be linked, so that communities can share their expertise.

There is an urgent need for family planning in parts of the world. Women and men need the same right to decide freely and responsibly on the number and spacing of their children. They need access to information, education and appropriate means to enable them to exercise this right. Governments should provide health programmes and facilities, which include women-centred, women-managed, safe and effective reproductive health care and affordable, accessible services for responsible family planning. They should provide the opportunity for all women to breast-feed fully, at least during the first four months post partum.



Poverty-stricken nations will not be able to develop if they are burdened with huge foreign debts, are unable to finance their development, and if prices for their commodities remain low on world markets. Financial assistance needs to be provided in ways that deal with environmental concerns and maintain basic services to the poor and needy.

The struggle against poverty is the shared responsibility of all countries.



4

Changing Consumption Patterns

The major cause of the continued deterioration of the global environment is the unsustainable pattern of consumption and production, particularly in the industrialized countries.

Excessive demands and unsustainable lifestyles among the richer segments of humanity place immense stress on the environment. The poorer segments, meanwhile, are unable to meet food, health-care, shelter and educational needs. This pattern, which aggravates poverty in the world, is a matter of grave concern. It is essential to have sustainable consumption patterns in order to reach the goals of Agenda 21.

We must examine the demand for natural resources generated by unsustainable consumption and seek ways of using resources that minimize depletion and reduce pollution.

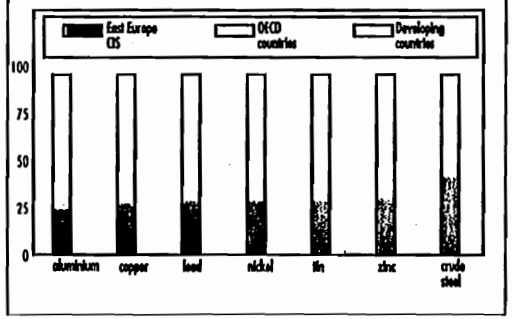
We must consider the need for new concepts of wealth and prosperity, which allow higher standards of living through changed lifestyles and are less dependent on the Earth's finite resources and more in harmony with the Earth's carrying capacity. Some economists are questioning traditional concepts of economic growth. They underline the importance of pursuing economic objectives that take account of the full value of natural resource capital. This may require the development of new indicators that include sustainability in the measurements of the economic well-being of nations.

Achieving sustainable development will require efficiency in production and changes in consumption patterns. In many instances, this will require reorientation of existing production and consumption patterns which have developed in industrial societies and are, in turn, emulated in much of the world.

All countries should strive to promote sustainable consumption patterns, but developed countries should take the lead in achieving this goal.

Developing countries should try to establish sustainable consumption patterns as they build their economies. They need to guarantee the provision of basic needs for the poor, while avoiding unsustainable patterns which are generally recognized as unduly hazardous to the environment, inefficient and wasteful. Such development will require technological and other assistance from industrialized countries.

4.1
World Consumption of Metals (by percentage)



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In order to develop sustainably, countries need to:

- Find ways of making economies grow and prosper while reducing the use of energy and materials and the production of waste.
- Identify balanced patterns of consumption worldwide which the Earth can support in the long term.

Governments should strive to:

- Promote efficient production and reduce wasteful consumption.
- Develop policies that encourage a shift to sustainable patterns of production and consumption.
- Encourage the transfer of environmentally sound technologies to developing countries.

Governments and industries need to cooperate in the development of environmentally sound and sustainable ways of using resources and of producing and using energy. Reducing the amount of materials and energy used to produce goods and services reduces environmental stress and increases economic productivity and competitiveness.

Society needs to cope with mounting levels of waste products by encouraging recycling, reducing wasteful packaging and encouraging the introduction of more environmentally sound products. In many countries, a more environment-conscious consumer public has emerged, combined with increased interest on the part of some industries in providing environmentally sound consumer products.

Governments, in cooperating with industry and other groups and through such means as consumer legislation, should develop or expand environmental labelling and other information that informs people of the health and environmental impact of products.

Governments themselves are often big consumers, and they should review their purchasing policies to improve the environmental content, where possible.

Significant changes in consumption and production patterns seem unlikely to occur soon without the stimulus of prices and market signals that make clear the environmental costs of the consumption of energy, materials and natural resources and the generation of wastes. The use of market signals, such as environmental charges and taxes and deposit and refund systems, should be encouraged.

It is important that individuals take responsibility for consuming goods and services in a sustainable manner. Government and business can promote sustainable consumption through education, public-awareness programmes and the positive advertising of products and services that encourage sustainability.

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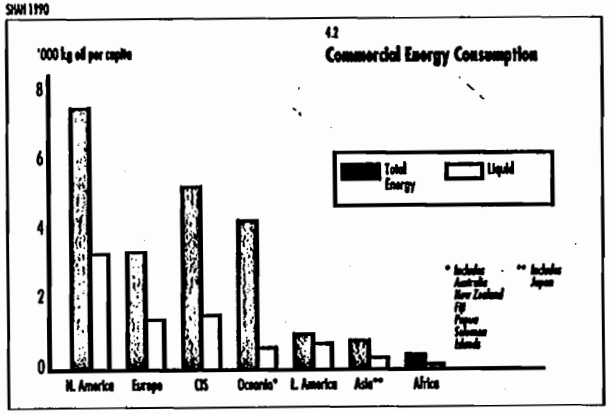
4.2
Commercial Energy Consumption



5

Population and Sustainability

The world's growing population and production, combined with unsustainable consumption patterns, is putting increasing stress on air, land, water, energy and other essential resources. The world's population was more than 5.5 billion in 1993, and is expected to exceed 8 billion by the year 2020.

Development strategies will have to deal with the combination of population growth, health of the ecosystem, technology and access to resources. The primary goals of development include poverty alleviation, secure livelihoods, good health and quality of life, including an improvement in the status of women. Development plans have to deal with such needs as food security, basic shelter, essential services, education, family welfare, reforestation, primary environmental care and employment.

Development strategies will have to deal with the combination of population growth, ecosystem health, technology and access to resources.

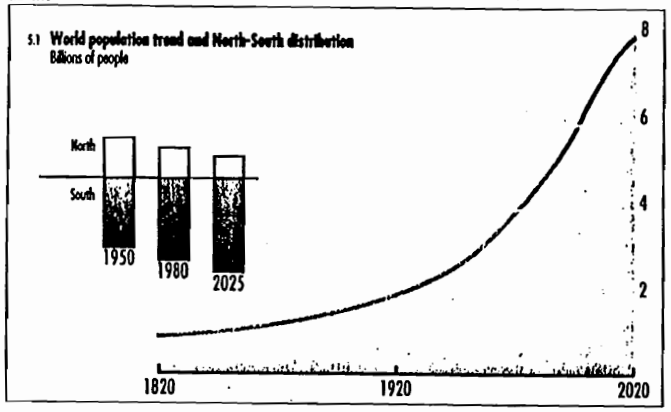
Population concerns should be part of national sustainable development strategies, and countries should establish population goals and programmes. Countries need to assess how the age structure of their populations will create future demands for resources.

Countries need to know their national population-carrying capacity. Special attention should be given to critical resources, such as water and land, and environmental factors, such as ecosystem health and biodiversity. (The carrying capacity is the ability of the resource base to support and provide for the needs of humans without becoming depleted.)

The world needs to do a better job of forecasting the possible outcomes of current human activities, including population trends, per capita resource use and wealth distribution. One outcome that may be expected is major migrations as a result of climate change and the cumulative environmental

UNDP 1990

5.1 World population trend and North-South distribution
Billions of people



change that may destroy people's local livelihoods. The world will need policies to deal with both the migrations that result from and lead to environmental disruption.

Sustainable development will require reproductive health programmes to reduce maternal and infant mortality, and provide men and women with the information and means to plan family size. Women should have access to pre-natal care, and the opportunity to breast-feed for at least four months after birth. They should also be assured of education and job opportunities.

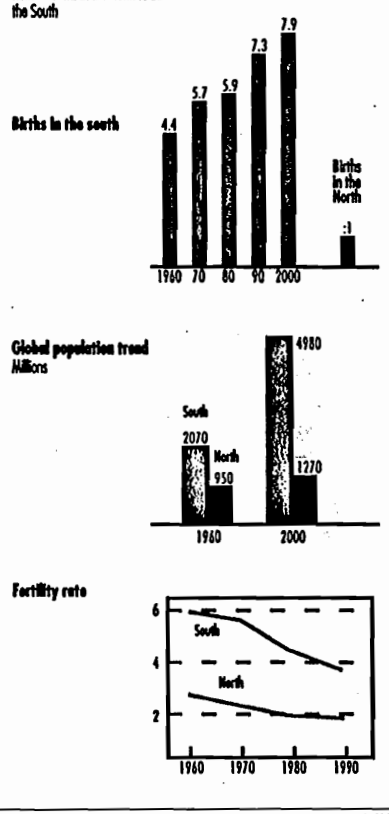
Population programmes need to be part of broader policies that also deal with such factors as ecosystem health, technology and human settlements, and with socio-economic structures and access to resources. Resource management must be able to cope with the needs of the people and be sustainable over the long term.

Population programmes will require the support of political, indigenous, religious and traditional authorities, the private sector and the scientific community. The programmes will also need adequate funding, including support to developing countries.

Population programmes need to be part of broader policies.

Countries need to know their national population-carrying capacity.

5.2 Shifting demographic balance
Ratio of births in the North to births in the South



UNDP 1992

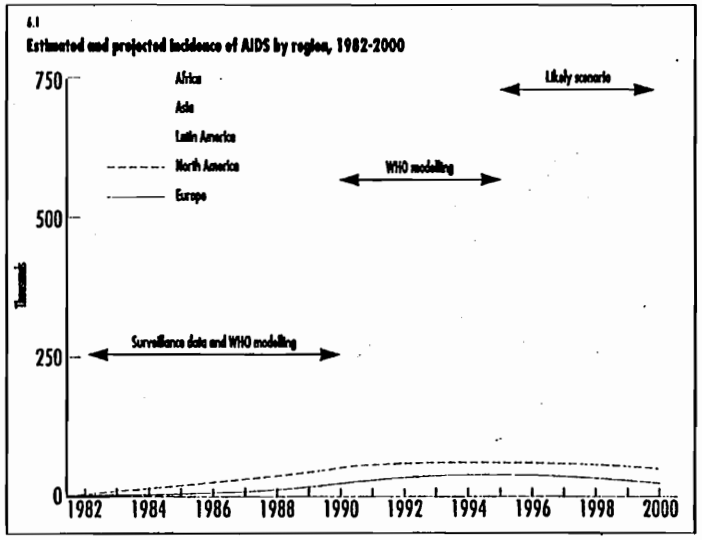
6

Protecting and Promoting Human Health

Human health depends on a healthy environment, including clean water, sanitary waste disposal and an adequate supply of healthy food. We must care for both human health and the health of our environment.

Among the challenges facing the world:

- At least 15 million children a year die from such preventable causes as birth trauma and asphyxia, acute respiratory infections, malnutrition and diarrhoea. Youth is increasingly vulnerable to drug abuse, unwanted pregnancy and sexually transmitted diseases.
- Most women in developing countries lack the means to improve their health and socio-economic status, or control reproduction. They continue to face increasing poverty, malnutrition and general ill-health.
- Despite the development of vaccines and other medicines, many people still suffer from such diseases as polio, cholera, tuberculosis, leprosy, diarrhoea, malaria and schistosomiasis. These result from a lack of housing, clean water and sanitation, combined with inadequate health care.
- In many regions, urban growth has outstripped society's capacity to meet human needs, leaving hundreds of millions without adequate livelihood, food, shelter or other services. Urban pollution is linked to illness and death, while overcrowding and poor housing contribute to tuberculosis, meningitis, respiratory and other diseases.
- HIV is expected to infect 30 to 40 million people by the year 2000, creating a pandemic that will affect all countries. This AIDS-related virus will substantially increase health costs, but the cost in lost income and the decreased productivity of working people will be even higher.
- Pollution, from such sources as energy production and use, industry and transportation, affects the health of hundreds of millions of people. Despite some improvements, environmental deterioration continues, because pollution controls have not kept pace with economic development.
- Indigenous peoples, whose traditional lifestyles have often been fundamentally changed, suffer higher than average rates of unemployment, poor housing, poverty and ill health.



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Good health depends on social, economic and spiritual development, and a healthy environment, including safe food and water. The world needs to use a broad-based campaign against ill health, ranging from training in molecular biology to educating mothers on how to prevent and treat diarrhoea at home. People need health education, immunization and essential drugs. Health care should be adapted to local needs, and local people trained to maintain and repair medical equipment.

Within the overall strategy to achieve health for all by the year 2000, some major goals for the world are:

- Eliminate guinea-worm disease (dracunculiasis) and polio, and control onchocerciasis (river blindness) and leprosy.
- Mobilize and unify national and international efforts to control HIV infection.
- Control tuberculosis, especially the new drug-resistant varieties.
- Provide 95 per cent of the world's children with treatment for acute respiratory infections.
- Cut the number of deaths from childhood diarrhoea in developing countries by 50 to 70 per cent.
- Have anti-malaria programmes in all countries where malaria presents a significant health problem.
- Reduce measles deaths by 95 per cent by 1995.

Every country needs a health action plan that includes a national public health system. Countries need to:

- Have a national health watch able to monitor and forecast the introduction of or increase in communicable diseases.
- Develop community-based health-care systems that meet basic health needs for clean water, safe food and sanitation.
- Ensure men and women of the same right and means to choose responsibly the number and spacing of their children.
- Provide children with basic health care, including immunization and nutrition, and protect them from sexual and workplace exploitation.
- Use effective traditional knowledge in national health-care systems.
- Develop programmes to control outdoor and indoor forms of air pollution and to dispose of solid wastes safely.
- Control the distribution and use of pesticides to minimize health risks.

All countries should have programmes to identify environmental health hazards and reduce the risks. They need to make environment and health safeguards part of national development programmes, and train people to deal with environmental health hazards.

Human health depends on a healthy environment.

7

Sustainable Human Settlements

By the year 2000, half the world's people will be living in cities. The urbanization of society is part of the development process, and cities generate 60 per cent of gross national product.

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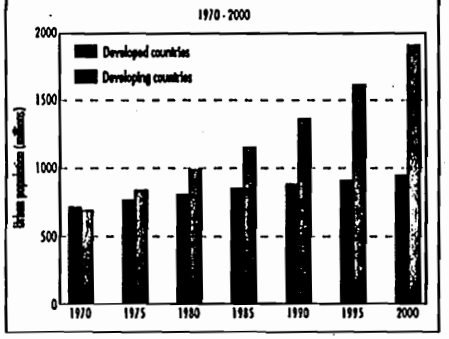
7.1 The growth of urban populations in developed and developing regions, 1970 - 2000



A growing number of cities, however, are showing symptoms of the global environment and development crisis, ranging from air pollution to homeless street dwellers. In most developing countries, a lack of clean water and sanitation leads to widespread ill-health and many preventable deaths each year.

To make urban life more sustainable, governments should see that the homeless poor and unemployed get access to land, credit and low-cost building materials. People also need security of tenure and legal protection against unfair eviction. Informal settlements and urban slums should be upgraded to ease the deficit in urban shelter. All urban areas need such services as clean water, sanitation and waste collection, and higher-income neighbourhoods should pay the full cost of providing such services.

Construction programmes should emphasize local materials, energy-efficient designs, materials that do not harm health and the environment, and labour-intensive technologies that employ more people.

Transportation uses about 30 per cent of the world's commercial energy production and consumes about 60 per cent of the world's petroleum production. Exhaust gases pollute urban air with ground-level ozone, particulate matter, carbon monoxide and other gases, all of which harm health. National action programmes are needed to promote energy-saving and renewable energy technologies, such as solar, hydro, wind and biomass. Transportation strategies should reduce the need for the motor vehicles by favouring high-occupancy public transport, and providing safe bicycle and foot paths. Municipalities need to be developed in ways that reduce the need for long-distance commuting.

Countries need to reduce urban poverty by supporting the informal economic sector, which operates many small businesses. Governments need to develop urban renewal projects in partnership with non-governmental organizations.

To reduce migration to the big cities, governments should improve rural living conditions and encourage the development of medium-sized cities that create employment and

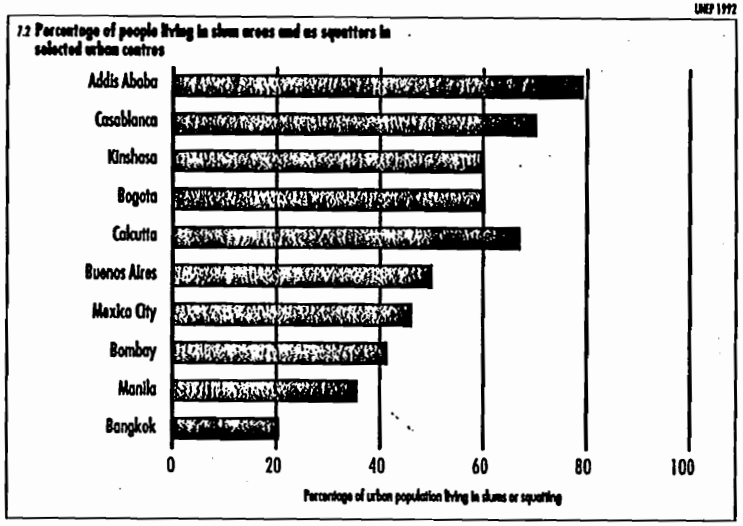
housing. Sound management is needed to prevent urban sprawl onto agricultural land and environmentally fragile regions.

It also important to see that settlements are built in locations and using designs and materials that reduce the risk of damage from such natural disasters as storms, flooding, earthquakes and landslides.

Developing countries need financial and technical assistance to help train experts in such fields as urban planning, waste reduction, water quality, sanitation, energy efficiency and clean, efficient transportation.

UNEP 1992

7.2 Percentage of people living in slum areas and as squatters in selected urban centres



By the year 2000, half the world's people will be living in cities.

8

Making Decisions for Sustainable Development

The way most people make decisions, whether in government, business or as individuals, separates economic, social and environmental factors.

It is necessary to understand the links between environment and development in order to make development choices that will be economically efficient, socially equitable and responsible, and environmentally sound.

Some governments have begun to consider systematically the environmental impacts of economic, social, fiscal, energy, agricultural, transportation, trade and other policies. More groups are participating in development decisions through discussions among national and local governments, industry, science, environmental groups and the public.

Governments should create sustainable development strategies to integrate social and environmental policies in all ministries and at all levels, including fiscal measures and the budget.

The strategies should aim for socially responsible economic development while protecting the resource base and the environment for the benefit of future generations. The strategies should be developed through the widest possible participation.

