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Mr. Ackerman: For your use and disposal

From Richard A. Carpenter,
East-West Center, Hawaii

BACKGROUND MATERIALS
FOR THE
PLANNING WORKSHOP ON
ENVIRONMENTAL ASSESSMENT IN DEVELOPMENT
PLANNING & ASSISTANCE

Rec'd 4/78

East-West Center
Environment & Policy Institute
Honolulu, Hawaii
May 8-11, 1978

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TO THE WORKSHOP PARTICIPANTS:

I am pleased that you will be with us on May 8 - 12 and look forward to personally welcoming you to the East-West Center and to the Environment and Policy Institute.

The material enclosed is designed to provide all of us with some equivalent background information so that the time in the workshop may be as productive as possible. I hope you can read through it before you arrive. We also invite and urge each of you to send ahead or bring along other pertinent materials -- those of general interest can be copied for distribution. Our own project library is just beginning and so your contributions will be greatly appreciated.

On Sunday evening May 7, Richard Carpenter, Project Coordinator, other EAPI staff, and I will be at the Pagoda Hotel from 7 - 9 p.m. to greet those who wish to meet informally. When you check in, there will be further information on the location of this meeting.

If there are any problems concerning travel or lodging arrangements, please contact Mr. Harold Ajirogi, EAPI Program Officer.

Your knowledge and experience promise to make this planning workshop a success for the EAPI, and I believe each of us will be rewarded as well by new friendships.

Aloha,

William H Matthews

William H. Matthews
Director

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Environment & Policy Institute
East-West Center
Honolulu, Hawaii 96848

March 24, 1978

TENTATIVE AGENDA

PLANNING WORKSHOP ON ENVIRONMENTAL ASSESSMENT IN DEVELOPMENT PLANNING AND ASSISTANCE

May 8-12, 1978
John A. Burns Hall, Room 3125
East-West Center
Honolulu, Hawaii

Richard A. Carpenter, Project Coordinator

MONDAY, May 8

9 AM Introductions
Presentation of EWC/EAPI goals and the objectives of the Workshop

10:30 Refreshments

10:45 Round table discussion in which each participant will be asked to introduce himself and describe his position and viewpoints on the Workshop topic

12:30 Luncheon - Jefferson Hall Cafeteria

1:30 Current practices and trends in environmental assessment. Each participant will be asked to summarize briefly his recent experiences with EA in development planning and assistance and knowledge of other work planned or going on in this field.

3:00 Refreshments

3:15 Continue individual remarks

4:35 Confirmation of agenda for the remainder of the week

5:00 Adjourn

5:30 Informal discussions during Reception and dinner - Jefferson Hall

TUESDAY, May 9

9 AM Presentation of case studies and illustrative experiences where EA played a significant role in development planning and assistance (by resource persons and selected participants). Discussion.

10:30 Refreshments

10:45 Continue

Tuesday continued

12:30 Luncheon

1:30 Preliminary identification of problems and topics that may be the subject of cooperative research and study under EWC/EAPI auspices

4:30 Adjourn

WEDNESDAY, May 10

9 AM Parallel small group discussions - each group to identify and refine the particular needs of:

a) donor officials
b) recipient officials
c) development planners
d) environmental agencies

10:30 Refreshments

10:45 Plenary session to aggregate and discuss group reports

12:30 Luncheon

Afternoon free for study, individual discussions or recreation

THURSDAY, May 11

9 AM Construction of work plan for the 3-5 year EAPI project including:

a) research topics in priority order
b) research strategies, scope, and time tables
c) appropriate topics for case studies
d) key persons to be involved
e) cooperating institutions
f) expected products
g) audiences, clients and dissemination plans
h) coordination with other related research
i) evaluation criteria and plans

(Refreshments at 10:30 and 3:00, Luncheon from 12:30 to 1:30)

FRIDAY, May 12

9 AM 1) Recapitulation and agreement on next steps
2) Specific activities for remainder of FY 1978 (to September 30, 1978)
3) Specific activities for FY 1979 (October 1, 1978-September 30, 1979)
4) Tentative schedule for FY 1980

(Refreshments at 10:30)

12:30 Luncheon and adjournment

INTRODUCTORY PAPER FOR PARTICIPANTS
IN THE PLANNING WORKSHOP ON
ENVIRONMENTAL ASSESSMENT IN DEVELOPMENT PLANNING AND ASSISTANCE

I. Background

The Environment and Policy Institute (EAPI) is a new unit of the East-West Center (EWC), having begun work on October 1, 1977. The concept for the Institute is to examine environmental factors as an integral part of various policies rather than as a separate focus of environmental policy. There are, of course, policies for protecting the environment and abating pollution. These policies and their administrative implementation may often become polarized vis-a-vis other policies in the minds of decision makers and the public with antagonism as the result. A more useful approach appears to be that of accomplishing of national goals via restoration and maintenance of environmental quality plus sustained productivity and wise use of national resources.

The premises of the EAPI are:

1) Progress of civilization is now coming to be measured in the meeting of basic human needs for all persons. These needs are expressed through policies of society that guide management of day-to-day activities in a rational manner.
2) Human activities combine social behavior with the physical environment that is governed by natural laws. Enhanced understanding of the structure and functions of the natural environment can optimize activities to meet basic human needs.
3) Tensions arise within and among nations when environmental factors are dissociated from technical, economic and political

factors in policy planning and decision making. The purposes of the EWC (to increase understanding among nations through cooperative research on problems of mutual concern and consequence) can be served by the program of the EAPI to address important issues in the context of environment as an integral part of policies.

4) The integration of environmental understanding into policy formation and management requires special efforts from both scientists and decision makers. The study and synthesis of environmental knowledge, as focused by the concerns of policy, through the cooperation of competent and experienced scholars, in an independent institutional setting, can make a significant contribution to the needed integration.

In international affairs the enphasis on environmental concerns that has grown rapidly in the developed countries has been viewed skeptically by the developing nations. The quest of poorer countries is to meet basic human needs for their peoples, to maintain political stability, and to obtain an equitable share of the wealth and resources of the world. Assistance in this task from the industrialized nations has never been adequate. Procedural requirements of development assistance (such as environmental assessments) that divert money, talent, organization and facilities from getting on with the business of economic growth are often not well received by planners in recipient countries or in donor agencies. At the same time, there is considerable evidence that environmentally sound development is a practical long term necessity for all nations in a world of expanding population, inadequate or maldistributed resources, and powerful technological capabilities for

perturbing natural systems. In particular, the quality of life for rural poor people cannot be improved unless a higher priority is given to restoring and maintaining the natural resource base.