Moving decision-makers from narrow sectoral approaches towards integrating environmental issues into sustainable development policy-making will require changes in information-gathering, management techniques and planning.

To make informed decisions, people need regular sustainable development progress reports that integrate economic and social conditions and trends with information on the state of the environment and natural resources. National accounting systems should measure the crucial role of the environment as a source of natural capital, and as a sink for our waste by-products.

Much environment and development law-making seems to be ad hoc and piecemeal, or lacks enforcement and updating. Governments need to foster the evolution of sustainable development law, based on sound economic, social and environmental principles and appropriate risk assessment, and backed up by enforcement.

Prices, markets and governmental fiscal and economic policies also shape attitudes and behaviour towards the environment. There is a tendency to treat the environment as a "free good", and to pass the costs of environmental damage to other parts of society, other countries, or future generations. Environmental costs need to be clearly visible to producers and consumers, and prices should reflect the relative scarcity and total value of resources. These changes are needed in such fields as energy, transportation, agriculture, forestry, water, wastes, health and tourism.

Governments should remove or reduce subsidies that do not meet sustainable development objectives, and move towards pricing policies consistent with these goals.

Advice and technical support in using markets to make development more sustainable should be provided to countries whose economies are developing or are in transition to market systems.

9

Protecting the Atmosphere

Our atmosphere is under increasing pressure from greenhouse gases that threaten to change the climate and from chemicals that reduce the ozone layer. Other pollutants, including those that cause acid rain, often travel long distances through the atmosphere to cause damage on land and water. In many parts of the world, these harmful subtances often cross national borders before they land.

Energy use is a major source of emissions. The use of energy is essential to economic and social development and improved quality of life. Much of the world's energy, however, is produced and consumed in ways that cannot be sustained if overall quantities increase substantially. Controlling emissions will depend on greater efficiency in energy production, transmission, distribution and consumption, and on creating environmentally sound energy systems.

At the same time, there is a need for equity and enough energy to meet increasing consumption in developing countries. Consideration is also needed for countries that are highly dependent on the export or consumption of fossil fuels, or use a lot of energy in their industries. Some countries do not have easy alternatives to fossil fuels.

Governments need to:

- Develop more precise ways of predicting levels of atmospheric pollutants and greenhouse gas concentrations that would cause dangerous interference with the climate system and the environment as a whole.
- Modernize existing power systems to gain energy efficiency, and develop new and renewable energy sources, such as solar, wind, hydro, biomass, geothermal, ocean, animal and human power.
- Help people learn how to develop and use more efficient and less-polluting forms of energy.
- Coordinate regional energy plans so that environmentally sound forms of energy can be produced and distributed efficiently.
- Promote environmental assessment and other ways of making decisions that integrate energy, environment and economic policies in a sustainable manner.
- Develop energy efficiency labelling programmes for consumers.

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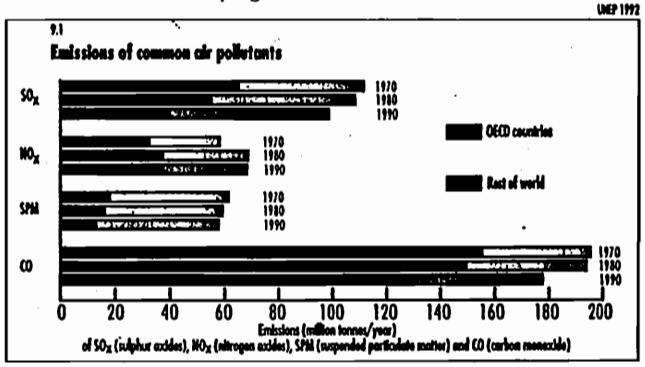


Transportation is essential for economic and social development, and the need will undoubtedly increase, but this activity is also a source of atmospheric emissions.

Governments should:

- Promote national energy efficiency and emission standards, and increase public awareness of environmentally sound energy systems.
- Develop efficient, cost-effective, less polluting and safer rural and urban mass transport, along with environmentally sound road networks.
- Encourage forms of transportation that minimize emissions and harmful effects on the environment.
- Plan urban and regional settlements to reduce the environmental impacts of transport.

Industry provides goods, services and jobs, but the industrial use of resources and materials causes atmospheric emissions. Industry needs to make more efficient use of materials and resources, instal pollution controls, replace chlorofluorocarbons (CFCs) and other ozone-depleting substances with safer substitutes, and reduce wastes. There are environmental and economic benefits from increasing efficiency and waste reduction.

Governments should:

- Use administrative and economic measures that encourage industry to develop safer, cleaner and more efficient technologies.
- Help transfer such technologies to developing countries.
- Use environmental impact assessments to foster sustainable industrial development.

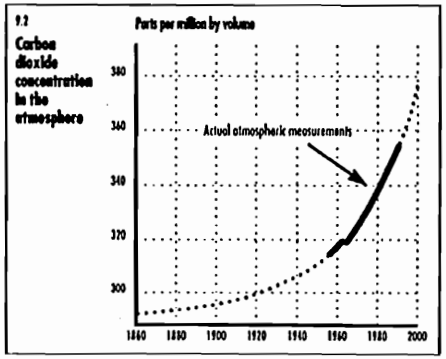
Certain uses of the land and seas can decrease the amount of plant material available to take carbon dioxide, a greenhouse gas, out of the air. Governments should promote the sustainable management and conservation of natural greenhouse gas sinks and reservoirs, including forests and salt-water ecosystems.

The planet's stratospheric ozone layer continues to decline because of releases of CFCs, halons and other substances containing reactive chlorine and bromine. Governments should put into force international agreements calling for reductions in the use of ozone-depleting substances. It is necessary to develop safe substitutes for these chemicals, and to see that they are made available to developing as well as developed countries.

Based on research on the effects of more ultraviolet radiation reaching the Earth's surface, governments should consider measures to protect human health, agriculture and life in the seas.

Governments should create or strengthen regional agreements, such as the 1979 Convention on Long-range Transboundary Air Pollution, in order to reduce flows of pollutants that harm human health and forests, and acidify lakes and rivers. Countries should also have early-warning systems and responses for air pollution coming from industrial accidents, natural disasters or the destruction of natural resources.

Our atmosphere is under increasing pressure...



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10

Managing Land Sustainably

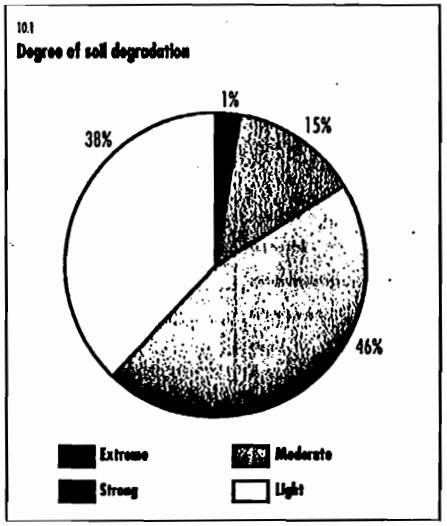
Increasing human demand for land and its natural resources is creating competition and conflicts. If we are going to meet human requirements in a sustainable manner, we must resolve these conflicts, and find more effective and efficient ways of using land and its natural resources.

The objective is to see that land is used in ways that provide the greatest sustainable benefits. The way to minimize conflicts and make the most efficient trade-offs and appropriate choices is to link social and economic development with environmental protection and enhancement. We also have to account for protected areas, private property rights, and the rights of indigenous people and other local communities.

As land-use choices arise, there are opportunities to support traditional patterns of sustainable land management, and to protect lands to conserve biological diversity and other ecological benefits.

Governments should take into account environmental, social, population and economic issues, then develop laws, regulations and economic incentives to encourage sustainable use and management of land resources. They should:

- Develop policies that take into account the land-resource base, population changes and the interests of local people.
- Improve and enforce laws and regulations to support the sustainable use of land, and restrict the transfer of productive arable land to other uses.
- Use techniques such as landscape ecological planning that focus on an ecosystem or a watershed, and encourage sustainable livelihoods.
- Include appropriate traditional and indigenous land-use practices, such as pastoralism, traditional land reserves and terraced agriculture in land management.
- Encourage the active participation in decision-making of those affected groups that have often been excluded, such as women, youth, indigenous people and other local communities.



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- Test ways of putting the value of land and ecosystems into national reports on economic performance, such as the gross national product (GNP).
- Ensure that institutions that deal with land and natural resources integrate environmental, social and economic issues into their planning.

The following are target dates:

- Develop policies for sustainable land management, and make it easier for all people affected by land planning to participate in decisions by 1996.
- Improve ways of coordinating land planning by 1998.
- Have stronger land planning and management systems by 2000.

Increasing human demand for land and its natural resources is creating competition and conflicts.

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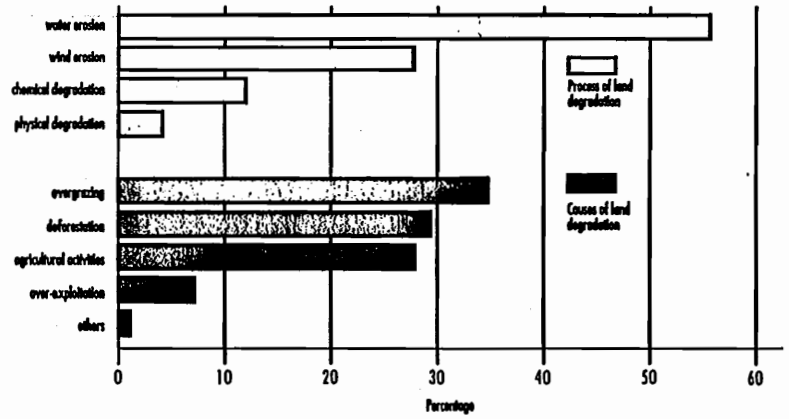
10.2
Processes and causes of land degradation



11

Combating Deforestation

Forests are a source of timber, firewood and other goods. They also play an important role in soil and water conservation, maintaining a healthy atmosphere and maintaining biological diversity of plants and animals.

Forests are renewable and, when managed in a way that is compatible with environmental conservation, can produce goods and services to assist in development.

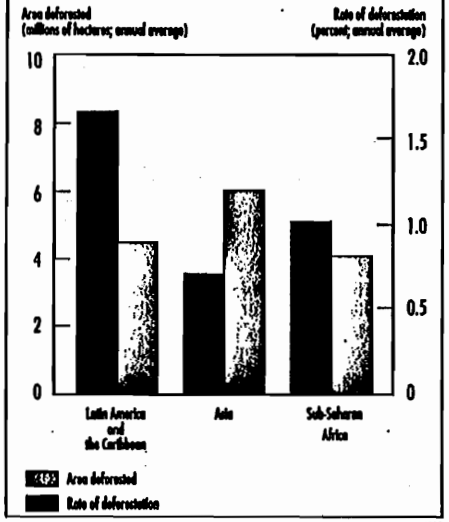
Now, forests world-wide are threatened by uncontrolled degradation and conversion to other uses because of increasing human pressure. There is agricultural expansion, overgrazing, unsustainable logging, inadequate fire control and damage from air pollution. Damage to and loss of forests causes soil erosion, reduces biological diversity and wildlife habitats, degrades watersheds and reduces the amount of fuel-wood, timber and other products available for human development. It also reduces the number of trees that can retain carbon dioxide, a greenhouse gas.

The survival of the forests depends on our recognizing and protecting their ecological, climate-control, social and economic values. These benefits should be included in the national economic accounting systems used to weigh development options.

There is an urgent need to conserve and plant forests in developed and developing countries to maintain or restore the ecological balance, and to provide for human needs. National governments need to work with business, non-governmental organizations, scientists, technologists, local community groups, indigenous people, local governments and the public to create long-term forest conservation and management policies for every forest region and watershed.

Better management will also require more information on the state of forests. In many cases, planners lack even basic information on the size and type of forests, and on the amount of wood being harvested.

11.1
Loss of tropical forests in developing regions, 1980-90



WORLD BANK 1992

Governments should create national action programmes for sustainable forestry development. This will require a broad range of actions, ranging from the use of satellite images of the forests through better logging equipment to government policies that encourage the most efficient use of the trees and other forest products.

Governments, along with business, non-governmental and other groups can:

- Plant more forests to reduce pressure on primary and old-growth forests. Plant valuable crops among the trees to further increase the value of managed forests.
- Breed trees that are more productive and resistant to environmental stress.
- Protect forests from fires, pests, poaching and mining and reduce pollutants that affect forests, including air pollution that flows across borders.
- Limit and aim to halt destructive shifting cultivation by addressing the underlying social and ecological causes.
- Use environmentally sound, more efficient and less polluting methods of forest harvesting and expand forest-based processing industries that use wood and other forest products.
- Minimize wood waste and find uses for tree species that are now discarded or ignored.
- Promote small-scale forest-based enterprises that support rural development and local entrepreneurship.
- Increase the amount of value-added secondary processing of forest products to increase the amount of employment and revenue for each tree harvested.
- Develop urban forestry for the greening of all places where people live.
- Promote the use of such forest products as medicinal plants, dyes, fibres, gums, resins, fodder, rattan, bamboo and works of local artisans.
- Encourage low-impact forest use, such as eco-tourism and the managed supply of genetic materials, such as those used to develop medicines.
- Reduce damage to forests by promoting sustainable management of areas adjacent to the trees.

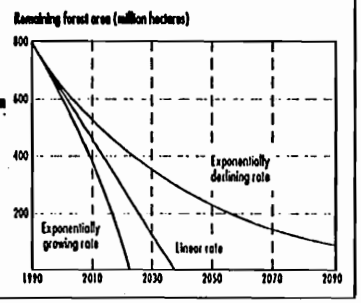
In order to get more value from their forests, some countries will need international cooperation in the form of advice on modern technologies, and the use of fair terms of trade, without unilateral restrictions and bans on forest products.

In addition to encouraging sustainable use of forests, countries need to create or expand protected area systems to preserve some forests. Such forests are needed to preserve ecological systems, biological diversity, landscapes and wildlife habitat. Forests also need to be preserved for their social and spiritual values, including that of traditional habitats of indigenous people, forest dwellers and local communities.

☛ *For more information on forests, please see the Statement of Principles on Forests.*

Governments should create national action programmes for sustainable forestry development.

11.2
Some possible paths of tropical deforestation



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12

Combating Desertification and Drought

Desertification is the process of land degradation caused by variations in climate and by human impact. It particularly affects drylands that are already ecologically fragile.

The most obvious impacts of desertification are the degradation of grazing lands, and a decline in food production. The results of drought and desertification include poverty and starvation. An estimated 3 million people died in the mid-1980s because of drought in sub-Saharan Africa.

The problem is very large. Seventy per cent of all the world's drylands — 3.6 billion hectares — are already affected by degradation. This is one-quarter of the world's land — an area three times larger than Europe. Degradation, particularly salination caused by inadequate drainage, affects large tracts of irrigated cropland.

The results of drought and desertification include poverty and starvation.

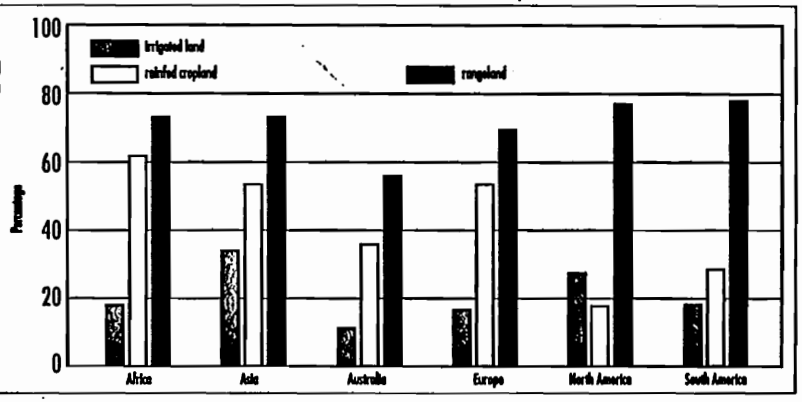
To stop desertification from spreading, land use, including farming and grazing, must be made environmentally sound, socially acceptable, fair and economically feasible.

One of the major tools to fight the spread of deserts is the planting of trees and other plants that retain water and maintain soil quality. Plantations can be harvested for such products as fuel, timber, fodder and food.

To combat desertification, governments should:

- Adopt national sustainable land-use plans and sustainable management of water resources.

12.1
Percentage of drylands affected by desertification



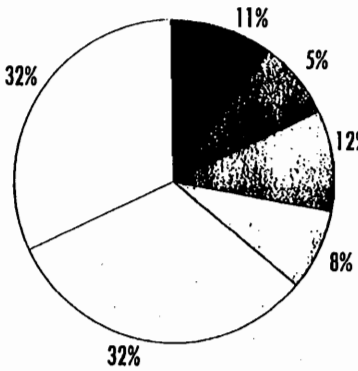
UNEP 1992

- Accelerate planting programmes, using fast-growing, drought-resistant local trees and other plants.
- Help to reduce the demand for fuel wood through energy efficiency and alternative energy programmes.

In areas prone to desertification and drought, traditional farming and grazing lifestyles are often inadequate and unsustainable, particularly in the face of increasing populations. Rural dwellers should be trained in soil and water conservation, water harvesting, agroforestry and small-scale irrigation. National anti-desertification programmes are needed to raise public awareness of measures needed to combat the problem.

In areas prone to desertification and drought, traditional farming and grazing lifestyles are often inadequate and unsustainable.

122
World arid lands, by continent



Total arid lands: 6.1 billion hectares

UNEP 1992

Poverty is a major factor in accelerating the rate of degradation and desertification. To reduce pressure on the fragile lands, it is necessary to rehabilitate degraded lands, and provide alternative livelihoods for people. Rural banking and credit systems should be set up to help people establish small businesses that use local resources.

In addition, it is necessary to establish an international drought emergency-response system equipped with food, health care, shelter, transport and finances.

It is necessary to strengthen such programmes as Earthwatch and the Sahara and Sahel Observatory, as well as national and regional weather and water monitoring networks. Their information will help governments to develop land-use plans, and will provide early warning of droughts, so that people can prepare in time.

An international convention to combat desertification, particularly in Africa, should be prepared by June 1994.

National anti-desertification programmes are needed.

13

Sustainable Mountain Development

Mountains are important sources of water, energy, minerals, forest and agricultural products and areas of recreation. They are storehouses of biological diversity, home to endangered species and an essential part of the global ecosystem.

The fate of mountain ecosystems affects half the world's people. About 10 per cent of the Earth's population lives in mountain areas, while about 40 per cent occupies watershed areas below. From the Andes to the Himalayas, and from Southeast Asia to East and Central Africa, there is serious ecological deterioration in these watersheds. Causes include deforestation, excessive livestock grazing and cultivation of marginal soils.

Mountain ecosystems are susceptible to soil erosion, landslides and the rapid loss of habitat and genetic diversity. Among mountain dwellers, there is widespread unemployment, poverty, poor health and bad sanitation. Most mountain areas are experiencing environmental degradation.

The proper management of mountain resources and the socio-economic development of the people need immediate action. There is a need to develop land-use planning and management for mountain-fed watersheds by the year 2000. It should aim at preventing soil erosion, increasing the amount of tree and plant life, and maintaining the ecological balance in mountains.

There is also a need to provide services, such as education, health care and energy for local communities and indigenous people. The people also need more opportunities to earn livelihoods from such activities as sustainable tourism, fisheries, environmentally sound mining and cottage industries, such as the processing of medicinal and aromatic plants.

Governments should:

- Promote erosion-control measures that are low-cost, simple and easily used.
- Offer people incentives to conserve resources and use environment-friendly technologies, help them to understand what kind of development is environmentally sustainable in mountains and involve them in resource management.
- Produce information on alternative livelihoods involving, for example, crops, livestock, poultry, beekeeping, fisheries, village industries, markets and transport.
- Create protected areas to save wild genetic material.
- Identify hazardous areas that are most vulnerable to erosion, floods, landslides, earthquakes, snow avalanches and other natural hazards and develop early-warning systems and disaster-response teams.
- Identify mountain areas threatened by air pollution from neighbouring industrial and urban areas.
- Create centres of information on mountain ecosystems, including expertise on sustainable agriculture and conservation practices where people can turn for help in learning about sustainable mountain development.

The fate of mountain ecosystems affects half the world's people.

14

Sustainable Agriculture and Rural Development

Hunger is already a constant threat to many people, and the world's long-term ability to meet the growing demand for food and other agricultural products is uncertain.

The global population was 5.5 billion in 1993 and is expected to reach 8.5 billion by 2025, when 83 per cent of the world will be living in developing countries. One of the world's great challenges is to increase food production in a sustainable manner so that a rapidly growing global population can be fed.

The productivity of huge food-producing areas is declining, even as the demand for food, fibre and fuel is growing. Soil erosion, salination, waterlogging and loss of soil fertility are increasing in all countries. Increased ultraviolet radiation resulting from thinning of the stratospheric ozone layer may also reduce food production.

Agriculture has to meet the rising needs mainly by increasing productivity, because most of the world's best food lands are already in use. At the same time, further encroachment on land that is only marginally suitable for cultivation must be avoided.

Sustainable agriculture and rural development will require major adjustments in agricultural, environmental and economic policies in all countries, and at the international level. This requires cooperation involving rural people, national governments, the private sector and the international community.

The world's long-term ability to meet the growing demand for food and other agricultural products is uncertain.

Techniques for increasing production, reducing food spoilage and loss to pests and for conserving soil and water resources are already available but are not widely or systematically applied. By the turn of the century, governments should have sound food policies, based on an awareness of the environmental costs and benefits of various policy choices.

Sustainable land-use policies should encourage planning on a scale large enough to maintain the health of regional ecosystems, such as watersheds. People should be encouraged to invest in the future of the land by giving them ownership and providing access to resources, financing and means to market their produce at fair prices.

People need advice and training in the use of technologies and farming systems that conserve and rehabilitate land, while increasing production. These include conservation tillage, crop rotation, use of plant nutrients (including organic fertilizers), agroforestry, terracing and mixed cropping. Both modern and indigenous conservation techniques should be used.

The productivity of huge food-producing areas is declining.

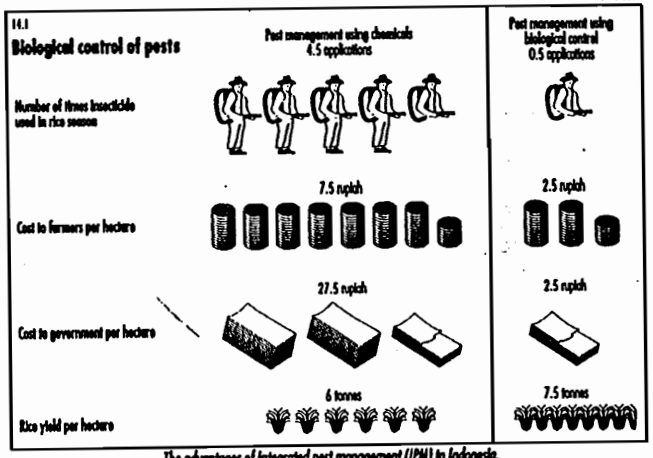
More energy will have to be used to increase food production. This should involve a cost-effective mix of fossil and renewable energy sources, including fuels from wood and plants.

Better use of the world's great variety of plant and animal genetic resources is essential to diversify and increase food production and improve the quality of draught animals. There is a steady loss of invaluable plant and animal species, and efforts to promote genetic diversity are underfunded and understaffed. The benefits of research and development in plant breeding and seed production should be shared equitably between sources and users of the material.

The amount of food lost to pests has been estimated at 25 per cent of harvests. Chemical control of food pests has been dominant, but its over-use is costly and has adverse effects on human health and the environment. The best option is integrated pest management, which combines biological controls, host-plant resistance and appropriate farming practices, to minimize pesticide use. This technique guarantees food production, reduces costs and is environmentally less harmful.

To keep poor rural populations from using marginal lands, off-farm work such as cottage industries, wildlife utilization, fisheries, village-based light industries and tourism should be developed.

UNEP 1992



The advantages of integrated pest management (IPM) to Indonesia.
Farmers switched from chemicals to encouraging natural predators of the pest destroying their rice crops.

15

Conservation of Biological Diversity

The essential goods and services on our planet depend on the variety and variability of genes, species, populations and ecosystems.

Biological resources feed and clothe us, and provide housing, medicines and spiritual nourishment. Those resources are found in natural ecosystems of forests, savannahs, pastures and rangelands, deserts, tundras, rivers, lakes and seas. They are also in farm fields, gardens, gene banks, botanical gardens and zoos.

The loss of the world's biological diversity continues, mainly from habitat destruction, over-harvesting, pollution and the inappropriate introduction of foreign plants and animals. This decline in biodiversity is largely caused by humans, and represents a serious threat to our development.

Urgent and decisive action is needed to conserve and maintain genes, species and ecosystems. Recent advances in biotechnology show that genetic material in plants, animals and microorganisms has potential for agriculture, health and welfare of people and for environmental protection.

Governments, with the cooperation of the United Nations, non-governmental organizations, the private sector and financial institutions, should:

- Conduct national assessments on the state of biodiversity.
- Develop national strategies to conserve and sustainably use biological diversity and make these part of overall national development strategies.
- Conduct long-term research into the importance of biodiversity for ecosystems that produce goods and environmental benefits.
- Encourage traditional methods of agriculture, agroforestry, forestry, range and wildlife management which use, maintain or increase biodiversity. Involve communities, including women, in conserving and managing ecosystems.
- Implement fair and equitable sharing of benefits from the use of biological and genetic resources between the sources and users of these resources. Indigenous people and their communities should share in the economic and commercial benefits.

15.1

The socio-economic benefits of biodiversity

- About 4.5 per cent of GDP in the United States (some $87 billion per year) is attributable to the harvest of wild species.
- In Asia, by the mid-1970s, genetic improvements had increased wheat production by $2 billion and rice production by $1.5 billion a year by incorporating dwarfism into both crops.
- A 'useless' wild wheat plant from Turkey was used to give disease resistance to commercial wheat varieties worth $50 million annually to the United States alone.
- One gene from a single Ethiopian barley plant now protects California's $160 million annual barely crop from yellow dwarf virus.
- An ancient wild relative of corn from Mexico can be crossed with modern corn varieties with potential savings to farmers estimated at $4.4 billion annually worldwide.
- Worldwide, medicines from wild products are worth some $40 billion a year.
- In 1960, a child suffering from leukoemia had only one chance in five of survival. Now the child has four chances in five, due to treatment with drugs containing active substances discovered in the rosy periwinkle, a tropical forest plant originating in Madagascar.

UNEP 1992

- Protect natural habitats. Areas can be further protected by promoting environmentally sound development around them.
- Promote the rehabilitation of damaged ecosystems, and the recovery of threatened and endangered species.
- Develop sustainable uses of biotechnology, and ways of safely and equitably transferring it, particularly to developing countries.

Governments, business and development agencies need to learn more about how to evaluate the impact of development projects on biological diversity, and how to calculate the costs of losing this diversity. Projects likely to have significant impacts should undergo environmental impact assessments involving the wide public participation.

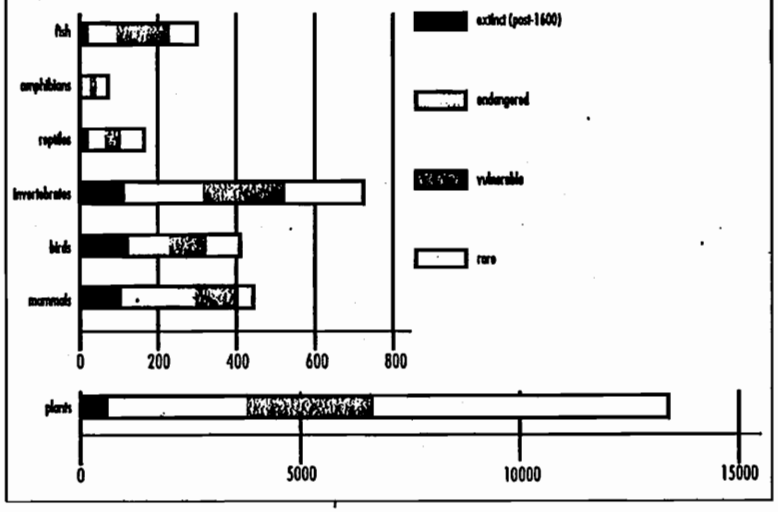
☛ *For more information on this issue, please see the section on the Convention on Biological Diversity.*

Biological resources feed and clothe us, and provide housing, medicines and spiritual nourishment.

UNEP 1992

15.2

Number of extinct and threatened species



16

Management of Biotechnology

Biotechnology uses traditional knowledge and modern technology to change the genetic material in plants, animals and microbes and create new products.

It promises to make a significant contribution to better health, increased food production, better reforestation, more efficient industrial processes, decontamination of water and the cleanup of hazardous wastes.

Most of the developments in modern biotechnology have been in the industrialized world. Biotechnology offers new opportunities for global partnerships between these countries – rich in technological expertise – and developing countries, which are rich in biological resources but lacking in funds and expertise to use them.

Governments, working with international and non-governmental organizations, the private sector and academic and scientific institutions, should improve both plant and animal breeding through the use of traditional and modern biotechnologies. Indigenous peoples have much to contribute and should share in the economic and commercial benefits arising from biotechnology. Care must be taken that new techniques do not damage environmental integrity or pose threats to health. People need to be aware of both the benefits and the risks of biotechnology. There is a need for internationally agreed principles on risk assessment and management of all aspects of biotechnology.

Biotechnology needs to be developed to:

- Improve productivity and the nutritional quality and shelf-life of food and animal feed products.
- Develop vaccines and techniques for preventing the spread of diseases and toxins.
- Increase crop resistance to diseases and pests, so that there will be less need for chemical pesticides.
- Develop safe and effective methods for the biological control of disease-transmitting insects, especially those resistant to chemical pesticides.
- Contribute to soil fertility and increase the efficiency with which plants use soil nutrients, so that agriculture does not drain nutrients from the ground.
- Provide renewable energy sources and raw materials from organic waste and plant material.
- Treat sewage, organic chemical wastes and oil spills more cheaply and effectively than conventional methods.
- Develop currently under-utilized crops for food and industrial raw materials.
- Develop more productive strains of fast-growing trees, especially for fuel wood.
- Tap mineral resources in ways that cause less environmental damage.

The success of biotechnology programmes depends on highly trained scientific professionals. There is a need to reduce the "brain drain" from developing countries by creating training programmes in advanced technology, geared to meet regional or national needs. The programmes would benefit from funding to allow collaboration between researchers in different countries.

17

Protecting and Managing the Oceans

The oceans, including enclosed and semi-enclosed seas, are an essential part of the global life-support system. They cover much of Earth's surface, influence climate, weather and the state of the atmosphere and provide food and other resources for our growing world population.

The Law of the Sea provides an international basis for the protection and sustainable use of the seas. However, oceans are under increasing environmental stress from pollution, over-fishing and degradation of coastlines and coral reefs.

About 70 per cent of marine pollution comes from sources on land, including towns and cities, industry, construction, agriculture, forestry and tourism.

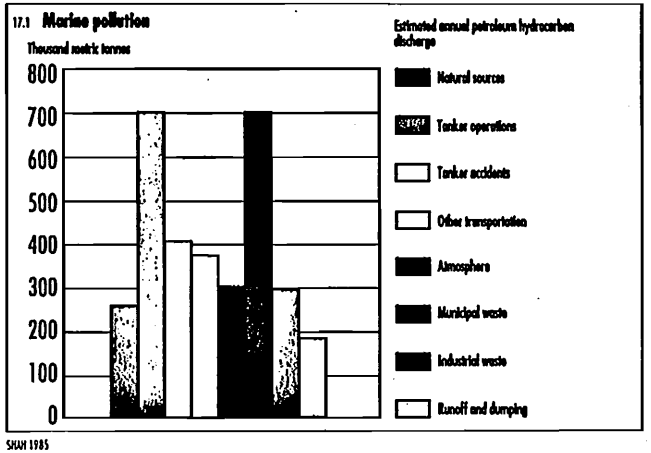
The contaminants that pose the greatest threat to the marine environment are sewage, chemicals, sediments, litter and plastics, metals, radioactive wastes and oil. Some of these materials are toxic, slow to break down in the environment and accumulate in living creatures. There is currently no global scheme to address marine pollution from land-based sources.

Pollution also comes from shipping and dumping at sea. About 600,000 tons of oil enter the oceans each year as a result of normal shipping operations, accidents and illegal discharges.

Nations commit themselves to control and reduce degradation of the marine environment so as to maintain and improve its life-support and productive capacities. It is necessary to:

- Anticipate and prevent further degradation of the marine environment and reduce the risk of long-term or irreversible effects on the oceans.
- Ensure prior assessment of activities that may have significant adverse impact on the seas.
- Make marine environmental protection part of general environmental, social and economic development policies.
- Apply the "polluter pays" principle, and use economic incentives to reduce pollution of the seas.

17.1 **Marine pollution**



SOAR 1985

- Improve the living standards of coast-dwellers, particularly in developing countries, so people can help to protect the coastal and marine environment.

Nations need to build and maintain sewage-treatment systems, and avoid discharging sewage near shell fisheries, water intakes and bathing areas. Industrial discharges also need to be controlled and properly treated.

Countries should change sewage- and waste-management, agricultural practices, mining, construction and transportation to control the run-off of pollutants from diffuse sources.

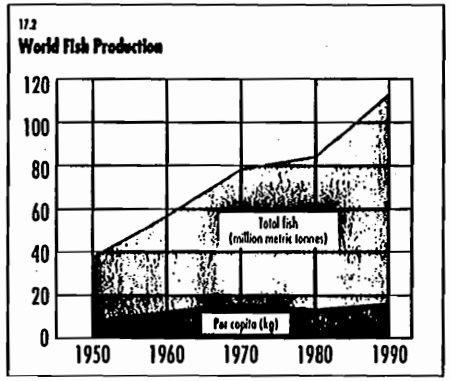
Countries should consider:

- Reducing or eliminating discharges of synthetic chemicals that threaten to accumulate to dangerous levels in marine life.
- Controlling and reducing toxic-waste discharges, and setting up safe land-based waste-disposal systems instead of dumping at sea.
- Stricter international regulations to reduce the risk of accidents and pollution from cargo ships.
- Controlling discharges of nitrogen and phosphorous that threaten to disrupt the marine environment by fertilizing excessive plant growth.
- Developing land-use practices that reduce run-off of soil and wastes to rivers, and thus to the seas.
- Using environmentally less harmful pesticides and fertilizers, and prohibiting those that are environmentally unsound. Using alternative methods for pest control.
- Stopping ocean dumping and the incineration of hazardous wastes at sea. Ports, marinas and fishing harbours should collect oil and chemical wastes and garbage. Pollution from ships should be controlled by stronger regulations.

Parts of the marine environment, such as coral reefs, mangroves and estuaries, are among the most highly diverse and productive of Earth's ecosystems. They protect coastlines and contribute to food, energy, tourism and economic development. In many parts of the world, these ecosystems are under stress or are threatened. Nations need to protect these ecosystems by such methods as controlling and preventing coastal erosion and silting, due to land uses such as construction.

Marine fisheries yield 80 to 90 million tons of fish and shellfish per year, 95 per cent of which is taken from waters under national jurisdiction. Fish landings have increased nearly fivefold over the past 40 years.

SMH 1990



There are increases in over-fishing, unauthorized incursions by foreign fleets, ecosystem degradation and in inappropriate equipment that catches too many fish. There is inadequate knowledge of the state of fish stocks, and too little cooperation among nations to prevent over-fishing on the high seas. Countries need to deal with highly migratory fish stocks and those which swim across the boundaries of national economic zones, particularly into the high seas.

About 70% of marine pollution comes from sources on land.

Nations commit themselves to the conservation and sustainable use of marine life, including fish and marine mammals, which include whales, dolphins, porpoises and seals.

Nations should:

- Set policies for sustainable use of the seas, accounting for the needs of local communities and indigenous people.
- Develop more aquaculture, in which fish are raised in pens in the sea.
- Negotiate international agreements to manage and conserve fish.
- Strengthen surveillance and enforcement of fisheries regulations.
- Reduce wastage in the catching, handling and processing of fish, and minimize the catches of species that are often discarded.
- Assess the environmental impact of major new fishery practices, and use environmentally sound fishing technologies.
- Prohibit dynamiting, poisoning and comparable destructive fishing practices.
- Protect certain areas, including coral reefs, estuaries, mangroves and wetlands, seagrass beds and other marine spawning and nursery areas.
- Deter the reflagging of vessels as a way of avoiding compliance with fishery conservation rules.
- Control the use of large-scale drift-net fishing on the high seas.

Global warming caused by climate change is likely to cause sea levels to rise, and even a small increase could cause significant damage to small islands and low-lying coasts. Precautionary measures should be undertaken to diminish the risks and effects, particularly on small islands and low-lying and coastal areas. Already, more than half the world's population lives within 60 kilometres of the seashore, and this could rise to three quarters by the year 2020.

Small-island developing states are particularly vulnerable, and some could be totally lost to a rise in sea levels. Most tropical islands are now experiencing the more immediate impact of the increasing frequency of cyclones, storms and hurricanes associated with climate change. They need assistance to prepare contingency plans for sea-level rise.