The policies for development planning and assistance are of mutual concern and consequence among countries participating in East-West Center programs and these policies contain a significant and growing environmental dimension. Discussions with officials and experts in the field confirm this hypothesis. A review of recent authoritative literature (see Appendix A) suggests the possibilities for misunderstanding and tension.

A prospectus for an EAPI project in this subject area was sent to about 40 knowledgeable persons in the US and Asia-Pacific countries. Constructive replies have been received from 25 experts urging that a project should be given serious consideration. Several staff members, visiting professionals, and students at the EWC who have had related experience were asked for advice about the project; the response was generally encouraging.

Therefore, this planning workshop has been convened. Its purpose is to:

1) Involve experts from several countries in setting the course and schedule of the work.
2) Involve persons who will be potential users of the products of the project.
3) Anticipate the nature of useful products, i.e., educational materials, decision making tools, new knowledge, and improved analytical methods.
4) Identify cooperating institutions and individuals.
5) Obtain knowledge of the work of others in the field.
6) Design research activities.

II. East-West Environment and Policy Institute Resources Available to the Project

In helping to plan the project, workshop participants should be aware of the approximate work years, money and facilities that may be allocated.

The goal of the East-West Center is to promote better relations and mutual understanding among nations of Asia and the Pacific through cooperative programs of research, study and professional education in problem areas that are of significant concern and consequence. The project will comprise activities such as workshops, conferences and team research involving individuals from many countries, different disciplines, different roles in the development business, and various levels of professional and managerial experience.

The major source of funding will be the East-West Center although additional support will be sought as the project develops. It is anticipated that permanent full-time academic staff of the EAPI will be assigned to the project approximately as follows: FY78 (Oct. 77-Sept. 78) 2 work years; FY79, 4 work years, FY80, 5 work years; FY81, 5 work years. One or two visiting Fellows will be appointed for the years FY79 and 80. One Joint Doctoral Intern and one Graduate Degree Student will work on the project in FY79 and this assistance will double or triple in later years. Support services will be supplied as needed.

Funds will be available for travel, stipends and per diem to support visiting scholars, conference attendance, and related research activities. Facilities are adequate for conferences, publication, preparation of audio-visual products, and computer assisted data processing.

Thus, the project may be envisioned as a total of 35-40 work years over the next 4 years involving participants from 10-20 countries who are skilled and experienced in elements of environmental assessment and economic development.

III. Scope

The US, the World Bank, and possibly other countries and financing institutions now require some form of environmental assessment in the development planning process and in the evaluation phase of loan or grant applications. This EAPI project will examine the consequences of these requirements and will explore ways to make the environmental assessment a positive and integral part of policy formulation and decision making. These requirements suggest that the propriety (or right) of a recipient country to set its own priorities for development of its natural resources, make its own tradeoffs between short and long term gains, and to establish its own environmental quality standards does not excuse donor agencies or governments from the responsibility of informing the recipient country about risks, consequences, and external costs accompanying development projects.

Other agencies and institutions are also investigating these topics and the EAPI project is intended to be a complementary contribution to the evolving business of environmental assessment in the next few years. The EWC has a credible independence from all official actors in the development finance field. The EAPI is committed to objective study and research on environmental dimensions of policies and is not predisposed toward either protection or exploitation of the environment, or any particular aid or development strategy. The premise of the EAPI is that the enhancement of the process of acquiring and using scientific environmental information can help improve development decision making.

We recognize that this limited scope lies within a broad set of issues regarding foreign aid and development assistance. Debate continues on the question of aid per se; i.e., how much, to what extent it leads to continued or increased dependency of the recipient countries, or how developed country values are thus imposed. But these are not the subject of this EAPI project.

regardless of present goals and shifting goals, most developing countries want to move away from their current state or condition. Alternate strategies for development are topics for serious study (i.e., emulation of industrial patterns with "trickle down" effects, or "getting services to the poor and poor to the services", or emphasis on ecological harmony and quality of life); but all strategies can benefit from better information about environmental potentials and constraints, and so intercomparisons are not necessary for this project. The present system of assessment and decision making is evolving and changing. We are interested in cooperative research to enhance the process of environmental assessment and to optimize its usefulness to all parties.

Definitions:

1) Environment: In this context of assessment for development projects, environment means man's bio-geo-physical surroundings. This delimitation is necessary to give special attention to the natural environment and to raise these considerations to an equal level and weight in decision making compared with other factors; i.e., economic, social, cultural, institutional and political. Special consideration is warranted by the long term character of environmental consequences, the ultimate dependence of society on the sustained productivity of ecosystems, and because environmental values are difficult to internalize in conventional economic analysis.

2) Environmental Assessment (EA): the continuing process of acquiring, analyzing, understanding, interpreting and transferring information about ecosystems as they are related to development projects.

An adequate and proper assessment of environmental consequences

is performed with an awareness that subjective political judgments determine the strategies of development and the scope of projects. The assessment process is objective scientific study and therefore generates essentially "neutral" information by which decision makers can judge among trade-offs and alternative plans. An EA may offer new technical alternatives for accomplishing the social goals of the subject project (including its abandonment). It should identify those social impacts that are significant and that are closely resultant from the predicted changes in the natural environment.

This rigorous analysis should reveal opportunities for exploitation of resources as well as undesirable effects to be avoided. Preparation of an EA can be a constructive, helpful, expediting activity within the total process of development planning and implementation. It identifies and evaluates all significant consequences explicitly and recognizes the degree of uncertainty in factual information. It addresses the conditions for long term sustained use of renewable resources and the environment and the optimum extraction rates and conditions for non-renewable resources.

3) Ecology: The study of the interrelationships of living things to one another and to their physical surroundings.

4) Ecosystem: a bounded structure of biological communities of organisms and their non-living surroundings, their interactions, and the flows of energy and materials; e.g., a pond, forest or grassland.

5) Environmental impact: the difference in the state of an ecosystem (as predicted for some future time) with and without the undertaking of a development activity.

6) Environmental impact statement (EIS): a document that organizes and presents knowledge from environmental assessment at one particular time. According to the U.S. National Environmental Policy Act (NEPA), the EIS is a formal entity that is made available to the public, and must accompany economic and social impact information through the decision making process. The adjudication of NEPA (Calvert Cliffs case) ordered U.S. federal agencies to compare environmental impacts against economic and social factors in a "finely tuned and systematic balancing analysis".

IV. Elements to be examined for the research plan

The following items are intended as points of departure for the discussions in the planning workshop. They are questions, hypotheses, information needs or analyses that can be structured into specific research activities. The list is derived from written and verbal responses to our preliminary work on the possibilities for the project. The workshop is expected to add, subtract, and modify these suggestions and to recommend a research plan. The rough categorizations are not mutually exclusive.