Tropical islands are home to many unique species of plant and animal life, and they have rich and diverse indigenous cultures with knowledge of the sound management of island resources. Development options for such nations are limited by their small size and they need to:

- Investigate their carrying capacity — the level of use their ecosystems can support over the long term.
- Prepare sustainable development plans that emphasize multiple use of resources, integrate environmental and economic planning, maintain cultural and biological diversity, and conserve endangered species and critical marine habitats.
- Review and modify existing unsustainable policies and practices, and identify technologies that should be excluded because they threaten essential island ecosystems.

Other countries and international organizations should assist small-island developing nations to plan and implement sustainable development.

Marine fisheries yield 80 to 90 million tonnes of fish and shellfish per year.

18

Protecting and Managing Fresh Water

Fresh water is vital for drinking, sanitation, agriculture, industry, urban development, hydro-power generation, inland fisheries, transportation, recreation and many other human activities. It is also critical for the healthy functioning of nature.

In many parts of the world, there is widespread scarcity, gradual destruction and increased pollution of fresh-water resources. The causes include inadequately treated sewage and industrial waste, loss of natural water catchment areas, deforestation and poor agricultural practices, which release pesticides and other chemicals into the water. Dams, river diversions and irrigation schemes also affect water quality and quantity. All these practices harm aquatic ecosystems, and threaten living fresh-water resources.

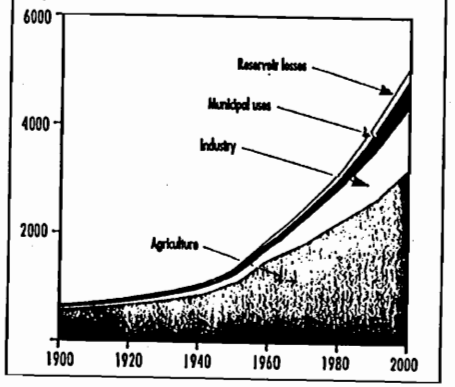
Food supplies for the world's growing population are highly dependent upon water, but irrigation systems have suffered from waterlogging and salt build-up, which reduce the land's ability to grow food.

Many of these problems are the result of a development model that is environmentally destructive, and a lack of public awareness and education about the need and the ways to protect water resources.. There is widespread failure to understand the linkages between various forms of development and their impact on water resources.

In the developing world, one person in three lacks safe drinking water and sanitation — basic requirements for health and dignity. In these nations, an estimated 80 per cent of all diseases and over one-third of deaths are caused by consumption of contaminated water.

18.1

Estimated annual world water use, total and by sector, 1900-2000



WORLDWATCH 1993

Although there are uncertainties about global climate change, a temperature increase and a decrease in rain and snowfall would further strain the already fragile balance between water supplies and demand in some parts of the world. In other areas, increased precipitation might lead to floods. If the warming causes sea levels to rise, this could cause salt-water intrusion into estuaries and coastal aquifers and flood low-lying areas, particularly low islands. The Ministerial Declaration of the Second World Climate Conference states that "the potential impact of

such climate change could pose an environmental threat of an up to now unknown magnitude ... and could even threaten survival in some small island states, and in low-lying coastal, arid and semi-arid areas".

Faced with such an array of threats, ways must be found of supplying everyone on the planet with an adequate supply of good quality water. To do this, human activities must be adapted to fit within the limits of nature, so that the healthy functioning of ecosystems can be preserved. The way to provide all people with basic water and sanitation is to adopt the approach "some for all, rather than more for some". A realistic strategy to meet present and future water needs is to develop low-cost but adequate services that can be installed and maintained at the community level.

Better water management will require innovative technologies, including the improvement of indigenous technologies, to make full use of limited water resources and to safeguard the water from pollution. It will require that water management be integrated into national economic and social policies, including planning of land use, utilization of forest resources and the protection of mountain slopes and river banks.

The management of water resources should be delegated to the lowest appropriate level. It should include full public participation, including that of women, youth, indigenous people and local communities in water management and decision-making.

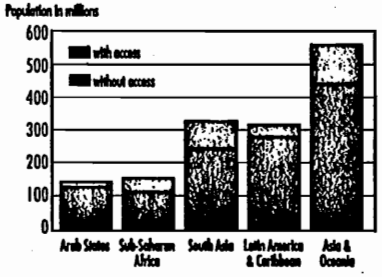
A realistic target date for universal water supplies is 2025. This can be achieved by developing low-cost services that can be built and maintained at the community level.

An interim set of goals for the year 2000 is:

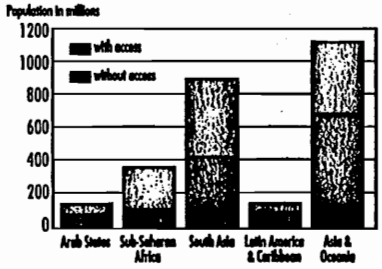
- To provide all urban residents with at least 40 litres of safe drinking water per person per day.
- To provide 75 per cent of urban dwellers with sanitation.
- To have in force standards for the discharge of municipal and industrial wastes.

18.2

Urban population: Access to safe water



Rural population: Access to safe water



SHAH 1991

- To have three-quarters of solid urban waste collected and recycled, or disposed of in an environmentally safe way.
- To ensure that rural people everywhere have access to safe water and sanitation for healthy lives, while maintaining essential local environments.

- To control water-associated diseases generally, and to set targets, such as the eradication of dracunculiasis (guinea-worm disease) and onchocerciasis (river blindness) by the year 2000.

Various approaches are needed to provide adequate water supplies and sanitation:

- There is a need for more research into the amount and quality of water that will be available for growing populations and economic needs. This comes at a time when water research lacks adequate funding and qualified experts.
- Water management must recognize the need to protect the integrity of aquatic ecosystems, and to prevent their degradation on a drainage-basin basis. Water protection should include the precautionary approach, with the aim of minimizing and preventing pollution.
- Nations need to identify and protect water resources and see that water is used on a sustainable basis. They need effective water pollution prevention and control programmes. There is a particular need for appropriate sanitation and waste-disposal technologies for low-income, high-density cities.
- There should be mandatory assessment of the environmental impact of all major water-resource development projects that have the potential to impair water quality and aquatic ecosystems.
- Alternative sources of fresh water must be developed. These include de-salting sea water, catching rain water - particularly on small islands, re-using waste-water and recycling water. Such projects must use low-cost water technologies that are available and affordable to developing countries.
- In developing and using water resources, priority has to be given to satisfying basic human needs and to safeguarding ecosystems. Beyond these requirements, water users should be charged appropriately.
- A prerequisite for the sustainable management of water as a scarce and vulnerable resource is the obligation to acknowledge its full cost during the planning and development of all projects.
- Nations need to protect the forest cover of watersheds, and minimize the impacts of agricultural pollutants on water.
- Fresh-water fisheries need to be managed to yield the greatest amount of food in an environmentally sound manner. Care must be taken that fishing and fish-farming do not damage the aquatic ecosystem.
- Livestock need adequate water supplies, and water quality has to be protected from contamination by animal wastes.
- New irrigation projects that may have significant environmental impacts should undergo environmental assessment while in the planning stage.

...some for all, rather than more for some.

In the developing world, one person in three lacks safe drinking water and sanitation...

The world needs more well-trained people to assess and develop fresh-water supplies and to manage water projects for sustainable use. Poor countries, in particular, need access to technologies that will allow them to assess their own water resources.

19

Safer Use of Toxic Chemicals

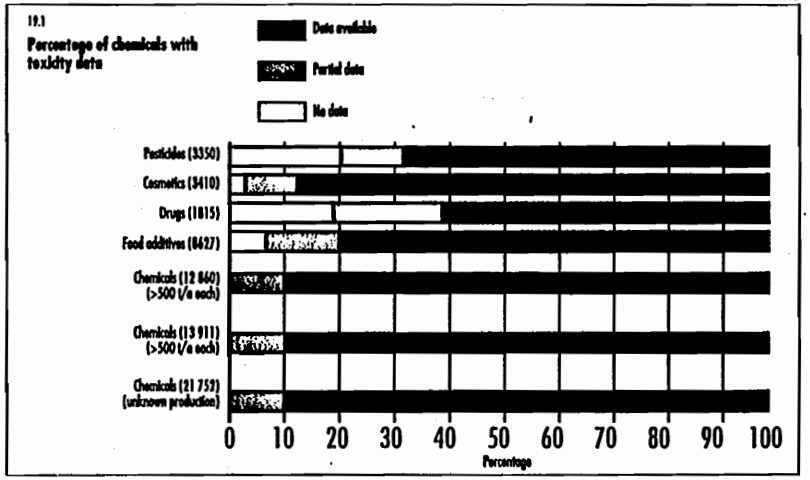
Chemicals are used throughout the world and are necessary to meet social and economic goals, but a better job must be made of reducing their health and environmental impacts.

Some of the world's major industrial areas are so contaminated by chemicals that there is damage to human health, genetic structures and reproduction. In addition, long-range pollution is affecting the Earth's atmosphere and climate. The illegal traffic in toxic and dangerous products and wastes involves chemicals banned in one country as hazardous being shipped to other countries, often developing nations.

There are about 100,000 commercial chemicals, although only 1,500 of them account for 95 per cent of world production. However, crucial data needed to assess the health and environmental risks of a great number of these high-volume chemicals are lacking.

Chemicals can be used in a cost-effective manner and with a high degree of safety, but most countries, particularly developing nations, lack the ability to manage chemicals safely. Countries need to develop and share expertise in assessing chemical risks.

UNEP 1992



Background Reading (Module 2)
Global and Cross-Sectoral Issues in Environmental Review
(excerpted sections from World Bank, 1991)

The following background reading has been adapted from the World Bank's Environmental Assessment Sourcebook (World Bank, 1991), Chapter 2: "Global and Cross-Sectoral Issues in Environmental Review". It provides some background on the following key cross-sectoral and global issues:

Atmospheric Pollution
International Waterways
Biological Diversity
Wildlands
Wetlands
Arid and Semi-Arid Lands
Coastal Zone Management
Land and Water Resource Management
Environmental Issues in Land Resource Management
Land Clearing
Environmental Issues in Water Resource Management
Natural Hazards

This reading provides some useful guidelines for identifying projects that might have significant impacts, and in some cases suggests mitigation steps that can be followed. More complete information can be found in the World Bank EA Sourcebook itself; additional information related to Bank procedures, environmental assessments, and mitigation issues were excluded in the interest of conciseness.

Atmospheric Pollution

Atmospheric pollution refers to a variety of physical and chemical alterations of the atmosphere, including natural alterations such as volcanic emissions of particulate matter, and anthropogenic (manmade) alterations such as climate warming (the "greenhouse effect"), ozone depletion, acid rain, and the release of airborne toxic pollutants. This section will discuss two phenomena of global significance, climate warming and ozone depletion, together referred to as global change. It will also consider acid rain, which can have significant transboundary impacts.

The greenhouse effect is a natural component of the earth's climate by which certain atmospheric gases (known as greenhouse gases) absorb some of the radiant heat which the earth emits after receiving solar energy. This phenomenon is essential to life on earth as we know it, since without it the earth would be approximately 30 degrees centigrade cooler. However, certain anthropogenic activities have the potential to amplify the greenhouse effect by emitting greenhouse gases (primarily carbon dioxide, methane, nitrous oxide, chlorofluorocarbons and halons, and tropospheric ozone) to the atmosphere and causing their concentrations to increase. The result is an increase in mean global temperatures, i.e., climate warming.

Ozone (O3) is a gas that occurs at low concentrations throughout the earth's atmosphere, although most resides in the upper atmosphere, or stratosphere (from about 10 to 50 kilometers above the earth's surface), where it acts as a protective shield, preventing harmful ultraviolet radiation from reaching the earth's surface. Ozone is constantly formed and destroyed in the stratosphere, forming a balance between O3, O2, and O. However, reactive chlorine and bromine species, originating primarily from the use of chlorofluorocarbons (CFCs) and halons, promote the destruction of ozone and upset this balance. It is the chemical stability of CFCs and halons, and consequently their extremely long atmospheric lifetimes of up to a century and longer, that allows them to reach the stratosphere. Once in the stratosphere, ultraviolet radiation causes the release of chlorine and bromine atoms, which act as catalysts in the destruction of ozone. Through this process, CFCs and halons contribute to general ozone depletion, as well as to localized seasonal ozone

holes over Antarctica and perhaps also in the Arctic.

The **anthropogenic activities** that contribute to climate warming and ozone depletion are an integral part of human life and economic development. Anthropogenic increases in concentrations of carbon dioxide (CO_2), which are responsible for about half of the climate forcing that occurred during the 1980s, result primarily from the combustion of fossil fuels (coal, oil, and natural gas) and tropical deforestation. Cement production produces a minor amount of CO_2. Anthropogenic methane (CH_4) emissions, responsible for about 15 percent of the climate forcing in the 1980s, result from agricultural activities (anaerobic decomposition of organic material in flooded rice fields and in the guts of domestic animals, burning of lands for pasture and crop management, and burning of agricultural wastes such as rice straw), fossil fuel production (coalbed methane release during mining, and venting and leakage of natural gas during production and transmission), and anaerobic decomposition in landfills. Anthropogenic nitrous oxide (N_2O) emissions, responsible for about 5 percent of the climate forcing in the 1980s, result primarily from agricultural activities (use of nitrogen fertilizers, land clearing, and biomass burning). A small, uncertain portion of the N_2O emissions arise from fossil fuel combustion. Tropospheric ozone, responsible for a small and highly uncertain portion of the climate forcing of the 1980s, is not emitted directly by human activity. However, its concentration is strongly governed by trace gas emissions resulting from industrial activity and transportation.

CFCs and halons are manmade chemicals, responsible for about 17 percent of the present climate forcing, and believed to the main cause of the ozone depletion observed to date. CFCs are used as aerosol propellants, refrigerants, electronics solvents, and in foam blowing and chemical production; halons are used for fire extinguishers. Two other long-lived, manmade chemicals, carbon tetrachloride, which is used in chemical production, as a solvent, and as a grain fumigant, and methyl chloroform, used in industrial degreasing, cold cleaning, and as a solvent, are additional important greenhouse gases as well as ozone depleters.

Anthropogenic emissions of greenhouse gases over the last century have already committed the earth to a warming of 1-2 degrees centigrade. An effective doubling of CO_2 (an increase in the atmospheric concentrations of all the greenhouse gases that in total is equivalent to a doubling of the pre-industrial concentration of CO_2), expected to occur around the middle of the next century, is predicted to result in warming of 1.5-4.5 degrees centigrade. For comparison, between the last glacial maximum (about 18,000 years ago) and today, average global temperature has risen about 5 degrees centigrade. Even over the last 700,000 years, the maximum global temperature swing was no greater than 5 degrees centigrade.

It is not only the magnitude of the potential warming that is alarming, it is also the **rate of expected climate change**. Natural eco- systems that could possibly migrate or adapt in a less rapidly changing world, may not be able to adjust quickly enough to survive. Potential impacts include loss of forests, wetlands, and other ecosystems, and the decline and possible extinction of many species. Managed systems may be more resilient, although impacts are still likely to be large, particularly in countries that are least equipped to adapt. Changes in temperature and precipitation will affect agricultural and water management practices. Sea level rise will cause coastal flooding and salt water intrusion into bays and coastal aquifers to increase, and will destroy valuable wetlands. The frequency of extreme weather events (e.g., heatwaves, hurricanes) is likely to increase, affecting human health and property, and natural and managed ecosystems. Higher temperatures may exacerbate air pollution, especially smog.

The **Antarctic ozone "hole"** was first recognized in the late 1970s, and its connection to the use of CFCs and halons was established about a decade later. Significant declines in ozone in the Southern Hemisphere mid-latitudes and more modest declines in the northern mid-latitudes observed in the 1980s, as well as the decrease in the global contration of ozone of a few percent between 1969 and 1986, are also believed to be due primarily to the use of CFCs and halons.

Continued **stratospheric ozone depletion** and the resultant increase in penetration of biologically-damaging ultraviolet radiation to the earth's surface will have harmful effects on human health and the environment. Solar ultraviolet radiation induces skin cancer, cataracts, suppression of the human immune response system, and indirectly (through immunosuppression) the development of some cutaneous infections,

such as herpes. Natural and managed ecosystems are likely to be affected through three mechanisms: (a) general damage to biological functions in plants resulting in stunted growth and lowered competitive capacity, (b) specific damage to DNA with similar effects, and (c) specific damage to germ cells resulting in increased mutation rates. Agricultural yields are likely to decrease and be of poorer quality, although plant breeding and genetic engineering may produce ultraviolet resistant crops. Nonmanaged ecosystems, however, may not fare so well; less resistant species will be more vulnerable and ecological balance may thus be threatened. Ozone depletion is also likely to cause accelerated degradation of plastics and paints used outdoors, and to exacerbate urban smog.

Because the gases responsible for climate warming and ozone depletion have very long lifetimes once they are introduced into the atmosphere, **delays in reducing emissions** produce a relatively longer commitment to global change, as amplified in Table 2.1. Although the magnitude of the effects are uncertain, they are potentially severe and possibly irreversible. Taking prompt action seems wise, in light of the risks associated with delay, as well as the fact that many commonly proposed actions make economic, social, and environmental sense on their own, such as:

- more efficient use of fossil fuel energy and development of alternative, renewable energy sources;
- reducing the rate of deforestation and increasing reforestation (e.g., carbon sink forests);
- collection and use (as an energy source) of coalbed methane and methane generated from anaerobic systems (landfills, animal wastes, etc.);
- more efficient agricultural practices (more efficient fertilizer use, sustainable rather than shifting agriculture); and . development and use of less damaging replacements for CFCs and halons.

Acid rain results from the presence of abnormally high atmospheric concentrations of substances that form acids in reaction with water -- principally sulfur dioxide (SO2) and, to a lesser extent, nitrogen oxides (NOx). These oxides are formed in nature (in volcanic gases and sea spray, for instance), but in highly industrialized or urbanized areas, man-made sources emit quantities which exceed natural amounts. Coal- and oil-fired generating plants are the largest sources of SO2, followed by use of high-sulfur coal and oil in industry and home heating. Energy generation and internal combustion engines are the largest sources of NOx. Data show that precipitation in wide areas of both Europe and North America is abnormally acidic.

Available evidence does not permit a complete assessment of the extent of **damage caused by acid rain** worldwide. However, poorlybuffered lakes and streams are susceptible to the changes in pH acid rain can cause, and food chains have been shown to be affected in North America and northern Europe. Certain tree species are also sensitive to acid rain, and forests have been affected on both of those continents. Stone buildings and monuments, among them many properties of historic and cultural importance, deteriorate faster where precipitation is acidic. In the cases of Canada, Germany, Yugoslavia and the Scandinavian countries, major sources of the SO2 that forms the acid rain are located in other countries.