A. Development Assistance Issues

1) Quandary: Few developing countries possess the talent, information and facilities to do EA; but relegation of EA to aid agencies or foreign consultants may result in a bad mismatch of standards, values and criteria for trade-offs. If US methods for EA (i.e., high technology, computer assisted modeling extensive monitoring, etc.) are not appropriate for developing countries, what is realistic to expect? Is a realistic attempt sufficient to guide recipient planning to environmentally sound decisions?

2) In the development finance flow, who should pay for EA, who should be responsible for getting it done, who should do it?

3) To what extent should EA be separated from other required studies in the feasibility stage of development assistance (i.e., market, technology, economic, social and administrative capability analyses)?

4) What is expected of EA by different actors: donor institution officials, development planners, recipient country government officials, recipient country citizens, and researchers or technical advisers?

5) Public participation and intervention in decision making in the United States are a result of implementation of the NEPA. To what extent are these actions possible or appropriate in development assistance projects?

6) What proportion of development financing in the next decade will be devoted to water supply, public health, waste disposal and other direct measures to improve air and water quality?

7) Cultural differences exist among countries in attitudes toward the future (e.g., concept of interest on loans, emphasis on kinships, reverence for past and traditions). How do these differences affect the acceptance of EAs? The permanent and inherent characteristic of both ecological and socio-economic systems is change. How does recognition of this fact vary among cultures and countries?

8) Different countries may have different timetables for the use of resources and environment: first, exploitation to meet immediate needs regardless of damage may be necessary; next

repair and reclamation can be afforded; and finally, conservation and sustained yield can become national policy. How should EA be adapted to reflect these different phases?

Fundamental Questions

1) How can EA avoid the appearance of advocacy for environmental quality and achieve acceptance as objective analysis?

2) To what extent and under what circumstances are the following complaints about EA valid:

   a) it generates unwarranted antagonism toward the project by bringing up a variety of hypothetical or uncertain negative impacts.

   b) it dwells on a long term view when problems are urgent.

   c) it causes delays in projects.

   d) it increases the cost of project management and diverts scarce manpower.

   e) it imposes Western values and standards on recipient countries.

3) To what extent is the primary environmental issue in developing countries the deterioration of the resource base through overutilization rather than pollution from urbanization and industrialization?

4) Should the EA be combined into a comprehensive "natural resources assessment" for each country or region? Would this defuse the problem of EA seeming to be anti-development? Would this help get environmental considerations into the planning at an earlier stage?

C. The Process of Assessment

1) Environmental assessment (EA) is a process rather than a product (i.e., environmental impact statement). To what extent can or should EA be a part of the entire sequence of development - from prefeasibility, project identification studies to post implementation retrospective analysis?

2) What are the means and methods for doing a comprehensive environment and resources survey of a developing country including opportunities for immediate exploitation and for long range sustained productivity? What are the immediate possibilities for worldwide implementation of such surveys?

3) The early availability of environmental information to planners seems highly desirable. What are the practical possibilities for useful EA when specific projects are unknown or vaguely defined? How should limited resources be allocated between early planning and EAs on specific projects?

4) EA as a management tool implies involvement of managers along with modelers and environmental scientists. What are some incentives, motives and rewards for development planners and managers to participate in EA?

5) Three types of government agencies can be involved in EA: policy level coordinating groups; environmental pollution control units; and mission agencies. Which should have primary responsibility for EA? What can be done to make EA effective if the inappropriate agency has the responsibility?

D. The Content of Assessments

1) How can environmental factors be quantified, given economic value, or otherwise prepared for equal consideration in decision making along with economic, social, technical and political factors?

2) Should EA include the capacity of a country to manage its environment including technical and informational capabilities, laws, regulations and institutions?

3) What are the possibilities for studying folklore, customs, etc. as a shortcut to obtaining ecological knowledge about an area? Are these cultural manifestations of environmental management capable of being validated (or rejected) in modern scientific terms? Is such study more efficient than de novo field research?

4) Are EAs more effective when they address a few critical issues in sufficient detail to modify a decision or when they are comprehensive? To what extent is there a trend toward smaller localized projects using local resources in order to bring assistance directly to the poor and to avoid undesirable social disruptions of large centralized schemes? What kind of EA is useful when each individual project may not be "significant"?

5) To what extent is the usefulness of EA in all countries limited by the paucity of data about resources and the environment? What types of research and monitoring should receive priority in order to remedy this lack of information?

V. Suggestions for Research Approaches

The following comments have been received so far in response to the preliminary prospectus sent to about 40 persons in November 1977.

1) Case studies on recent development projects that contained a significant environmental component should be useful in evaluating the present EA capabilities and in providing cirricular material for an educational product of the project. Find out why actual implementation deviated from superior available alternatives. Develop the technique of post hoc analysis; avoid second guessing and harping on errors. Case studies must overcome the inevitable uniqueness of site, time, personalities and other non-technical factors so that general conclusions may be drawn.

2) The particular problems of the developing countries in doing EA should be the focus rather than giving attention to EA work going on in the developed world. The EA process must be simplified and tailored to developing country capabilities, cultures, and needs. Examine the significant similarities and differences between developed and developing countries as to the nature of environmental problems, relevant institutions and laws, social aims, available skills, etc. in order to reveal opportunities and constraints for environmental management and the extent to which Western methods are transferable or require modification.

3) Emphasize getting EA into earliest phases of development planning. Include user at the outset and continuously during EA process. Shift to "resources and environment" as the scope

of assessment rather than environmental protection. Look at USAID Initial Environmental Examination and AID and World Bank country profiles. Try to make EA anticipatory and preventive rather than reactionary. Pool donor and recipient expertise and information at the outset. Watch for cultural and political interpretations of technical facts.

4) Seek a coherent blending of economic and ecological information in models, decision making and management. Help the decision maker deal with uncertainty. View the desirable future as one of preserving options. Seek more useful expressions of environmental costs and benefits and avoid overaggregation and oversimplification into ratios and indices.

5) Study the possibility of different content and scope of EA for different types and stages of development. The EA may emphasize a) minimizing damage to the environment, b) opportunities for using environmental resources such as assimilative capacity, c) restoration of environmental quality, or d) sustained use of renewable resources. The emphasis may depend on the type of development project (e.g., industrialization, a program of many small scale changes, reclamation, or large scale land use planning such as resettlement of populations. Match the process and content of EA to the project.

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Appendix A

Recent Documents Pertinent to Environmental Assessment in Development Planning and Assistance

1. "Multi-lateral Aid and the Environment--A Study of the Environmental Procedures and Practices of Nine Development Financing Agencies." Report of Work in Progress, International Institute for Environment and Development (IIED), Sept., 1977, Washington, D.C. Funded by the United Nations Environment Program (UNEP) and the Canadian International Development Agency (CIDA), this interim report describes the procedures and practices of the World Bank, the Asian Development Bank, the Inter-American Development Bank, the Organization of American States, the African Development Bank, the Arab Bank for Economic Development in Africa, the Carribean Development Bank, the UN Development Program and the European Development Fund. The Study concludes that there is a general awareness and acceptance of the environmental dimension in all of these institutions. Except for the World Bank, however, there appears to be little attempt to systematically include environmental considerations in loan decisions. The report further notes a general lack of personnel trained to make environmental assessments, both in the borrowing country governments and the lending institutions.

   A report on the experiences of the World Bank was issued in June 1975 and a handbook for the preparation of environmental

assessments, entitled "Environmental, Health and Human Ecologic considerations in Economic Projects" was published in 1974 in French, Spanish and English.

A second phase of the IIED project will measure operational results (de facto standards and practices) of existing procedures by analyzing specific loans for human settlements, water resource development, forestry and energy.

2. The 1975 Dag Hammarskjold Report on Development and International Cooperation, "What Now: Another Development," foresees the possibilities within global ecological limits for further development but of a kind that is geared to the satisfaction of human needs:

> "Development is a whole; it is an integral, value-loaded, cultural process; it encompasses the natural environment, social relations, education, production, consumption and well-being. The plurality of roads to development answers to the specificity of cultural or natural situations; no universal formula exists. Development is endogenous; it springs from the heart of each society, which relies first on its own strength and resources and defines in sovereignty the vision of its future, cooperating with societies sharing its problems and aspirations. At the same time, the international community as a whole has the responsibility of guaranteeing the conditions for the self-reliant development of each society, for making available to all the fruits of others' experience and for helping those of its members who are in need." (p. 7)

The report prescribes a new role for science and technology:

> "Another development requires another approach to technology. This is true in Third World and industrial countries alike. However, just as another development does not imply jettisoning all that has been achieved to date, so, too, another approach to technology would not only be innovative but also use, adapt and build on substantial elements of existing technologies. However, it

would also diverge from them in several basic orientations; it should aim at; meeting needs; providing meaningful employment; sustaining ecological viability; and making the best possible use of the specific resources of local eco-systems. It should be: diversified so as to relate to the needs, resources and capacities of different societies and communities; be more closely linked to science; be broadly participatory and draw on the contributions of workers and peasants as well as specialized professionals." (p. 17)

3. The South Pacific Forum and the South Pacific Conference have commissioned a paper "Comprehensive Environmental Management Programme" (20 June 1977) that proposes a five-year effort to "insure that environmental activities become an integral part of sustained development (ecodevelopment) in the countries and territories of the region." Early work will result in proposals to the UN South Pacific Conference on the Human Environment in 1978. Ecodevelopment, as conceived by Maurice Strong in 1973, is based on priority for human needs, self-reliance rather than increasing dependence on outside groups, and harmony between people and their environment. Ecodevelopment does not question the kind of development per se, but only its appropriateness to a particular place and culture.

According to the paper, environmental management will require a substantial expansion of scientific research and surveys in the South Pacific, and the collection and distribution of natural resources data. "It is essential that environmental management be seen as an integral part of the development process, and not independent of or opposed to it." (p. 7)

4. The International Council of Scientific Unions (ICSU), through its Scientific Committee on Problems of the Environment (SCOPE) has issued a report on "Environment and Development" (1974). This compilation from a symposium in Nairobi on February 11-23, 1974 includes a paper on "Alternative Patterns of Development" by Ignacy Sachs (pp. 385-99). He notes that "the notion of organizing possible futures and choosing a desired future is gaining acceptance . . . Problems of resources, energy, environment, population and development cannot, in fact, be correctly understood unless they are examined in relation to one another . . ." He discusses ecodevelopment as a style that "in each ecoregion, calls for specific solutions to the particular problems of the region in the light of cultural as well as ecological data and long-term as well as immediate needs." Sachs calls for "a network of scientific collaboration in which our colleagues of the Third World will have primary responsibility, since encouragement must be given above all the exchange within the Third World, on a South-South axis, by insisting on cooperation between ecoregions which are similar but situated in areas geographically distant from one another."

5. "More Effective Aid," SPEC (76) 11, is a report to the South Pacific Forum by the AID Review Task Force. The report presents a vigorous indictment of the aid process that "not only enables governments to do things they could not otherwise have done, but also enables--or in some cases positively encouraged--them to do those things

- in the wrong place;
- with unsuitable materials;
- with inappropriate technology;
- too lavishly;
- with inadequate preparation;
- sloppily; and
- with inadequate follow-up."

Many of these problems can be seen to stem from a lack of environmental consideration. The report further states that, in the South Pacific, "To date, there is no common policy on foreign investment, natural resources exploitation or protection of the environment . . . . On the face of it, the region is wide open for rich pickings by suitably competent and well-backed operators . . . . Alternatively, there is scope for well-planned and mutually-rewarding agreements between recipient and donor governments and foreign investors--regionally or nationally."

6. "International Requirements for Project Preparation: Aids or Obstacles to Development Planning?" is a paper written in 1976 by Dennis A. Rondinelli, who was a Senior Fellow at the East-West Center. He argues that complex procedures and requirements for project planning are beyond the administrative capabilities of developing nations and that foreign standards are imposed without sensitivity to local needs. "International assistance agencies may, in fact, be imposing analytical requirements on

developing nations that cannot be met even in modern, developed countries. The experience with environmental impact study requirements for new projects and programs in the United States suggests that local governments and private firms face the same difficulties attempting to meet Federal requirements that developing nations must cope with to satisfy international procedures for project preparation." This suggests that the experiences of the states would be a useful mutual exchange with the developing nations.

7. "Workshop on the National Environmental Policy Act," U.S. Congress, House of Representatives Committee on Merchant Marine and Fisheries, Serial 94-E, February 1976. In a paper by R.A. Carpenter, "The Adequacy of Scientific Information for the Implementation of the NEPA," it is concluded that the state of knowledge is inadequate to accomplish the purpose of the Act, i.e., to raise environmental considerations to an equal level with those of economics and engineering feasibility. A pre-occupation with EIS procedure has concealed the lack of ecological understanding and the uncertainty with which predictions can be made about changes in the environment. "There are few established principles of ecology upon which to construct a prediction. Most importantly, ecology by its very definition involves such a broad and complex number of things and interactions that adequate knowledge for practical application is very difficult to obtain. The

synthesis of observations and data into a complete and accurate description of a natural system to be impacted by technology, and the prediction of some future state of that system is a science (perhaps art) practiced by a very few and not satisfactorily."