Numerous development activities, such as the following, may influence climate change and ozone depletion:

- energy projects involving increased production, transportation, and consumption of fossil fuels;
- forestry projects involving clear-felling or intensive logging,
- construction of access roads and establishment of forest products industries which induce development and further forest clearing;
- agriculture projects involving conversion of forests to pasture or crops, cultivation of paddy rice, livestock management, use of nitrogen fertilizers, burning of savanna and other lands for pasture management, burning of agricultural wastes; and
- industrial development projects involving the use of CFCs, halons, and related manmade chemicals; and construction of landfills.

Activities that may **decelerate the threat** of global change are:

- energy projects involving increased fossil energy efficiencyand conservation, the development of alternative energy sources (e.g., biomass, solar, wind, hydroelectric, and cogeneration), collection and use of coalbed methane as an energy source, improved natural gas transmission systems to

reduce leakage;

- industrial development projects involving the use of substitutes for CFCs, halons, and related manmade chemicals; collection of methane from landfills and other waste streams and use as an energy source;
- forestry projects involving sustainable fuelwood use and agro-forestry development, forest conservation and reforestation/ afforestation;
- agriculture projects involving the development of sustainable systems, restoration of degraded lands and accumulation of soil carbon, and improved efficiency of livestock management and fertilizer use; and
- development of effective environmental regulations and agencies.

International Waterways

Projects involving international waterways ... are those corresponding to the following descriptions:

(a) Types of international waterways:

(i) river, canal, lake or any similar body of water which forms a boundary between, or any river or body of surface water which flows through two or more states, whether members of the Bank or not;

(ii) any tributary or any other body of surface water which is a part or component of any waterway described in (i) above; and

(iii) bays, gulfs, straits, or channels -- bounded by two or more states or, if within one state, recognized as necessary channels of communication between the open sea and other states -- and any river flowing into such waters.

(b) Types of projects:

(i) hydroelectric, irrigation, flood control, navigation, drainage, water and sewerage, industrial, orsimilar projects which involve the use or pollution of international waterways as described above; and

(ii) detailed design and engineering studies of projects under (b)(i) above, including those to be carried out by the Bank as executing agency.

Waterways have always been important to countries, for trade and defense and as a commodity to be used, and likely will become more so as awareness of the interconnectedness of global resources (as reflected in such terms as "global commons") and as concern for global pollution and potential global threats (such as depletion of the ozone layer and global warming or forcing) grow.

Biological Diversity

Biological diversity, or **biodiversity**, refers to the variety of the world's biological resources -- its living organisms. It is a function not simply of the number of ecosystems and distinct plant and animal species in existence at any given time, but also of genetic differences within individual species. This great diversity of the world's plant and animal species has intrinsic value, simply for existing. Further, biological diversity is more than a concept; it is a precious natural resource -- a resource essential to human existence and commerce.

All **principal food crops** of today were derived from wild species, and the existence of genetic variability in the form of wild relatives of domestic crops is the source for continued improvement in yield and resistance to disease or stressful changes in environmental conditions. Many industries depend on plants and animals for tannin, resins, dyes, oils and other raw materials. A large number of modern drugs originate from wild species of fungi, bacteria, higher plants and animals. Many crops are pollinated by naturally occurring events. Wild species help prevent pest outbreaks. With only a small fraction of existing species inventoried (perhaps as few as five percent), the diversity of biological resources promises numerous

discoveries of useful products as yet unidentified.

No less important are the **intangible, cultural values** of biodiversity. Wild plant and animal species are sources of recreation and aesthetic pleasure to many people. They are deeply embedded in folklore and our shared heritage; they inspire works of art and expressions in languages and figure prominently in religions.

Biological diversity is also the characteristic of wild species and natural ecosystems that allows them to **withstand external stress**. Genetic variability within a species is the basis for its developing resistance to a disease or a change in climate which would otherwise cause its extinction. Species diversity affords stability to ecosystems; while a particular pollutant may destroy or drive away some of the species at one level in a food chain, others which are more resistant may remain to reproduce in greater numbers and sustain the organisms which depend on them.

Conservation of biological diversity is therefore a form of natural resource management which has as its primary goal maintaining the long-term potential of world biological resources to meet the needs and aspirations of future generations -- a fundamental principle of sustainable development. Natural resource management practices which seek only to maximize short-term productivity, and even some practices which maximize long-term productivity of specific resources, often have the opposite effect. Thus we are witnessing the **loss of biological diversity at an alarming rate**, due largely to the demands of growing populations on biological resources and habitats -- and the losses are irreversible. Some scientists believe 15 to 20 percent of the estimated 10 to 30 million species of plants and animals extant in 1980 may become extinct by the year 2000 if present trends continue. They estimate that extinctions are occurring 1,000 to 10,000 times more rapidly today than during the millions of years before human intervention become a significant force. These statistics illustrate the urgent need for sound management of natural resources (and especially for conservation of biological diversity) in the work of development agencies worldwide.

Examples of development activities which may have the most significant negative consequences for biological diversity are:

- agriculture and livestock projects involving land clearing, wetlands elimination, inundation for irrigation storage reservoirs, displacement of wildlife by fences or domestic livestock, heavy use of pesticides, introduction of cash crop monoculture into settings previously dependent on a large suite of local crops for subsistence agriculture;
- fisheries projects involving conversion of important natural breeding or nursery sites for aquaculture or mariculture, overfishing, introduction of exotic species in natural aquatic eco-systems;
- forestry projects involving construction of access roads, in- tensive logging, establishment of forest products industries which induce other development near the project site;
- transportation projects involving construction of highways, bridges, roads, railways, or canals, all of which may facili- tate access to and spontaneous settlements in natural areas;
- channelization of rivers;
- dredge and fill activities in coastal or inland wetlands;
- hydropower projects involving large water diversion, inunda- tion or other major transformation of aquatic or terrestrial natural areas, leading to habitat reduction or modification with resultant forced movement of fauna into new areas and likely violation of carrying capacity there;
- irrigation and other water supply projects that may remove water, drain wetland habitats or eliminate essential watering sources;
- industrial projects involving air, water, or soil pollution;
- large-scale loss of habitats due to mining and mineral exploration; and
- conversion of biological resources for industrial fuels or feedstocks.

Ideally, any implications for biological diversity will be among the major issues identified during the **screening** of proposed projects. During environmental reconnaissance conducted as part of an early preparation mission, the significance of the issues can be determined and any additional concerns identified. The resulting information is useful both for integrating biological diversity into project planning and design

and for establishing the scope of an environmental assessment or other environmental study which may be conducted in conjunction with project preparation. A **simple checklist** to assist in early identification of biological diversity issues is provided here.

(a) Identify the specific types of ecosystem the proposed project will affect (e.g., tropical forest, salt marsh, wet savanna, etc.). Are any of them wildlands of special concern or designated natural sites of national or international importance?
(b) What are important biological features of the ecosystems (e.g., habitat for endangered species, or only breeding and nesting area for a particular species)?
(c) Determine the general nature of the project's impact on ecosystems (e.g., deforestation, flooding, draining, changing hydrologic regime, facilitating human access, vehicle traffic and noise).
(d) Assess the significance of likely negative impacts relative to:
total area of ecosystem type in region and/or country (e.g., project will destroy approximately 10 percent of nation's remaining lowland swamp forest); and
cumulative effects and trends for ecosystem type (e.g., tidal wetlands area is being lost in the country at an annual rate of three percent a year; this project and two other harbor facilities projects planned for the coastal zone will involve a total of 6 percent of the remaining area).

In making a rapid assessment of habitats and species composition of plant and animal communities, the following are important information sources:

- publications on natural areas of special concern or international importance;
- national compilations of flora and fauna;
- stock assessments and timber, fish or other biological surveys providing census data and trends in species and populations;
- national or regional programs monitoring the status of or trends in biological resources; and
- local and regional research institutions and NGOs.

The technical aspects of mitigation plans for projects which may have adverse impacts on biological diversity include actions such as:

- establishing wildlands management areas or other protected habitats in the project's area of influence;
- establishing equivalent conservation units elsewhere in the region to offset unavoidable loss of habitat in the project area;
- designing buffer zones, wildlife corridors, and other features to maximize the benefits of the wildlife management areas or minimize impacts of the project on wildlife;
- restoring damaged habitats;
- creating new habitat, such as wetlands, artificial reefs, bird nesting sites; and
- maintaining rare or endangered species in special facilities, such as zoos, botanical gardens, seed storage.

Wildlands

Wildlands are natural land and water areas that have been modified by human activities only slightly or not at all. Any relatively undisturbed natural ecosystem may be a wildland; forests, grasslands, inland bodies of water, inland and coastal wetlands, and marine areas such as coral reefs are all examples.

Wildlands merit **special attention in environmental assessments.** They are valuable because (a) they constitute habitats for indigenous plant and animal species (and thus contribute to maintaining biological diversity); (b) they perform important environmental services for society at little or no direct cost; and (c) they are in some cases essential to the livelihood of indigenous peoples. Wildlands are vulnerable to the pressures of population growth, landlessness, and economic development and have been rapidly disappearing in many countries, developing and developed alike.

Wildlands of special concern are those recognized as exceptionally important in preserving biological

diversity or performing environmental services. Some of these have been **officially designated** by national governments, sometimes in collaboration with international agencies such as the United Nations (e.g., World Heritage Natural Sites). Others are as yet unprotected but recognized nationally or internationally as biologically unique, ecologically fragile, or of special importance for local people or environmental services.

Wildlands are potentially **linked to virtually every sector** ... either as resources which may be damaged or eliminated as a direct or indirect impact of a project, or as resources on which the success of the project in part depends.

- Agriculture and livestock projects may result in the displacement of wildlife and the elimination of wildlands.
- Aquaculture projects sometimes lead to loss of natural breeding and nursery grounds and disturbance of ecosystems by introduction of exotic species; many natural fisheries, however, are dependent on headwater and wetland nursery areas and may be adversely affected if these are not protected.
- Forestry projects may include logging of wildland areas and can facilitate uncontrolled access to them via logging roads.
- A variety of transportation projects, including roads, railways, canals, river dredging, and port development, also make wildland areas more accessible, induce development, and may directly eliminate wildlands.
- Shipping channel maintenance becomes more costly when a watershed has a high rate of soil erosion, which may be caused by the elimination of natural vegetation.
- Dams may inundate wildland areas but may also benefit from them for control of siltation, protection of reservoir water quality and maintenance of a balanced hydrologic cycle.
- Industrial development can affect wildlands adversely (through thermal pollution from cooling water discharges, for example, or chemical pollution of aquatic and terrestrial wildlands via water or air).

Environmental impacts on wildlands are often **intersectoral**. For instance, wetlands and headwaters are vulnerable to industrial or municipal wastewater discharges, agricultural runoff, siltation from forestry operations, or dredging and filling for transportation projects or shoreline development. If these wildland areas are not protected, fishery productivity and revenue can be diminished. Where the wildlands in question are tourist attractions, loss or damage can reduce tourism revenues as well.

There are also linkages to **regional or global environmental conditions**. Wildlands can be breeding, resting or wintering sites for fish or bird species which migrate long distances to other ecosystems. Large tracts of forest can have a moderating effect on regional climate, and destruction of them may also contribute to global warming.

The processes of analyzing project alternatives and predicting environmental impacts of the proposed project include consideration of potential effects on wildlands, and the environmental assessment report should present the results explicitly. **Measuring impacts** is a task for specialists in the types of ecosystems involved. It includes but is not limited to the following concepts:

- area lost, in absolute terms and as a proportion of the total area of the ecosystem type in the region or country;
- area altered, in the same terms, and the nature of the alteration;
- extent of change in resources critical to the wildland, e.g., water quality, freshwater flow, tidal flushing, ambient air quality, nutrient cycles;
- extent and duration of external disturbances (e.g., noise, smoke, dust and fumes during construction or operation; vehicle or ship traffic; visitors to previously undisturbed site; interference with animal migration or daily movement);
- extent of habitat loss or modification and the likely effects on numbers and diversity of plant and animal species;
- changes in plant and animal productivity, including economic value when possible (e.g., annual fishery revenue);
- losses in environmental service levels (e.g., waste assimilation, erosion control, and groundwater

recharge); replacement costs of the lost services);

- numbers of indigenous peoples affected and the nature of the impact;
- change in numbers of visitors, and associated revenues, if the wildland is an important tourist site;
- changes in other social benefits and services (e.g., recreation, aesthetic enjoyment, conservation education, medical research);
- indirect impacts of loss of wildland (e.g., increased pressures on remaining wildland areas, need for more frequent channel dredging); and
- indirect impacts of improved access to wildlands, such as increased tourist revenues, recreational benefits, poaching, disturbance of wildlife, illegal conversion to other land uses, and illegal harvesting.

...Often mitigation measures and management techniques, of which examples are listed below, will overlap or coincide.... Measures to be considered are:

- alternative project siting or routing to avoid wildlands;
- establishment of WMA's to provide for protection or some form of controlled use of wildlands (see Annex I of OPN 11.02 for categories of WMA) either in project area or elsewhere (as compensation for converted wildlands);
- including wildland-sensitive features in project design, such as fish ladders, wildlife passages or crossings, noise barriers;
- establishing buffer zones around wildlands;
- rehabilitating or creating ecosystems to offset wildland conversions or add to existing stock;
- supporting research programs relevant to wildlands management and preservation of biological diversity;
- strengthening wildland management institutions, both government and nongovernment, with staff, equipment, training, and support of enforcement activities; and
- establishing environmental and conservation education programs at local schools.

Wetlands

The United Nations convention on Wetlands of International Importance (**Ramsar Convention**) defines wetlands as "areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters." Among the most important wetlands are: tidal and fresh water marshes, bogs, fens, herbaceous and wooded freshwater and peat swamps, mangroves, coastal lagoons, floodplains, deltas and estuaries. Wetlands are wildlands of particular importance both economically and environmentally. The most important roles which wetlands perform are:

- **Production of services.** Wetlands can contribute to local rainfall and can be an efficient, low cost water purification system (herbaceous swamps), a recreation area (hunting, fishing, boating), a buffer against floods, and protection from coastal erosion by storms (mangroves).
- **Preservation of biological diversity**. For many species of shrimp, fish, and waterfowl, tidal and fresh water marshes, coastal lagoons and estuaries are of vital importance as breeding grounds as well as staging areas in their migration routes. All types of wetlands may harbour unique plants and animals.
- **Production of goods**. Wetlands are among the most productive ecosystems in the world. Estuaries and tidal wetlands, in particular mangroves, are important nursery areas for most species of fish and shrimp which are later caught offshore. Shallow water areas are, in general, rich fishing grounds. Floodplains are important grazing areas for cattle and wildlife and vital spawning grounds for many fish species. Swamp forest may yield valuable timber.

Note that certain of the roles of wetlands are institutionally significant. For example, fishes do not recognize national boundaries or may migrate long distances. Consequently, destruction or degradation of wetlands in one country may have direct impacts on the biological resources of others. (See "International Waterways" section.)

Despite their importance, wetlands everywhere are under threat. These **threats** come from conversion to intensive agriculture and/or aquaculture, industrial development, artificial hydrological changes or degradation through over-exploitation.

The issue of wetland conservation is relevant to a large variety of ... projects, such as:

- projects which affect the hydrology of a wetland, such as construction of a road or high dam, flood control, lowering of the aquifer drainage, and irrigation and other water supply systems;
- direct conversion of wetlands for agriculture, port facilities, navigation projects, and aquaculture (in particular mangroves for shrimp culture);
- projects which indirectly influence wetlands through disturbance of the ecological conditions, such as those causing pollutants to flow into the wetlands, those posing the threat of introduction of exotic species (aquaculture), those introducing physical disturbance by people, and those contributing to acid rain or to rise in sea level; and
- watershed management on other projects conducted for environmental purposes.

In case a particular project is likely to impact a wetland, the following **questions** are usually relevant.

- Is the area on the Ramsar list?
- Will there be changes in the hydrology of the wetland?
- Will the project pollute or increase nutrients or physical disturbance in the wetland?
- Will (parts of) the wetland be converted or will there be a change in use?
- What is the socioeconomic value of the wetland as it is used at present? What would be the sustainable yield under better management? What is the replacement cost of the free goods and services now being produced by the wetlands if it were destroyed?
- What institutions exist which can or could manage or protect the wetlands and what are their capabilities and limitations? . Are local people willing and able to adapt their traditional exploitation systems to the eventual changes in the wetland caused by the project?

In conversion of wetlands for agriculture, the costs associated with the loss of opportunity to exploit the wetlands sustainably should be incorporated into the economic analysis. However, many wetlands contain poor acid soils, hardly suitable for agriculture. Drainage and exposure to air exacerbates acidity, especially in mangroves.

When a project has potential adverse impacts on wetlands, the design should be modified to avoid them, or to **mitigate or compensate** for those that are unavoidable. Options include any or all of the following:

- selections of alternative sites to avoid impact on wetland;
- design features to prevent disturbance of the flow patterns and hydrologic regimes critical to conservation of the wetland (e.g., flow regulating works, road crossings on trestles or pilings, rather than on embankments);
- enhancement and/or protection of other weltands in substandard conditions to offset losses at project site;
- artificial construction of wetlands to replace areas lost (where experience has shown that the wetland type in question can, in fact, be constructed);
- strengthening institutions to manage and protect wetlands;
- including local NGOs in the institutional arrangements for wetlands conservation;
- promoting development of national wetland incentives and management strategies;
- requiring wetland concerns to be considered in national and local planning and law use decision-making processes; and
- environmental education programs to disseminate knowledge on the importance of wetlands.

Arid and Semi-Arid Lands

Drylands of the world constitute a natural low-productivity environment, where the major limiting factor to biological production is normally water. When limiting factors are overcome -economically and

technically -- drylands can become moderately productive. However, under intensive production systems they require careful management as they are highly prone to soil salinization, alkalinization, waterlogging, and wind and water erosion. Insect pests also threaten to agricultural production (e.g., locusts,grasshoppers, aphids, etc.), especially where the project reduces the natural pest control value of the dry season.

The drylands of the developing world, including lands receiving a long-term annual average precipitation of 200-1000 mm, harbor some 550 million people, many of whom are among the poorest and most vulnerable groups.

Recent degradation and famines in drylands, together with frequent economic, physical and health problems in major irrigation schemes, have demonstrated the difficulties involved in developing suitable mechanisms and the need for concerted actions. Yet, drylands have remained remarkably resilient over generations, producing magnificent civilizations, as well as untold human misery.