8. Another SCOPE document is the result of a Workshop on Impact Studies in the Environment in 1974. The report "Environmental Impact Assessment: Principles and Procedures" (SCOPE No. 5, Toronto, 1975) surveys the state of the art at that time. The difficulty in getting the decision makers to actually use the assessments is explained. "The political and economic bases for action are tuned to the immediate and short-range influences of the market place. Here, cost-benefit analyses are based on interest rates related to present-day costs of investment capital, modified to account for uncertainty and risk and thus with a time scale of 10-15 years. Economic systems aim to maximize gains over the short term; ecological considerations suggest ways to minimize liabilities over the long term."

9. A third SCOPE report is "Environmental Modeling and Decision Making: The U.S. Experience" (Holcomb Research Institute, Indianapolis, 1977). The report surveys the use of models in environmental policy and decision making and reveals significant shortcomings in the availability of data, the lack of ecological theory and the difficulty of validation. It is concluded that except for short-term decision making on small simple systems,

models have a "limited chance of playing a useful role in planning or policy formation." Although additional technical work is expected to continue to improve model utility, a crucial requirement for future development is to include the manager-user from the beginning along with environmental scientists and modeler-analysts.

Appendix B

Relationship of the Project Activities to EAPI'S "Methodology and Information Base"

An important long-term goal of the Environment & Policy Institute (EAPI) is to develop a Methodological and Information Base in a number of fundamental areas pertinent to the multi-disciplinary scope of the Institute. The various projects chosen will provide significant input to this base which, in turn, will help to contribute an underlying unity, continuity, and structural foundation for tying together the different activities of EAPI.

The first project initiated at the Institute focusses on "Environmental Assessment in Development Planning and Assistance." A number of issues which will be considered during this project will provide valuable information for the Methodological and Information Base. This being the Institute's first project, the flow of information will be initially uni-directional. However, as other projects - including the elements of the Methodological and Information Base itself - develop, the transfer of knowledge will take place in both directions.

The components of the Methodological and Information Base have been classified into seven general categories, with some inevitable overlay between them. These are:

1. Structure and Functions of Ecosystems -- with particular emphasis on the role and effect of man's activities in modifying natural systems.
2. Environment and Resource Surveys, Inventories, and Baseline Studies -- with emphasis on the use of this information in planning and policy-making.

3. Environmental Perceptions -- with a focus on the differences among cultures, societies, and nations.
4. Simulation Modeling -- with a concentration on the use of mathematical models as management tools.
5. Policy Analysis Methods -- with emphasis on techniques for decision analysis and the incorporation of environmental dimensions into economic analysis.
6. Integration of Environmental Assessment into Policy and Administrative Procedures -- with special attention to the differences and similarities among countries of East and West as they confront local, national, and international problems.
7. Dissemination and Utilization Methods -- with special emphasis on techniques that are useful for professional education in various cultural contexts.

The interaction between these elements and the research activities of the project can be illustrated by considering one of the issues which the latter project will be examining. The question "How can Environmental Assessment be adapted to reflect the differing needs of countries at different stages of economic and technological development?" is closely linked to several of the Methodological and Information Base components listed above. For example, the availability of Environment and Resource Surveys, inventories, and baseline studies (Item 2) will vary greatly between countries, and will influence the type of assessment which can be undertaken. Similarly, the perceptions of environmental quality (Item 3), and the process by which environmental concerns are incorporated into decision-making (Item 6) will differ greatly between countries with different cultures, and at different levels of economic and technological development. Research on the adaptation

of Environmental Assessment for countries showing this diversity, will provide valuable information for the elements mentioned. Also, as the elements of the Methodological and Information Base are built up in tandem with other projects at EAPI, they will become a valuable source of knowledge for answering some of the questions related to "Environmental Assessment in Development Planning and Assistance."

January 1978

Conservation Foundation
A MONTHLY REPORT ON ENVIRONMENTAL ISSUES
Letter

A Growing Worry: The Consequences Of Development

IN THIS ISSUE: Foreign countries and outsiders involved in their development efforts often overlook the environmental impacts of their projects. But many techniques are available to bolster environmental planning and analysis. These include more and better scrutiny by aid and lending agencies, and use of the United States' environmental impact statement procedures.

In their rush to development, foreign countries and their aid benefactors frequently overlook or ignore the secondary impacts of their projects, including adverse environmental consequences. The resulting damage to community or country can be severe. Expensive programs can in fact be counterproductive or self-defeating.

The evidence of this is everywhere. Consider water development alone. A new water supply system renders obsolete a well that was the town's social focal point. Another system intensifies urbanization in a Third World city unable to cope with it. A well in Africa's Sahelian zone, equipped with a motorized pump to boost the flow of water, intensifies settlement and grazing and contributes to the horrendous effects of drought. A dam and irrigation system, such as the Aswan in Egypt, spreads the disease schistosomiasis to hundreds of thousands of people.

Drawbacks are widely associated with other forms of development as well—they include industrial pollution, habitat destruction, pesticide misuse, deforestation, and adverse impacts of energy development.

There is, unfortunately, another ominous dimension to this environmental neglect: the impacts of development often spread to other nations or to their joint life-support system, the so-called "global commons." Again, the evidence of actual and potential international damage has become increasingly plentiful and clear:

Pollution in one country sends acid rain to others. Toxic chemicals, including carcinogens and mutagens, spread worldwide. Fluorocarbons may endanger the ozone layer. A favorable climate may be threatened by carbon dioxide, by desertification, and by the clearing of tropical forests. Habitat and ecosystem destruction wipes out animal and plant species, of which thousands have not been tested for medicinal properties and other values. Nuclear proliferation poses risks everywhere.

All nations, furthermore, are directly or indirectly affected by the erosion or loss of agricultural land, and by the misuse or waste of such resources as water and oil. For these impinge on the global system of economy and trade, the competition for control of resources, national security, and humanitarian programs.

"The question of control over resources use, which over the years has led to innumerable controversies and a number of wars, has now emerged as a major international issue whose many dimensions and full magnitude may not yet be fully appreciated," says a report of the United Nations Environment Program (UNEP). "It reflects today a growing awareness of the

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"Many countries have become less resentful."

"Environment and development are two sides of the same coin."

nature and pervasiveness of global interdependence and the exhaustibility of global resources which has sharpened the competition for resource control."[1]

All of which further illustrates the elementary fact, trite as it sounds, that everyone is in this together now. That fact, increasingly evident as pressures grow, must be faced politically by all nations.

It will be faced, inevitably. With growing populations, scarcer resources, and intensified development, greatly increased environmental planning, assessment, and regulation will evolve everywhere. The main questions are, how soon will such efforts be effective, and how much will be lost to global society in the process. Will reform come too late?

Certainly, much environmental concern and activity is now evident throughout the developing world. Since the 1972 United Nations conference in Stockholm, many countries, though not all, have become less resentful and have tempered their views that developed nations are trying to impose self-serving or irrelevant constrains on their economic growth. They are acknowledging the advantages of obtaining more environmental information, of avoiding the rich countries' mistakes, of protecting their natural resources, and of cooperating to safeguard the international commons.

R. Thomas Hoffmann, of the International Institute for Environment and Development (IIED), speaks of the "growing recognition by officials in the developing world that 'environment' is not simply the problem of pollution in highly industrialized nations, but embraces a total system on which the development process itself ultimately depends."[2]

A Worldwatch Institute study puts it this way: "The struggle to preserve environmental quality stands squarely at the center, many now realize, of the overriding challenge of the closing century: meeting the basic needs of all people."[3]

Mostafa Tolba, the Egyptian microbiologist who heads UNEP, has elaborated the concept of "ecodevelopment." He has said that the relationship between the environment and development is intimate, inevitable, and inseparable. "They are two sides of the same coin."[4]

It is useful to keep in mind a distinction between two types of projects: those which have development goals but need environmental assessment, and those which themselves have environmental goals (such as pollution control, waste disposal, or reforestation). The latter also may have secondary environmental effects that need analysis.

For example, a proposal to develop a water supply system for Surabaya, second largest city in Indonesia, has had to consider the fact that adequate and safe water supplies would be a prime attraction for rural people. Such population redistribution, however, is contrary to Indonesian government policy and would exacerbate various urban environmental problems.[5]

One might say that the ultimate purpose of wise development is to increase the well-being of people—with respect to their basic needs and more—and to do so on a sustainable basis through rational use of resources and protection of ecosystems.

The two basic purposes expressed often are inherently contradictory, of course, particularly when present and future generations are considered. Clearing a tropical forest may increase farming and food production in the short run, but if the land loses its productivity in a few years, the future cost is high. A World Bank booklet cites U.S. studies to suggest that "by postponing action on the environment, developing countries can expect to incur very large expenditures in the not-too-distant future."[6]

These are the basic questions facing those who seek to resolve ecodevelopment issues:

1. If the benefits to environment and development conflict, can environmental damage be sufficiently eliminated or mitigated?

2. if not, to what degree should one be sacrificed to the other? (This may involve the choice between short-term and long-term costs and benefits.)

3. What political mechanisms or leverage should be used to encourage or require environmental assessment or protective measures? (And who is to pay the costs?)

Following is a discussion of what is being done in this regard, and what could be done.

Generally, there are two points at which to require environmental analysis and protection: in the government of a country where the development is to take place, or in an outside country, organization, or corporation doing the work or providing the support.

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Rice Odell, Editor

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"Exchanging the indispensable for the superfluous."

Certainly the most rational and efficient locus for environmental concern and planning—and the point of ultimate responsibility—is in the developing nation itself. It is only there that control can be exercised over the many development projects carried out internally or directly with foreign corporations.

That may be where the greatest needs lie and, generally speaking, where the least is done. Certainly one does not look to multinational companies to give high priority to environmental considerations in less-developed countries that don't require it, though some do.[7] Their chief imperative of profit-making may be achieved most easily by promoting the products or technologies they have developed, whether it be forest-clearing machinery, nuclear reactors, or dangerous pesticides and other chemicals.

(The federal pesticides law does not impose any controls on exports by U.S. firms, but as this was written Senate and House conferees were expected to approve an amendment for at least minimal control. The 1976 Toxic Substances Control Act also exempts export chemicals from testing requirements unless EPA finds they will present "an unreasonable risk of injury to health within the United States or to the environment of the United States."[8])

Denis Goulet, a senior fellow at the Overseas Development Council, has noted in a stimulating book that foreign companies have great leverage for imposing their technologies on poorer countries, and furthermore that the technologies transferred often are ill-suited to the environmental or other values of the people.[9]

Among many examples, he cites tourism, a favorite form of development for many nations and lending organizations. But he suggests ways of matching tourism development to the cultures of host communities.[10]

An editorial in the Ecologist says that development is a "means of exchanging the indispensable for the superfluous." (The magazine actually calls for "dedevelopment" on ecological grounds. Of Third World countries, it says: "Material prosperity will never be within their grasp, but what they can develop is another type of prosperity—probably a more satisfying, certainly a more durable one, based on a more subtle exploitation of the vast capital that Nature has put at our disposal."[11])

Along the same lines, Goulet suggests that "the very inability of some poor nations to achieve 'development' may prove a blessing in disguise, enabling them to avoid that economic 'cannibalism' by which nations devour their own prosperity."[9]

The UNEP paper says that transnational corporations are likely to ignore environmental and other social costs. Profit motivations induce them, for example, to "deplete mineral resources rapidly in one country because they are high-grade, easily transportable or under threat of nationalization, while holding similar resources in another country as reserves . . .

"Governments, and particularly those of poor countries, may find themselves too weak to bargain effectively or to uphold principles which depend on coordinated and concerted intergovernmental efforts for their effectiveness. Thus higher tax rates, requirements for in-country processing of resources, and pollution controls imposed by one country alone may simply destroy its own hopes for immediate development as the corporation affected takes its business to less far-sighted nations."[1]

Goulet says that most transnational corporations apparently conduct their Third World activities "with far less regard for ecological health than they are obliged to show in their home countries . . . Otherwise stated, foreign investments and technology transfers exact a high ecological price in the Third World."[9]

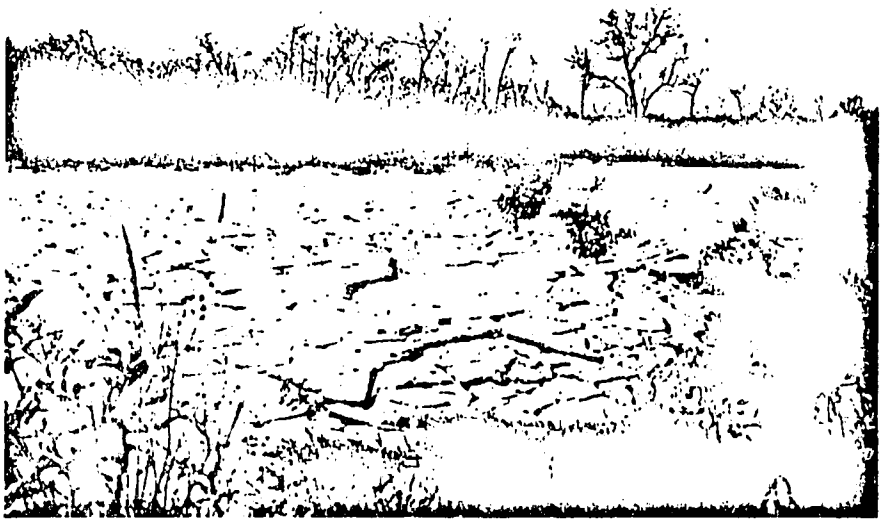

Photo by Fred P. Bosselman

This mangrove area in Mexico has been filled in for development use. It is at Cancun, in the northeastern part of the Yucatan peninsula, where a major tourist resort area recently has been built up.