The famines of the last few generations, in China, India and recently in Africa, have revealed the **fragility** of these ecologically marginal areas. While the media have focused on famines and the worst affected areas, little attention has been paid to the less marginal and potentially more productive environments. Recent evidence suggests that the impact on the environment of growing populations and their needs for food, energy and water may in the long run prove more acute in the more productive areas than in the driest ones.

Much uncertainty has developed among lending institutions and the donor community in general on how best to support drylands development. While some claim that investment in the drylands represents a low return, an unacceptable economic risk-taking, and a potential increase in debt-burden to borrowing dryland countries, others stress the need to avoid recent famines. It is important to consider the consequences of the economic (opportunity) costs of doing nothing.

Coastal Zone Management

There is no precise definition of "the coastal zone." All **definitions** seek to include coastal waters, marine and estuarine (and nearshore waters of large lakes and inland seas), and some portion of the land along the coast in which human activities and natural processes both affect and are affected by those in the waters. The extent of land area included varies, because its limits are determined not only by ecological and geological characteristics but also by some concept of what is politically and administratively manageable. Thus while one might include the entire land area of watersheds which drain to the sea, and the entire water area out to the continental shelf, in practice, the coastal zone is a relatively narrow band of water and land along a shoreline. Its natural features include beaches, wetlands, estuaries, lagoons, coral reefs, and dunes. Man-made features include ports, commercial fisheries and aquaculture operations, industries, recreational and tourist developments, archeological sites and, above all, some of the largest and most densely populated urban areas in the world.

The **economic significance** of the coastal zone is vast. Virtually all shellfish used by humans live and are harvested there. Most of the world's commercially important finfish depend on the coastal zone, and much of the commercial fishery takes place in it. Coastlines have been the obvious locations for seaports and for the siting of industrial and commercial operations which involve movement and processing of large volumes of raw materials or finished products. The land is attractive and valuable for residential use; in many areas of the developing world, population growth rates and urban population are highest along the coasts. Coastal areas have been used for recreation for centuries, but tourism is now big business, sometimes the largest sector of a country's economy. Less obvious, but also important economically, are services the natural features of the coastal zone perform, without cost: shoreline stabilization, protection from storms, fish nurture, flood control, nutrient cycling, and waste treatment.

It is a particular challenge to **manage development** in the coastal zone in a way which is environmentally sound and sustainable: coastal and marine areas are among the most sensitive to the impacts

of development and, as described above, especially attractive for it. Some of the activities associated with coastline development, such as extensive dredging and filling, intensive urbanization of watersheds, siting of industries, and conversion for agriculture or aquaculture are relatively irreversible transformations. Most economic development projects in coastal and marine areas have the potential to seriously affect the resources located in these environments and to present conflicts among competing resource uses. Consequently, EA alone is insufficient for coastal zone management. Special attention to regional planning is required, both to minimize or mitigate adverse impacts and promote optimal use of the resources available.

The following types of **projects** have potential impacts on coastal and marine areas:

- Agriculture: coastal and upland; large irrigation dams.
- Fisheries: coastal capture fisheries and mariculture/aquaculture, including conversion of marshes and mangroves.
- Forestry: mangrove forest products harvesting; fuelwood and other renewable resources; large-scale forestry in uplands.
- Energy: oil and gas exploration and operation; coastal power generation; large inland hydroelectric dams.
- Transportation: ports and harbors; channel construction and maintenance dredging; dredge spoil disposal; roads, railroads and bridges.
- Urbanization: shoreline modification; waste disposal; recreation and tourism; large-scale water resource development; urbanization of watersheds.
- Industry/commerce: industrial plant siting; coastal and marine mining (e.g., sand); salt manufacture; and waste disposal.

Land and Water Resource Management

Environmental Issues in Land Resource Management

Almost any development project will involve disturbance of the land surface. When the area involved is small, the environmental impact is likely to be minimal. However, the cumulative impacts of many separate small disturbances can be substantial. The kinds of alterations to the land that are of concern are listed below. Many of these topics are discussed elsewhere in the [World Bank] Sourcebook, as indicated by a cross reference in parentheses, and most are therefore discussed only in general in this section.

- clearing (Roads and Highways; Large-Scale Housing Projects)
- topsoil removal (see above)
- grading (see above)
- filling (Wetlands; Coastal Zone Management; Roads and Highways)
- draining (Wetlands)
- landscape planting (Large-Scale Housing Projects)
- cultivation (Agricultural Management; Forestry)
- paving (Roads and Highways; Large-Scale Housing Projects)
- building construction (Large-Scale Housing Projects)
- waste disposal (Solid Waste Collection and Disposal Systems;Wastewater Collection, Treatment, Reuse and Disposal Systems)

The direct and immediate environmental impacts of these alterations can be grouped into four categories.

Loss of Habitat: Any of the activities listed result in loss of habitat. The seriousness of the impact depends on the type of habitat being converted, as well as on the way in which the conversion is carried out. When wildlands, wetlands, tropical forests or other sensitive ecosystems are involved, the EA team should carefully assess the impacts, examine the alternatives that were considered, and perhaps propose new alternatives. (See the "Wildlands" section.)

Loss of Soil Productivity: Certain forest soils, when stripped of natural cover, become laterized or subject to rapid erosion, and essentially unproductive. Removal of topsoil during grading also reduces

productivity. Soil loss through erosion has the same effect, and in addition may degrade water resources. Conversion of high-quality agricultural land to urban uses also reduces productivity. Mitigation measures an EA might recommend include avoidance of construction on steep slopes, retention of forest cover, stockpiling and replacement of topsoil, conservation of prime agricultural land, application of good cultivation practices, and control of erosion and sedimentation through use of mulch during construction and rapid replacement of vegetative cover on slopes
and construction of siltation basins and barriers of straw or filter fabric to protect waterways.

Modified Hydrology: Clearing, grading, filling, paving or construction of buildings alter patterns of surface runoff and infiltration. The results include local ponding and flooding, increased flood frequency and/or magnitude downstream, lowered water table, diminished groundwater recharge, and increase in low flows in streams. Management measures include design and construction techniques to maintain or replace local drainage channels, retention or detention structures to avoid increases in rates of runoff, measures to offset reduced infiltration (porous pavement, infiltration ponds, etc.), and conservation of open space on critical aquifer recharge areas.

Soil Contamination: Soil can be contaminated through salinization if irrigationsystems are not properly designed and operated. It can also be contaminated by disposal of hazardous waste or improper operation of solid waste and land-base wastewater disposal systems.

Land Clearing

Land clearing for agriculture is discussed as a separate topic because of the environmental implications of the choice of land to be cleared and the method employed to clear it. In general, the impacts of clearing are more significant in tropical than temperate regions because the former experience higher temperatures which accelerate chemical degradation of soils and higher intensity of precipitation leading to more severe erosion.

There are three basic methods, and they are often used in combination on single project:

(a) Manual methods -- felling or cutting vegetation, allowing a drying period, and then burning the debris;

(b) Mechanical methods -- using heavy equipment (e.g., bull-dozers, heavy chains and tractors) to fell trees and cut and lay down underbrush, windrowing (raking debris into rows or piles), burning, and final clearing of the residue;

(c) Chemical methods -- using herbicides to establish areas for crops, either leaving dead trees standing, felled, or burned.

Mechanical methods have significant adverse impacts, including topsoil loss or inversion, destruction of soil structure, and compaction leading to increased runoff. Both mechanical and manual methods involve burning, which often reduces soil nutrient content and the activities of beneficial soil organisms as well as contributing to elevated atmospheric carbon dioxide concentrations. Chemical techniques have been shown to have less drastic effects on soil. However, the long-term effects of herbicide use in the tropics are not well understood.

Inappropriate **post-clearing management practices**, such as lack of manuring, failure to employ soil conservation practices, and repeated fires have often led to reduction in soil fertility to the point at which economic agricultural production cannot be sustained. Abandonment and weed infestation are the ultimate results.

Environmental Issues in Water Resource Management

Water resource management issues that may emerge in an EA are associated with water use or land use decisions that affect the quantity or quality of surface water or groundwater. Changes in quantity or quality may in turn affect the range of uses the particular water resource can support or alter the functions of a natural system dependent on the water.

The actions related to development projects which can alter water quality or quantity include: contamination of surface water by directly discharged effluents; contamination of surface water by non-point or diffuse pollutant sources; contamination of surface water by atmospheric pollutants; contamination of ground or surface water by wastes disposed of on or beneath the land; increase in runoff by clearing, grading, paving, drainage or channel modification; decrease in surface water flow by diversion, impoundment, consumptive use; and reduction in water table elevation or artesian flow by interference with groundwater recharge or excessive groundwater withdrawals.

Environmental Impacts of Increased Runoff: Increases in runoff, result from any activities which make theland surface less permeable, "smoother" or both. The rate of runoff, the total amount of runoff or both may be affected. The impacts include declining water tables, more frequent or more intense flooding, more prolonged or extreme dry-weather flows, and scouring or silting of channels. Changes in natural flow patterns can modify or eliminate wetlands and affect agriculture that depends on seasonal flooding for irrigation and maintenance of soil fertility. Where these impacts are predicted, structural and non-structural measures can be incorporated into projects to mitigate them.

Environmental Impacts of Reduced Surface Water Flow: When the overall flow of surface water is reduced significantly by impoundment, diversion, or consumptive use, downstream users and natural systems experience impacts. Two common causes of the flow reductions are growth in the watershed in excess of that which existing water resources can support or overcommitment of water resources from failure to take all uses and users into consideration in project planning. The immediate impacts may include: decline in water quality from diminished dilution of pollutants; seasonal or continuous shortfall in supply for downstream users; reduction in wetland area; and increases in salinity and changes in circulation in estuaries.

Each of these impacts can in turn have secondary impacts, such as decline in shellfish harvests, loss of revenue from water-dependent industry and commerce, or reduced hydroelectric power output. Mitigating measures are few, and most are expensive; relocating industries or importing water from other watersheds are examples. The sound approach is prevention through water resource planning and management on a watershed scale. The terms of reference for the EA on any project involving large-scale water consumption or diversion should require an analysis of existing, planned and projected water availability and use to avoid these impacts from the outset.

Environmental Impacts of Lowered Water Table or Reduction in Artesian Flow: The most obvious impact is the increased cost of drilling deeper wells and pumping water from greater depths. More disruptive is interruption of previously reliable water supply as a result of overpumping from nearby wells or cessation of artesian flow. When the aquifers affected are near the seacoast, saline water may intrude as fresh-water flow diminishes, making coastal wells unusable. Finally, a long-term impact which can occur over a large area and be virtually impossible to reverse is subsidence of the land surface caused by reduced water pressure in unconsolidated rock. Mitigation measures are again few and difficult. They involve replacing lost or salt-contaminated groundwater supplies with surface water. Attempts at reversing saline intrusion have met with only limited success. Subsidence may be arrested but is not realistically reversible by any artificial means.

Watershed Planning and Management: Water use and land use are interrelated. Decisions regarding water use in one part of a watershed are likely to pose opportunities and constraints for users in another part. These circumstances argue for integrated planning on a watershed basis, to ensure that the basin's water is not overcommitted, that upstream water users do not deprive those downstream of opportunities, that projects meet their intended purposes, and that patterns and amounts of growth are kept in balance with the capacity of the water resources. Tools and technical knowledge exist to accomplish such planning and management. The difficulties are institutional. Water resources do not respect political boundaries and there is thus a need for an institution with sufficient capacity and power to influence land and water use decisions in mulitiple jurisdictions. This frequently entails a corresponding willingness on the part of those jurisdictions to subordinate their authority to the watershed institution. In projects which depend on watershedwide planning and management, EA teams should carefully analyze the institutional structure, the needs for strengthening it, and whether it is politically realistic to anticipate success in the effort.

Natural Hazards

Major areas of the world are subject to risks from **natural hazards**. Earthquakes, volcanic eruptions, droughts, floods and hurricanes hinder development through their direct, indirect and cumulative impacts. There is a two-way, direct relationship between environmental deterioration and natural hazards; that is, soil erosion, deforestation, desertification, and coastal degradation increase the risks of extreme events, and in turn, natural hazards exacerbate environmental degradation. Furthermore, the potential for human and economic losses in an area is directly related to its vulnerability to natural hazards.

The resilience and sustainability of development may be significantly improved by **reducing disaster vulnerability**. Reducing losses from natural hazards can be brought about through appropriate and sound planning strategies and management. Disaster-resilient planning and management must be based on a sound understanding of natural hazard risk and such understanding must be incorporated into social and economic planning. In addition, scenarios concerning climate change indicate a potential for sea level rise, increased severe droughts, shifting in agricultural zones and more frequent hurricanes which underline the need for efficient mitigation and preparedness.

Appendix D

Appendix D: References

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THE CONCEPT OF ENVIRONMENTAL SUSTAINABILITY[1]

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KEY WORDS: economic sustainability, development, economic development, natural capital, growth, limits of growth

ABSTRACT

This paper reviews the current status of the debate about the concept of environmental sustainability and discusses related aspects of growth, limits, scale, and substitutability. While the paths leading to environmental sustainability in each country or sector will differ, the goal remains constant. But this conceptualization is far from an academic exercise. Ensuring, within less than two human generations, that as many as 10 billions people are decently fed and housed without damaging the environment on which we all depend represents a monumental challenge.

INTRODUCTION

As soon as Prime Minister Gro Harlem Brundtland and her United Nations commission (105), in a brilliant feat, garnered almost worldwide political consensus on the urgent need for sustainability, many countries and institutions started to grapple with the same problem: Precisely what is sustainability, and, specifically, what does it mean for this particular sector, nation, or region? This paper outlines the concept of sustainability, then focuses on environmental sustainability (ES).

This paper seeks to define environmental sustainability partly by sharply distinguishing it from social sustainability and, to a lesser extent, from eco-

[1]NOTE: These personal opinions should in no way be construed as representing the official position of the World Bank Group.

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nomic sustainability. These are contrasted in Figure 1. While overlap exists among the three, economic sustainability and ES have especially strong linkages. Defining each component of sustainability distinctly may help organize the action required to approach global sustainability in real life. Although this paper focuses more on the environmental aspects of sustainability, perhaps in the future, a general sustainability will come to be based on all three aspects—environmental, social, and economic.

Historically, economic theory has focused on efficiency of use of goods and, to a much lesser degree, on equity of distribution. Recent recognition of the pervasive economic significance of environmental conditions has forced two changes. First, the relatively new criterion of scale must now be added to the traditional criteria of allocation of resources and efficiency of use (30, 66). The "growth" debate emphasizes the scale of the growing human economic subsystem relative to the finite ecosystem. Ecologists and other biophysical scientists need to take more responsibility for leading the thinking on sustainable development and for seeing that efforts to achieve it are implemented promptly. Second, we must recognize that markets are almost invariably deficient as distributive mechanisms when natural resources are concerned.

Economic sustainability focuses on that portion of the natural resource base that provides physical inputs, both renewable (e.g. forests) and exhaustible (e.g. minerals), into the production process. ES adds consideration of the physical inputs into production, emphasizing environmental life-support systems without which neither production nor humanity could exist. These life-support systems include atmosphere, water, and soil—all of these need to be healthy, meaning that their environmental service capacity must be maintained. A healthy ozone shield, for example, prevents damage by ultraviolet b radiation to biota such as humans and crops. Continuous depletion or damage by human activities to irreplaceable and unsubstitutable environmental services would be incompatible with sustainability.

SOCIAL SUSTAINABILITY

The environment has now become a major constraint on human progress. Fundamentally important though social sustainability is, environmental sustainability or maintenance of life-support systems is a prerequisite for social sustainability. Redclift (74–76) claims that poverty reduction is the primary goal of sustainable development, even before environmental quality can be fully addressed. Poverty is increasing in the world in spite of global and national economic growth (see below). Poverty reduction has to come from qualitative development, from redistribution and sharing, from population stability, and from community sodality, rather than from throughput growth. Politicians will doubtless want the *impossible* goal of increasing throughput—

Social Sustainability	Economic Sustainability	Environmental Sustainability (ES)
Achieved only by systematic community participation and strong civil society. Cohesion of community, cultural identity, diversity, sodality, comity, tolerance, humility, compassion, patience, forbearance, fellowship, fraternity, institutions, love, pluralism, commonly accepted standards of honesty, laws, discipline, etc. constitute the part of social capital least subject to rigorous measurement, but for social sustainability. This "moral capital," as some call it, requires maintenance and replenishment by shared values and equal rights, and by community, religious and cultural interactions. Without this care it will depreciate as surely as will physical capital. Human capital—investments in education, health, and nutrition of individuals—is now accepted as part of economic development (102–104 108), but the creation of social capital as needed for social sustainability is not yet adequately recognized.	Economic capital should be stable. The widely accepted definition of economic sustainability "maintenance of capital", or keeping capital intact, has been used by accountants since the Middle Ages to enable merchant traders to know how much of their sales receipts they and their families could consume without reducing their ability to continue trading. Thus Hicks' (48) definition of income—"*the amount one can consume during a period and still be as well off at the end of the period*"—can define economic sustainability, as it devolves on consuming interest, rather than capital. We now need to extrapolate the definition of Hicksian income from sole focus on human-made capital and its surrogate (money) now to embrace the other three forms of capital (natural, social and human). Economics has rarely been concerned with natural capital (e.g., intact forests, healthy air) because until relatively recently it had not been scarce. This new scarcity, that of natural capital, arose because the scale of the human economic subsystem has now grown large relative to its supporting ecosystem (26–32). To the traditional economic criteria of allocation and efficiency must now be added a third, that of scale (28). The scale criterion would constrain throughput growth—the flow of material and energy (natural capital) from environmental sources to sinks, via the human economic subsystem. Economics values things in money terms, and is having major problems valuing natural capital, intangible, intergenerational, and especially common access resources, such as air. Because people and irreversibles are at stake, economics needs to use anticipation and the precautionary principle routinely, and should err on the side of caution in the face of uncertainty and risk.	Although ES is needed by humans and originated because of social concerns, ES itself seeks to improve human welfare by protecting the sources of raw materials used for human needs and ensuring that the sinks for human wastes are not exceeded, in order to prevent harm to humans. Humanity must learn to live within the limitations of the biophysical environment. ES means natural capital must be maintained, both as a provider of inputs ("sources"), and as a "sink" for wastes (23, 25, 72, 73, 74, 81, 83, 101). This means holding the scale of the human economic subsystem to within the biophysical limits of the overall ecosystem on which it depends. ES needs sustainable production and sustainable consumption. On the sink side, this translates into holding waste emissions within the assimilative capacity of the environment without impairing it. On the source side, harvest rates of renewables must be kept within regeneration rates. Non-renewables cannot be made fully sustainable, but quasi-ES can be approached for non-renewables by holding their depletion rates equal to the rate at which renewable substitutes can be created (38, 39). Ultimately, there can be no social sustainability without ES. ES supplies the conditions for social sustainability to be approached.