"It is the rural poor who are most dependent upon renewable natural resources."

A Natural Resources Defense Council study says that many developing countries are poorly equipped for protecting and managing their natural resources and environment. They lack necessary policies and laws; they do not have adequate resource data to make sound decisions; and they do not have enough trained personnel to carry out programs.[12]

Some, however, have adopted policies, set up environmental ministries or councils, and established protective measures. The new development plan for Malaysia calls for environmental assessments of all major projects. Ghana has directed that environmental impact statements be filed by all new industries.[13] However, as Robert E. Stein, director of IIED's Washington office, notes, "Some nations draft laws with environmental language, but implementing them is something else again."

Developing countries can benefit from impact statements in several ways, says a case study by Donald E. Cullivan, president, and Richard Careaga, a planner, of Camp Dresser & McKee International, Inc. EIS's enable them to identify major adverse or irretrievable impacts, and to discover alternative solutions or methods to mitigate them. "A potential bonus is the identification of beneficial impacts, both primary and secondary."[5]

Some efforts are being made to help less-developed countries acquire better resource data from satellite remote sensing. Other programs provide technical assistance or training. This is particularly important, because some elaborate and expensive development projects are wasted when personnel are not available for adequate operation and maintenance.

The NRDC study points out that the U.S. Agency for International Development has undertaken or proposed a number of activities to help build environmental information and institutional capabilities, as well as to combat problems directly through erosion control, reforestation, and other projects. The study urges increased emphasis on such activities since this would serve the "overriding objective" of U.S. aid. "It is the rural poor of developing nations who are most dependent upon renewable natural resources. They suffer most from resource abuse and ill-planned development efforts."[12]

The study also recommends that AID carry out a thorough survey of environment and natural resource problems and institutional capabilities for solving them in each host country. Such surveys could lay the groundwork for the general expansion of environmental activities.[14]

Influence or pressure from outside a country—applied by foreign aid and lending agencies—can induce environmental concern and analysis. Such influence and pressure gradually is becoming stronger, though obviously there is a long road ahead.

A recent IIED study evaluated the environmental procedures and practices of nine international development financing agencies, including the World Bank, Inter-American Development Bank, and United Nations Development Program.[15] It gave the World Bank pretty good marks for dealing with the environmental implications of projects it funds. The Bank has cited many examples of funded activities that have been redesigned or had mitigation measures included at its behest.[6]

Still, the IIED study found many problems yet to be solved. Projects are reviewed by a small Office of Environmental and Health Affairs with a high degree of environmental consciousness, but this does not mean that the staff people who design projects give appropriate attention to environmental factors. "We frequently heard that by the time a project reaches the OEHA review point, it is 'set in concrete,'" the study said.

The OEHA workload also suggests that some reviews involve "hurried and superficial judgments." One of the OEHA staffers said he had reviewed over 100 projects in 45 days and had made recommendations on 65 of them.

Another weakness cited was the Bank's inability to review the environmental soundness of the many smaller projects financed indirectly by the Bank through regional or national development banks. "It is precisely this type of project which often offers the largest scope for the introduction of alternative approaches and incorporation of environmental protection measures."

Nevertheless, IIED said the World Bank's environmental position seems "more sophisticated and comprehensive than that of any of the other banks that we studied, and it is evolving continuously in a positive direction."[16]

Yet it should be kept in mind that the Bank—like so many of its member governments—is not subject to the kind of public, press, legislative, or other oversight controls regarded as essential in the United States. There is a built-in resistance to public scrutiny that makes it extremely difficult to investigate and evaluate environmental performance.[17]

Most U.S. agencies have resisted—and still resist—the idea that environmental analyses are prerequisites for projects they support in developing countries. Among other things, they are skittish about the foreign policy implications of "dictating" terms to other governments. Indeed, a foreign government may greatly resent any strings attached as an impingement on its sovereign authority—for example, if a U.S. agency requests an alternative

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"Foreign countries have no inherent or vested right to receive American assistance."

course of action to achieve an environmental goal. (After all, U.S. agencies have resisted reforms dictated by their *own* country's laws.) The opposite viewpoint is presented in a recent Environmental Law Reporter article:

"Foreign countries have no inherent right or vested right to receive American agency assistance, and the American agency may predicate granting the assistance, purely on a contractual basis, on receiving certain information concerning the environmental impacts of the aid, and on the aid being consistent with statutory American policy."[18]

The article said the contract argument could be carried a step further to require that a project include specific plans to mitigate environmental damage.

Environmental organizations have challenged some reluctant agencies in court. They are trying to establish a "global reach" for the National Environmental Policy Act, though not necessarily with inflexible adherence to its environmental impact statement requirements. There have been some favorable rulings, though the battle continues on a number of fronts. (See box on this page.)

It was under a court settlement that the Agency for International Development agreed to publish new environmental regulations covering all its programs.[19] Issued in mid-1976, these require a brief environmental examination of each project to determine whether it requires a full EIS or an Environmental Assessment. An EIS must be prepared for any AID activity having

COURTS REVIEW INTERNATIONAL CASES

A series of lawsuits filed by environmental organizations seek to force federal agencies dealing with foreign development to meet National Environmental Policy Act impact statement or other requirements. The principal cases:

- The pesticides programs of the Agency for International Development were challenged in a court suit brought by four environmental organizations. In a settlement in December 1975, AID agreed to prepare a programmatic impact statement on its pest control activities, as well as general environmental regulations.[18]

Basically, AID plans to stop financing wholesale procurement of pesticides, except in emergency situations, and to increase emphasis on integrated pest management. It will no longer approve the use in AID projects of pesticides whose registrations have been cancelled or suspended by EPA, except in emergencies or where an environmental analysis clearly shows the benefits outweigh the risks or there is no practical alternative.

- Under prodding of a court suit by three environmental organizations in 1973, the Atomic Energy Commission agreed to prepare a generic environmental impact statement on the overall nuclear power export program. (Since then, the Nuclear Regulatory Agency—in the case of a license to export reactor components for a nuclear plant in West Germany—ruled that NEPA does not require analysis of environmental impacts limited to a foreign site.)
- A federal judge in Washington, D.C., has twice enjoined the Federal Highway Administration from further work on the 250-mile Darien Gap Highway through Panama and Colombia on grounds that its environmental impact statement was greatly deficient. (FHA is financing two-thirds of the highway's cost.)