Figure 1. Comparison of social, economic and environmental sustainability

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the flow of materials and energy from the sources of the environment, used by the human economy, and returned to environmental sinks as waste—by increasing consumption by all.

Countries truly sustaining themselves, rather than liquidating their resources, will be more peaceful than countries with unsustainable economies (41). Countries with unsustainable economies—those liquidating their own natural capital or those importing liquidated capital from other countries (e.g. Middle East oil or tropical timber 'mining') are more likely to wage war than are those with sustainable economies. When social sustainability has been clarified, possibly it will be relinked with ES, the whole contributing to sustainable development. Just as much of the world is not yet environmentally sustainable, neither is it socially sustainable. Disaggregation of social unsustainability will show what needs to be changed.

SUSTAINABILITY AND DEVELOPMENT

Sustainable development (SD) should integrate social, environmental, and economic sustainability and use these three to start to make development sustainable. The moment the term development is introduced, however, the discussion becomes quite different and more ambiguous. This paper is not focused on sustainable development, here assumed to be development that is socially, economically, and environmentally sustainable, or "development without throughput growth beyond environmental carrying capacity and which is socially sustainable" (27, 28, 30). World Wildlife Fund's (107) definition of sustainable development is similar: "Improvement in the quality of human life within the carrying capacity of supporting ecosystems." These definitions need to have the social aspects clarified, but they are less ambiguous than the Brundtland (105) definition: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."[2]

Part of the success of the Brundtland Commission's definition stems from its opacity (49), and the definition of sustainability in a growth context. But when the World Commission on Environment and Development (WCED) (106) reconvened five years later, calls for growth were striking for their absence. HRH Prince Charles commended WCED in their publication (106)

[2]This UN definition does not distinguish among the different concepts of growth and development. While development can and should go on indefinitely for all nations, throughput growth cannot. Sustainability will be achieved only when development supplants growth; when the scale of the human economy is kept within the capacity of the overall ecosystem on which it depends. If we acknowledge the finite nature of our planet, "sustainable growth" is an oxymoron (28, 29). Throughput growth has to be kept within carrying capacity or within the capacity of the environmental services of assimilation and regeneration.

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for dropping their 1987 call for huge (5- to 10-fold) increases in economic growth.

This paper offers the case that ES does not allow economic growth, much less sustained economic growth. On the contrary, environmentally sustainable development implies sustainable levels of both production (sources), and consumption (sinks), rather than sustained economic growth. The priority for development should be improvement in human well-being—the reduction of poverty, illiteracy, hunger, disease, and inequity. While these development goals are fundamentally important, they are quite different from the goals of environmental sustainability, the unimpaired maintenance of human life-support systems—environmental sink and source capacities.

The need for sustainability arose from the recognition that the profligate, extravagant, and inequitable nature of current patterns of development, when projected into the not-too-distant future, leads to biophysical impossibilities. The transition to environmental sustainability is urgent because the deterioration of global life-support systems—which compose the environment—imposes a time limit. We do not have time to dream of creating more living space or more environment, such as colonizing the moon or building cities beneath the ocean. We must save the remnants of the only environment we have and allow time for and invest in the regeneration of what we have already damaged. We cannot "grow" into sustainability.

The tacit goal of economic development is to narrow the equity gap between the rich and the poor. Almost always this is taken to mean raising the bottom (i.e. enriching the poor), rather than lowering the top by redistribution (44). Only very recently has it been admitted that bringing the low-income countries up to the affluent levels of the countries of the Organization for Economic Cooperation and Development (OECD) in 40 or even 100 years is a totally unrealistic goal. Most politicians and most citizens have not yet realized that this goal is unrealistic. Most people would accept that it is desirable for southern low-income countries to be as rich as those in the northern hemisphere—and then leap to the false conclusion that it must therefore be possible. But if greater equality cannot be attained by growth alone, then sharing and population stability will be necessary.

Serageldin (78) makes the persuasive case that in low income countries achieving per capita income levels of $1,500 to $2,000 (rather than OECD's $21,000 average) is quite possible. Moreover, that level of income may provide 80% of the basic welfare provided by a $20,000 income—as measured by life expectancy, nutrition, education, and other aspects of social welfare. This tremendously encouraging case remains largely unknown, even in development circles. Its acceptance would greatly facilitate the transition to environmental sustainability. Colleagues working on the northern hemisphere's overconsumption should address the corollary not dealt with by Serageldin (78):

Can $21,000/capita countries cut their consumption by a factor of 10 and suffer "only" a 20% loss of basic welfare? If indeed both raising the bottom (low income rises to $2000) and lowering the top (OECD income declines to $16,000) prove feasible, that would be tremendously encouraging and would speed ES. But to accomplish the possible parts of the imperative of development, we must stop idolizing the impossible. The challenge to development specialists is to deepen this important argument.

Intergenerational and Intragenerational Sustainability

Most people in the world today are either impoverished or live barely above subsistence; the number of people living in poverty is increasing. Developing countries can never be as well off as today's OECD average. Future generations seem likely to be larger and poorer than today's generation. Sustainability includes an element of not harming the future (intergenerational equity), and some find the intergenerational equity component of sustainability to be its most important element (e.g. 105). If the world cannot move toward intragenerational sustainability during this generation, it will be that much more difficult to achieve intergenerational sustainability sometime in the future, for the capacity of environmental services will be lower in the future than it is today.

World population soars by 100 million people each year: Some of these people are OECD overconsumers, but most of them are poverty stricken. World population doubles in a single human generation—about 40 years. This makes achieving intergenerational equity difficult, although achieving intergenerational equity will probably reduce total population growth. Rather than focusing on the intergenerational equity concerns of ES, the stewardship approach of safeguarding life-support systems today seems preferable.

WHAT SHOULD BE SUSTAINED?

Environmental sustainability seeks to sustain global life-support systems indefinitely (this refers principally to those systems maintaining human life). Source capacities of the global ecosystem provide raw material inputs—food, water, air, energy; sink capacities assimilate outputs or wastes. These source and sink capacities are large but finite; sustainability requires that they be maintained rather than run down. Overuse of a capacity impairs its provision of life-support services. For example, accumulation of CFCs is damaging the capacity of the atmosphere to protect humans and other biota from harmful UVb radiation.

Protecting human life is the main reason anthropocentric humans seek environmental sustainability. Human life depends on other species for food, shelter, breathable air, plant pollination, waste assimilation, and other environmental life-support services. The huge instrumental value of nonhuman species

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to humans is grossly undervalued by economics. Nonhuman species of no present value to humans have intrinsic worth, but this consideration is almost entirely excluded in economics (exceptions are existence and option values). A question rarely posed by economists and not yet answered by any is: With how many other species is humanity willing to share the earth, or should all other species be sacrificed to make room for more and more of the single human species? Surely it is arrogant folly to extinguish a species just because we think it is useless today. The anthropocentric and ecocentric views are contrasted by Goodland & Daly (42).

Although biodiversity conservation is becoming a general ideal for nations and development agencies, there is no agreement on how much should be conserved, nor at what cost. Leaving aside the important fact that we have not yet learned to distinguish useful from nonuseful species, agreeing on how many other species to conserve is not central to the definition of environmental sustainability. Reserving habitat for other species to divide among themselves is important; let evolution select the mix of species, not us. But reserving a nonhuman habitat requires limiting the scale of the human habitat. "How much habitat should be conserved?", while an important question to ask, is moot; the answer is probably "no less than today's remnants." This brings us to the precautionary principle: In cases of uncertainty, sustainability mandates that we err on the side of prudence. Because survival of practically all the global life-support systems is uncertain, we should be very conservative in our estimate of various input and output capacities, and particularly of the role of unstudied, apparently "useless," species.

Many writers (15, 16, 19, 32, 40, 46, 52, 54, 60, 84) are convinced that the world is hurtling away from environmental sustainability, but economists have not reached consensus that the world is becoming less sustainable. What is not contestable is that the modes of production prevailing in most parts of the global economy are causing the exhaustion and dispersion of a one-time inheritance of natural capital—topsoil, groundwater, tropical forests, fisheries, and biodiversity. The rapid depletion of these essential resources, coupled with the degradation of land and atmospheric quality, shows that the human economy as currently configured is already inflicting serious damage on global supporting ecosystems, and future potential biophysical carrying capacities are probably being reduced (21, 22).

A HISTORY OF SUSTAINABILITY

A notion of economic sustainability was firmly embodied in the writings of JS Mill (61), and TR Malthus (57, 58). Mill (61) emphasized that environment ("Nature") needs to be protected from unfettered growth if we are to preserve human welfare before diminishing returns set in. Malthus emphasized the

pressures of exponential population growth on the finite resource base. The modern neo-Malthusianism version is exemplified by Ehrlich & Ehrlich (33a–35) and by Hardin (45, 46). Daly's "Toward a Steady State Economy" (25, 26) and "Steady State Economics" (23) synthesized and extended these viewpoints on population and resources. Daly's "Steady State Economics" is a seminal work in which population and consumption pressures on environmental sources and sinks are clearly demonstrated—the flow of matter and energy from the environment, used by the human economy, and released back into the environment as wastes. Daly magisterially subsumes the issues of population and consumption factors into the single critical factor of *scale*.

Neither Mill nor Malthus is held in great esteem by most of today's economists, who are more likely to follow the technological optimism of David Ricardo (77). Ricardo believed that human ingenuity and scientific progress would postpone the time when population would overtake resources or "the niggardliness of nature." However, as poverty is increasing worldwide, that postponement seems to have ended.

The definition of environmental sustainability (Figure 2) hinges on distinguishing between throughput growth and development. The "Growth Debate" moved into the mainstream two decades after World War II. Boulding (12–14), Mishan (62, 63), and Daly (23–26), for example, seriously questioned the wisdom of infinite throughput growth on a finite earth. Throughput growth is defended by most economists, including Beckerman (7–9), who still rejects the concept of sustainability (10). "The Limits to Growth" (59) and "Beyond the Limits" (60) shook the convictions of the technological optimists. Meadows et al (59) concluded that "it is possible to alter these growth trends and establish a condition of ecological and economic stability that is sustainable into the future." Barney's (5) US Global 2000 Report (1980) amplified and clarified the limits argument. Large populations, their rapid growth and affluence, are unsustainable. The Ricardian tradition that still dominates conventional economics is exemplified by the Cornucopians Simon & Kahn in their 1984 response to the Global 2000 Report. Panayotou (70), Summers (89), and Fritsch et al (39) found growth compatible with sustainability and even necessary for it. The 1980 World Conservation Strategy (51) by the International Union to Conserve Nature and the World Wildlife Fund, and Clark & Munn's 1987 International Institute for Applied Systems Analysis report "Sustainable Development of the Biosphere" (17), reinforced these conclusions. Daly & Cobb's (32) prizewinning "For the Common Good" estimated that growth, at least in the United States, actually decreased people's well-being, and they outlined pragmatic operational methods to reverse environmental damage and reduce poverty. The growth debate and sustainability issues are usefully synthesized by Korten (54).

Few Nobel prizewinners in economics write on sustainability. Haavelmo & Hansen (44) and Tinbergen & Hueting (90) repudiate throughput growth and urge the transition to sustainability. Solow's earlier writings (85) questioned the need for sustainability, but he is now modifying that position (87, 88). The World Bank adopted environmental sustainability in principle rather early on, in 1984, and now promotes it actively (2, 56, 65, 80–82). Major contributions to the sustainability debate were published as contributions to the 1992 UN Commission on Environment and Development conference in Rio de Janeiro, such as WCS's 1991 "Caring for the Earth: a strategy for sustainable living." An addendum to the Brundtland Commission (106) rectified and reversed the earlier (105) calls for "5- to 10-fold more growth," by placing the population issue higher on the agenda to achieve sustainability. Goodland, Daly, and El Serafy (43), supported by two Economics Nobelists (Tinbergen and Haavelmo), made the case that there are indeed limits, that the human economy has reached them in many places, that it is impossible to grow into sustainability, that source and sink capacities of the environment complement human-made capital (which cannot substitute for their environmental services), and that there is no way the southern hemisphere can ever catch up with the north's current consumerist life-style.

Since the late 1980s, a substantial corpus of literature on "Ecological Economics" [which now has a journal, society and textbook of the same name (19)], has espoused stronger types of sustainability (e.g. 3, 4, 18, 48, 50, 52, 64, 91, 94).

GROWTH COMPARED WITH DEVELOPMENT

The dictionary distinguishes between growth and development: "To grow" means "to increase in size by the assimilation or accretion of materials;" "to develop" means "to expand or realize the potentialities of; to bring to a fuller, greater or better state."

Growth implies quantitative physical or material increase; development implies qualitative improvement or at least change. Quantitative growth and qualitative improvement follow different laws. Our planet develops over time without growing. Our economy, a subsystem of the finite and nongrowing earth, must eventually adapt to a similar pattern of development without throughput growth. The time for such adaptation is now. Historically, an economy starts with quantitative throughput growth as infrastructure and industries are built, and eventually it matures into a pattern with less throughput growth but more qualitative development. While this pattern of evolution is encouraging, qualitative development needs to be distinguished from quantitative throughput growth if environmental sustainability is to be approached.

Development by the countries of the northern hemisphere must be used to free resources (the source and sink functions of the environment) for the growth

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and development so urgently needed by the poorer nations. Large-scale transfers to the poorer countries also will be required, especially as the impact of economic stability in northern countries may depress terms of trade and lower economic activity in developing countries. Higher prices for the exports of poorer countries, as well as debt relief, will be required. Most importantly, population stability is essential to reduce the need for growth everywhere. This includes both where population growth has the greatest impact (i.e. in the northern high-consuming nations) and where population growth is highest (i.e. in the southern, poor, low-consuming countries).

THE DEFINITION OF ENVIRONMENTAL SUSTAINABILITY

The definition of ES as the "maintenance of natural capital" constitutes the input/output rules in Figure 2.

The two fundamental environmental services—the source and sink functions—must be maintained unimpaired during the period over which sustainability is required (23, 27, 31). ES is a set of constraints on the four major activities regulating the scale of the human economic subsystem: the use of renewable and nonrenewable resources on the source side, and pollution and waste assimilation on the sink side. This short definition of ES is the most

1. *Output Rule:*
   Waste emissions from a project or action being considered should be kept within the assimilative capacity of the local environment without unacceptable degradation of its future waste absorptive capacity or other important services.
2. *Input Rule:*
   (a) *Renewables:* harvest rates of renewable resource inputs should be within regenerative capacities of the natural system that generates them.
   (b) *Nonrenewables:* depletion rates of nonrenewable resource inputs should be set below the rate at which renewable substitutes are developed by human invention and investment according to the Serafian quasi-sustainability rule (36–38). An easily calculable portion of the proceeds from liquidating nonrenewables should be allocated to research in pursuit of sustainable substitutes.
3. *Operational Principles:*
   (a) The scale (population × consumption per capita × technology) of the human economic subsystem should be limited to a level which, if not optimal, is at least within the carrying capacity and therefore sustainable.
   (b) Technological progress for sustainable development should be efficiency-increasing rather than throughput-increasing.
   (c) Renewable resources should be exploited on a profit-optimizing, sustained-yield, and fully sustainable basis.

Figure 2. The definition of environmental sustainability

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useful so far and is gaining adherents. The fundamental point to note about this definition is that ES is a natural science concept and obeys biophysical laws (Figure 2). This general definition seems to be robust irrespective of country, sector, or future epoch.

The paths needed by each nation to approach sustainability will not be the same. Although all countries need to follow the input/output rules, countries differ in the balance of attention between output and input that will be needed to achieve ES. For example, some countries or regions must concentrate more on controlling pollution (e.g. former centrally planned economies); some countries must pay more attention to bringing harvest rates of their renewable resources down to regeneration rates (e.g. tropical timber–exporting countries); some countries must bring their population to below carrying capacity; others must reduce their per capita consumption (e.g. all OECD countries).

There are compelling reasons why industrial countries should lead in devis-

Laws:

1. Neither growth in human population nor growth in the rates of resource consumption can be sustained.
2. The larger the population of a society and the larger its rates of consumption of resources, the more difficult it will be to transform the society to the condition of sustainability.
3. The response time of populations to changes in the total fertility rate is the length of time people live from their childbearing years to the end of life, or approximately 50 years.
4. The size of population that can be sustained (the carrying capacity) and the sustainable average standard of living are inversely related to one another.
5. Sustainability requires that the size of the population be less than or equal to the carrying capacity of the ecosystem for the desired standard of living.
6. The benefits of population growth and of growth in the rate of consumption of resources accrue to a few individuals; the costs are borne by all of society (the tragedy of the commons).
7. (Any) growth in the rate of consumption of a nonrenewable resource, such as a fossil fuel, causes a dramatic decrease in the life expectancy of the resource.
8. The time of expiration of nonrenewable resources, such as a fossil fuel, causes a dramatic decrease in the life expectancy of the resource.
9. When large efforts are made to improve the efficiency with which resources are used, the resulting savings are easily wiped out by the added resource needs that arise as a consequence of modest increases in population.
10. When rates of pollution exceed the natural cleansing capacity of the environment, it is easier to pollute than it is to clean up the environment.
11. Humans will always be dependent on agriculture so land and other renewable resources will always be essential.

Figure 3a. Bartlett's Laws relating to sustainability and hypotheses about sustainability

Hypotheses:

1. For the 1994 average global standard of living, the 1994 population of the earth exceeds carrying capacity.
2. Increasing population size is the single greatest and most insidious threat to representative democracy.
3. The costs of programs to stop population growth are small compared to the costs of population growth.
4. The time required for a society to make a planned transition to sustainability increases with increases in the size of its population and the average per capita consumption of resources.
5. Social stability is a necessary, but not a sufficient, condition for sustainability. Social stability tends to be inversely related to population density.
6. The burden of the lowered standard of living that results from population growth and from the decline of resources falls most heavily upon the poor.
7. Environmental problems cannot be solved or ameliorated by increases in the rates of consumption of resources.
8. The environment cannot be enhanced or preserved through compromises.
9. By the time overpopulation and shortage of resources are obvious to most people, the carrying capacity has been exceeded. It is then too late to think about sustainability.

Figure 3b. Bartlett's Sustainability Hypothesis (6)

ing paths toward sustainability. They have to adapt far more than do developing countries. If OECD countries cannot act first and lead the way, it is less likely that developing countries will choose to do so (95). Not only would it be enlightened self-interest for the north to act first, but it could also be viewed as a moral obligation. Second, developing countries are rightly pointing out (1, 11) that OECD countries have already consumed substantial amounts of environmental sink capacity (e.g. nearly all CFCs that are damaging the atmosphere were released by OECD countries) as well as source capacity (e.g. several species of great whales are extinct, and many stocks of fish and tropical timbers have been depleted below economically harvestable levels). Third, OECD countries can afford the transition to sustainability because they are richer. The rich would do themselves good by using the leeway they have for cutting overconsumption and waste (Figure 3a, 3b).

CAUSES OF UNSUSTAINABILITY

When the human economic subsystem was small, the regenerative and assimilative capacities of the environment appeared infinite. We are now painfully learning that environmental sources and sinks are finite. These capacities were very large, but the scale of the human economy has exceeded them. Source and sink capacities have now become limited. As economics deals only with scarcities, in the past source and sink capacities of the environment did not

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have to be taken into account. Conventional economists still hope or claim that economic growth is infinite or at least that we are not yet reaching limits to growth; hence the fierce recent repudiation of *Beyond the Limits of Growth* (60), and the welcome for Brundtland's call for "5- to 10-fold more growth" (105). The scale of the human economy is a function of throughput—the flow of materials and energy from the sources of the environment, used by the human economy, and then returned to environmental sinks as waste. Throughput growth is a function of population growth and consumption. Throughput growth translates into increased rates of resource extraction and pollution (use of sources and sinks). The scale of throughput has exceeded environmental capacities: That is the definition of unsustainability.

There is little admission yet that consumption above sufficiency is not an unmitigated good. The scale of the human economy has become unsustainable because it is living off inherited and finite capital (e.g. fossil fuels, fossil water); because we do not account for losses of natural capital (e.g. extinctions of species), nor do we admit the costs of environmental harm. The second reason for unsustainability is related to the first: government failure to admit that pollution and fast population growth are doing more harm than good.

THE TIME FOR ENVIRONMENTAL SUSTAINABILITY

Approaching sustainability is urgent. Consider that if release were halted today of all substances that damage the ozone shield, the ozone shield may need as much as one century to return to pre-CFC effectiveness. Every passing year means sustainability has to be achieved for an additional 100 million people. Though environmental sources and sinks have been providing humanity with their services for the last million years, and until recently have seemed vast and resilient, we have at last begun to exceed them and to damage them worldwide. Where environmental services are substitutable, the substitution achieved has been marginal. Most natural capital or environmental services cannot be substituted for, and their self-regenerating properties are slow and cannot be significantly hastened. That is why environmental sustainability has a time urgency.

Much of the resistance to accepting the necessity of a sustainability approach is that politicians have considered the consequences of doing so—controlling consumerism and waste, halting human population growth, and probably reducing population size, and relying on renewable energy—to be politically unacceptable. These are all felt to be politically damaging, so they are not put forward as much-needed societal goals. Instead, society calls for incremental progress in such disparate areas as enforcing the 'polluter pays' principle, support of women's reproductive health, educating girls, or clean technology. Important though these goals are, they are not enough, yet no one calls for the

redistribution of resources from rich to poor. It is impossible for us to grow out of poverty and environmental degradation. It is precisely the nonsustainability of throughput growth beyond a certain scale that gives urgency to the concept of sustainability (27, 28). All forms of growth are unsustainable, whether in the number of trees, people, great whales, levels of atmospheric CO_2, or GNP.

The world will in the end become sustainable, one way or another. We can select the timing and nature of that transition and the levels of sustainability to be sought, or we can let depletion and pollution dictate the abruptness of the final inevitable transition. The former will be painful; the latter deadly. The longer we delay agreement on goals for levels of sustainability, the more the source and sink capacities will be damaged, the larger the number of people that will have to be accommodated on earth, and the more difficult the transition will be. For example, species extinctions are happening fast now, and they are accelerating. If that process continues for several decades, we will inevitably reach sustainability at a much poorer and less resilient level.

NATURAL CAPITAL AND SUSTAINABILITY

Of the four kinds of capital (natural, human, human-made, and social), environmental sustainability requires maintaining natural capital; understanding ES thus includes defining "natural capital" and "maintenance of resources" (or at least "non-declining levels of resources"). Natural capital—the natural environment—is defined as the stock of environmentally provided assets (such as soil, atmosphere, forests, water, wetlands), which provide a flow of useful goods or services; these can be renewable or nonrenewable, and marketed or nonmarketed. Sustainability means maintaining environmental assets, or at least not depleting them. "Income" is sustainable by the generally accepted Hicksian definition of income (47). Any consumption that is based on the depletion of natural capital is not income and should not be counted as such. Prevailing models of economic analysis tend to treat consumption of natural capital simply as income and therefore tend to promote patterns of economic activity that are unsustainable. Consumption of natural capital is liquidation, or disinvestment—the opposite of capital accumulation.

Now that the environment is so heavily used, the limiting factor for much economic development has become natural capital. For example, in marine fishing, fish have become limiting, rather than fishing boats. Timber is limited by remaining forests, not by sawmills; petroleum is limited by geological deposits and atmospheric capacity to absorb CO_2, not by refining capacity. As natural forests and fish populations become limiting, we begin to invest in plantation forests and fish ponds. This introduces an important hybrid category that combines natural and human-made capital—a category we may call "cultivated natural capital." This category is vital to human well-being, accounting for most of the food we eat, and a good deal of the wood and fibers we use. The fact that humanity has the capacity to "cultivate" natural capital dramatically expands the capacity of natural capital to deliver services. But cultivated natural capital (agriculture) is separable into human-made capital (e.g. tractors, diesel irrigation pumps, chemical fertilizers, biocides) and natural capital (e.g. topsoil, sunlight, rain). Eventually the natural capital proves limiting.

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Natural Capital Is Now Scarce

In an era in which natural capital was considered infinite relative to the scale of human use, it may have been reasonable not to deduct natural capital consumption from gross receipts in calculating income. That era is now past. Environmental sustainability needs the conservative effort to maintain the traditional (Hicksian) meaning and measure of income now that natural capital is no longer a free good but is more and more the limiting factor in development. The difficulties in applying the concept arise mainly from operational problems of measurement and valuation of natural capital, as emphasized by Ahmad et al (2), Lutz (56), and El Serafy (37, 38).

Three Degrees of Environmental Sustainability

Sustainability can be divided into three degrees—weak, strong and absurdly strong—depending on how much substitution one thinks there is among the four types of capital (natural, human, human-made, and social) (32):

> *Weak environmental sustainability*: Weak ES is maintaining total capital intact without regard to the partitioning of that capital among the four kinds. This would imply that the various kinds of capital are more or less substitutes, at least within the boundaries of current levels of economic activity and resource endowment. Given current liquidation and gross inefficiencies in resource use, weak sustainability would be a vast improvement as a welcome first step but would by no means constitute ES. Weak sustainability is a necessary but not sufficient condition for ES. Weak sustainability is rejected by Beckerman (10), but the concept is finding some acceptance in economic circles. It means we could convert all or most of the world's natural capital into human-made capital or artifacts and still be as well off! For example, society would be better off, it is claimed by those espousing weak sustainability, by converting forests to houses, and oceanic fish stocks into nourished humans. Human capital—educated, skilled, experienced, and healthy people—is largely lost at the death of individuals, and so it must be renewed each generation, whereas social capital persists in the form of books, knowledge, art, family and community relations.
>
> *Strong environmental sustainability*: Strong ES requires maintaining separate kinds of capital. Thus, for natural capital, receipts from depleting oil should be invested in ensuring that energy will be available to future generations at least as plentifully as that enjoyed by the beneficiaries of today's oil consumption. This assumes that natural and human-made capital are not perfect substitutes. On the contrary, they are complements at least to some extent in most production func-

tions. A sawmill (human-made capital) is worthless without the complementary natural capital of a forest. The same logic would argue that if there are to be reductions in one kind of educational investments, they should be offset by increased investments in other kinds of education, not by investments in roads. Of the three degrees of sustainability, strong sustainability seems greatly preferable mainly because of the lack of substitutes for much natural capital, the fact that natural capital and not human-made capital is now limiting, and the need for prudence in the face of many irreversibilities and uncertainties. Pearce et al (71–73), Costanza (19), Costanza & Daly (20), Opschoor, Van der Straaten, van den Bergh, most ecologists, and most ecological economists prefer or are coming round to some version of strong sustainability.

Absurdly strong environmental sustainability: We would never deplete anything. Nonrenewable resources—absurdly—could not be used at all. All minerals would remain in the ground. For renewables, only net annual growth increments could be harvested in the form of the overmature portion of the stock. Some ecologists fear we may be reduced to this type of sustainability—harvesting only overmature growth increments of renewables, in which case this sustainability is better called "superstrong" sustainability (67).

There are tradeoffs between human-made capital and natural capital. Economic logic requires us to invest in the limiting factor, which now is often natural rather than human-made capital, which was previously limiting. Operationally, this translates into three concrete actions as noted in Figure 4.

SUSTAINABILITY AND SUBSTITUTABILITY

Conventional economics and technological optimists depend heavily on substitutability as the rule rather than the exception. Ecology has paid inadequate

1) FOSTER REGENERATION OF NATURAL CAPITAL:
Encourage the growth of natural capital by reducing our current level of exploitation of it. For example, lengthen rotations (of forest cutting or arable crops) to permit full regeneration; limit catches (e.g. of fish) to prudently well within long-term sustained yield estimates.

2) RELIEVE PRESSURE ON NATURAL CAPITAL:
Invest in projects to relieve pressure on natural capital stocks by expanding cultivated natural capital, such as tree plantations to relieve pressure on natural forests. Reducing pollution and waste provides more time for assimilative capacities to regenerate themselves.

3) IMPROVE EFFICIENCY IN USE OF NATURAL CAPITAL:
Increase the end-use efficiency of products (such as improved cookstoves, solar heaters and cookers, wind pumps, solar pumps, manure rather than chemical fertilizer). Extend the life-cycle, durability, and recyclability of products to improve overall efficiency, as would taxing planned obsolescence and ephemerata.

Figure 4. Rebuilding natural capital stocks

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attention to the extent of substitutability between natural and human-made capital, yet it is central to the issue of sustainability. Substitutability is the ability to offset a diminished capacity of environmental source and sink services to provide healthy air, water, etc, and to absorb wastes. The importance of substitutability is that if it prevails, then there can be no limits, because if an environmental good is destroyed, it is argued, a substitute can replace it. When White Pine or sperm whales became scarce, there were acceptable substitutes. When easily gathered surficial oil flows were exhausted, drilling technology enabled very deep deposits to be tapped. In Europe, when the native forest was consumed, timber for houses was replaced with brick. If bricks did not substitute for timber, then timber was imported.

The realization that substitutability is the exception, rather than the rule, is not yet widespread, despite Ehrlich's warning (33, 34). However, once limits of imports cease to mask substitutability (e.g. US Pacific Northwest and British Columbia timber controversies show the limits of imports), then it becomes plain that most (but not all) forms of capital are more complementary or neutral and are less substitutable. Economists who hope that natural capital and human-made capital are substitutes claim that total capital (i. e. the sum of natural and human-made capital) can be maintained constant in some aggregate value sense. This reasoning, built on the questionable premise that human-made capital is substitutable for natural capital, means it is acceptable to divest natural capital (i.e. deplete environmental source or sink capacities) as long as an equivalent value has been invested in human-made capital. Even this weak sustainability is not required by national accounting rules. Indeed, our national accounts simply count natural capital liquidation as income (37, 38).

Unfortunately, that is also the way the world is being run at the micro or firm level; user costs are rarely calculated (53). We consume environmental source capacity by releasing many wastes (e.g. CO_2, CFCs, oxides of sulfur and nitrogen that make acid rain) into the air because we claim the investment in energy production and refrigeration (human-made capital) substitutes for healthy air or atmosphere. We extinguish species (depletion of biodiversity source capacity) by converting jungle to cattle ranches because the human-made capital (or strictly quasi-human made agriculture) is a substitute for the natural capital of biodiversity. Such "weak sustainability" has not yet been achieved, and it would be a great improvement were it attained. But, because human-made and natural capital are far from perfect substitutes, weak sustainability is a dangerous goal. It would be risky as an interim stage on the way to any reliable concept of sustainability.

Ecologists attach great importance to Baron Justus von Liebig's Law of the Minimum—the whole chain is only as strong as its weakest link. The factor in shortest supply is the limiting factor because factors are complements, not substitutes. If scarcity of phosphate is limiting the rate of photosynthesis, then

photosynthesis would not be enhanced by increasing another factor such as nitrogen, light, water, or CO_2. If one wants faster photosynthesis, one must ascertain which factor is limiting and then invest in that one first, until it is no longer limiting. More nitrogen fertilizer cannot substitute for lack of phosphate, precisely because they are complements. Environmental sustainability is based on the conclusion that most natural capital is a complement for human-made capital, and not a substitute. Complementarity is profoundly unsettling for conventional economics because it means there are limits to growth, or limits to environmental source and sink capacities. Human-made capital is a very poor substitute for most environmental services. Substitution for some life-support systems is impossible.

A compelling argument that human-made capital is only a marginal substitute for natural capital is the reductio ad absurdum case in which all natural capital is liquidated into human-made capital. We might survive the loss of fossil fuels, but what would substitute for topsoil and breathable air? Only in science fiction could humanity survive by breathing bottled air from backpacks, and eating only hydroponic greenhouse food. If there is insufficient substitutability between natural capital and human-made capital, then throughput growth must be severely constrained and eventually cease. While new technology may postpone the transition from quantitative growth to qualitative development and environmental sustainability, current degradation shows that technology is inadequate. *"For natural life-support systems no practical substitutes are possible, and degradation may be irreversible. In such cases (and perhaps in others as well), compensation cannot be meaningfully specified."* (92, 93).

COMMON MISCONCEPTIONS ABOUT ENVIRONMENTAL SUSTAINABILITY

Is ES the Same as Sustained Yield?

There is a lively debate, especially in forestry and fishery circles, about whether environmental sustainability is "sustained yield" (S-Y). Clearly ES includes, but is far from limited to, sustained yield. ES is applied at the aggregate level to all the values of an ecosystem, not to just a few species of timber trees or fish. ES is akin to the simultaneous S-Y of many interrelated populations in an ecosystem. S-Y is ES restricted to a small fraction of the members of the ecosystem under consideration. S-Y is often used in forestry and fisheries to determine the optimal—most profitable—extraction rate of timber or fish. ES counts all the natural services of the sustained resource. S-Y counts only the service of the product extracted and ignores all other natural services. S-Y forestry counts only the timber value extracted; ES forestry counts all services,

including protecting vulnerable ethnic-minority forest dwellers, biodiversity, genetic values, intrinsic as well as instrumental values, climate, wildlife, carbon balance, water source and water moderation values, ecosystem integrity in general (96), and of course, timber extracted. The relation between the two is that if S-Y is actually achieved, then the stock resource (e.g. the forest) will be nearer sustainability than if S-Y is not achieved. S-Y in tropical forestry is doubtful now (55) and will be more doubtful in the future as human population pressures intensify. But even were S-Y to be achieved, that resource is unlikely to have also attained ES. The optimal solution for a single variable, such as S-Y, usually (possibly inevitably) results in declining utility or declining natural capital sometime in the future, and therefore it is not sustainable.

Is ES Certain or Uncertain?

Environmental sustainability is a rather clear concept. However, there is much uncertainty about the details of its application. After scientists have spent centuries trying to estimate sustained yield for a few species of timber trees or fish, they are now questioning whether they can ever be successful (55), leaving aside whether humans would accept sustainable yield extraction rates once they were determined. Considering that ES is more complex than S-Y suggests a high degree of uncertainty. Today we are largely empirical in our assessment of assimilative capacity also. We allow a limit to be exceeded, often for years, before we muster the political will to start addressing the problem. Damage to the ozone shield was argued for years before CFC manufacturers agreed to phase CFCs out, and then they did so only when economic substitutes had been found. Even so, scientific understanding of biophysical linkages is weak, so there is much uncertainty, and hence a compelling need for the precautionary principle to prevail widely. Colleagues addressing ES should seek rough rather than precise indicators of sustainability so that we can move on. Better to be roughly right than precisely wrong.

Is ES More of a Concern for Developing Countries?

The countries of the northern hemisphere are responsible for the overwhelming share of global environmental damage today, and it is unlikely that poor countries will want to move toward sustainability if the north doesn't do so first. The northern hemisphere more than the southern can decrease global warming risks by reducing greenhouse gas emissions, for example. The north has to adapt to ES more than the south, and arguably before the south. The main exception is biodiversity, most of which is contained in tropical ecosystems. The north can afford to exert leadership on itself. But because developing economies depend to a much greater extent than do OECD economies on natural resources, especially renewables, the south has much to gain from reaching ES. In addition, because much tropical environmental damage is

irreversible, it is either impossible or more expensive to rehabilitate tropical than temperate environments, so the south will gain more from a preventive approach than from emulating the short-sighted and expensive curative approach and similar mistakes of the north.

Does ES Imply Reversion to Autarky or the Stone Age?

As soon as society perceives that environmental sustainability means conservation of life-support systems, people will demand it on the grounds of welfare, equity, or economics. The poor suffer most from pollution and from the higher prices caused by depletion. The poor are least able to protect themselves against scarcities (e.g. of clean water, clean air) and pollution. Among the rich, only a few are acting on the message that affluence and overconsumption do not increase welfare. Much more education is needed for overconsumers to realize that rides in limousines are often slower as well as more polluting than those on the metro, and that eating three steaks a day reduces fitness. As the costs of overconsumption increase (sickness and decreased productivity, health costs, heart attack, stroke), this message will spread. Reducing waste means needing fewer land fills and trash incinerators, which would improve human welfare. The concept of sufficiency (doing more or enough with less) needs dissemination.

ES Involves Public Choice

ES as biophysical security is connected to welfare, and both are somewhat connected to economics, especially to efficiency of use. Public choice governs the rate at which society elects to approach ES voluntarily and purposefully, or, as at present, to recede from it. Society has the choice of an orderly transition to environmental sustainability on our terms, or of letting biophysical damage dictate the timing and speed of the transition. If society allows biophysical deterioration to make the transition to ES for us, the transition is likely to be unacceptably harsh for humans. That is why clarity and education are so important in the race to approach ES. Partly because recognition of the need for ES is so recent, political will and institutional capacity now have to catch up. There will be powerful losers when society decides to move toward ES and toward making polluters pay. Institutional strengthening therefore is a necessary condition for ES.

CONCLUSION

This paper reviews the current status of the debate about the concept of environmental sustainability and discusses related aspects of growth, limits, scale, and substitutability. While the paths leading to ES in each country or sector will differ, the goal remains constant. But this conceptualization is far

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from an academic exercise. The monumental challenge of ensuring, within less than two human generations, that as many as ten billion people are decently fed and housed without damaging the environment on which we all depend, means that the goal of environmental sustainability must be reached as soon as humanly possible.

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