Most ominous of the feared impacts is the possible transmission of foot-and-mouth disease along the completed highway into North America, where its destruction could be enormous. Judge William B. Bryant has been highly skeptical of programs to prevent the disease's northward march. His injunction has been appealed, and a decision is expected soon.

- Two environmental groups are seeking a court order that the Export-Import Bank must comply with the requirements of NEPA. The Bank is a U.S. agency which finances and insures exports of U.S. equipment and services. The case is still being tried.

At issue are the impacts of equipment used for producing offshore oil, generating nuclear power, constructing railroads and highways, building polluting industrial plants, clearing forests, and filling wetlands. Among the projects cited in the suit are a 400-mile railroad in central Gabon and a 650-mile transmission line in southern Zaire, both of which would disrupt tropical forest ecosystems, endanger scientifically valuable species and other wildlife, and induce damaging development.

Also cited is a loan to Indonesia for the purchase of 24 dredges for reclaiming 2.2 million acres of tidal wetlands and mangrove forest on the coasts of Sumatra and Kalimantan (formerly Borneo). The purpose is to increase cultivation of rice and other crops. The suit, however, points to the dangers of siltation, destruction of fisheries, loss of wildlife, and the lessened value of the wetlands as a buffer against floods.

"If AID has taken notable strides, other agencies certainly have not."

"Ideas and concerns trickle through."

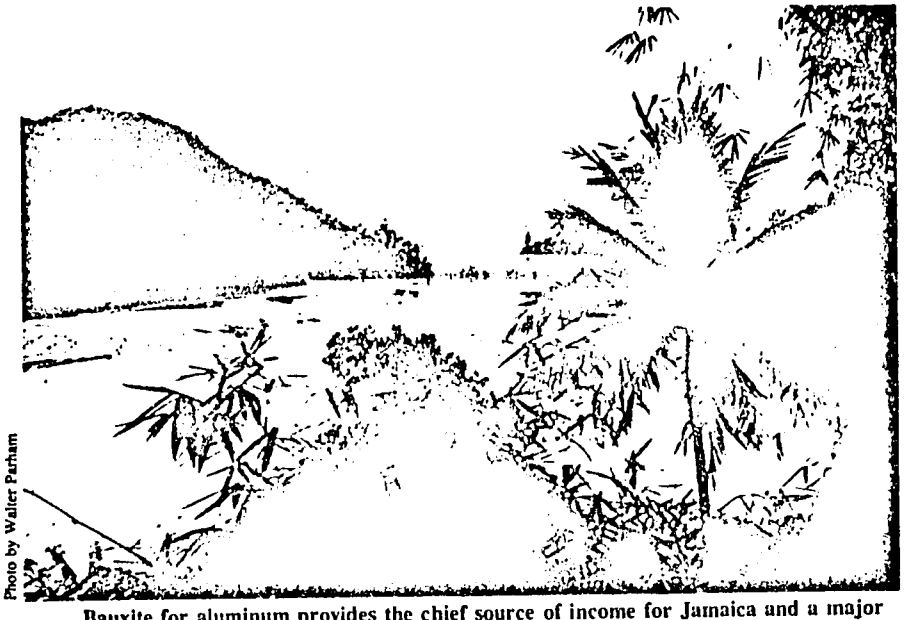

Photo by Walter Parham

Bauxite for aluminum provides the chief source of income for Jamaica and a major source for other countries, but in the conversion process, great volumes of sludgelike waste called "red mud" are produced. The disposal problem becomes more and more serious, but the experts are stymied in the search for a solution.

"Ponds and pits in the limestone regions of Jamaica are used as red mud disposal sites," says Walter Parham, of AID's Office of Science and Technology, "and in some areas, large earth dams have been constructed across valleys and have been filled with red mud" (as shown in the picture). Parham says a major concern is the possibility of dam failure, since earthquakes have struck the areas in the past. A further worry is groundwater contamination near the disposal sites.

a significant effect *on the U.S. environment or on the global commons* (typically very difficult to show), or if the administrator of AID finds it appropriate.

Otherwise, an Environmental Assessment is prepared. This, however, does not require, either in the U.S. or the host country, any public review or comment. (AID missions are to encourage host countries to make assessments available to the public.) "It's our policy to have joint environmental analysis with the host country to the extent that it is willing to participate," says Albert C. Printz, AID's environmental coordinator.

Finally, AID can decline to participate in a project if it feels the environmental risk is too great or efforts to include adequate safeguards have failed.

If AID has taken notable strides toward environmental protection, other agencies certainly have not. A strong overall federal policy on NEPA and international activities was provided by a memorandum of the Council on Environmental Quality in September 1976. It said NEPA requires environmental analysis even if a project's impacts are confined to the host country. But the memo was not binding.

Now, however, President Carter has given CEQ authority to issue *regulations* on NEPA implementation rather than just advisory guidelines.[20] These will include international applications. The key issues—and currently the subject of bitter interagency controversy—are the extent to which NEPA will apply to the State, Commerce, Treasury, and Defense departments as well as other agencies, and the extent to which it will apply to impacts internal to the host country.

Illustrating the difficulty of coming to grips with these issues is this equivocating language in CEQ's draft regulations on NEPA that have been distributed for informal review by other federal agencies: "The human environment is not confined to the geographical borders of the United States and includes (to be added)."[21]

As noted, it usually is very difficult to demonstrate effects that reach back to the U.S., though we can expect more and more examples in an increasingly impacted biosphere.[22] (A sobering example is the case of the deadly pesticide leptophos, or Phosvel. Banned in the U.S., it nevertheless was exported to other nations. Then it was discovered that some vegetables shipped from Mexico to the United States were contaminated with residues of leptophos.[23])

In addition to the general NEPA regulations, CEQ has sent out for review a separate set of special provisions dealing with international NEPA issues. Later, all proposed CEQ regulations will be subject to public comment. After final regulations are promulgated, each affected agency will have to develop procedures for implementing them.

One official said the CEQ regulations will be designed for flexibility in the level of detail required in analyses, and in the extent of public disclosure and review.

Environmental analysis or requirements worked out with, or imposed upon, a country—whether it be under NEPA's strictures, World Bank procedures, or some other process—undoubtedly play an important role in sensitizing foreign governments to environmental problems. Ideas and concerns trickle through to all levels and branches.

The World Bank says that, in lending for a project with significant environmental implications, it "often has an opportunity to influence the larger insti-

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"Democratic procedures do seem to recommend themselves."

tutional framework within which decisions will be made."[6]

The information alone that is developed in environmental analysis can be invaluable to a host government. Also, the appealing model of the NEPA process seems likely to prove compelling for more and more countries—particularly with the reinforcement that comes from experiencing environmental degradation itself. (One thinks of such examples as the Sahel drought, the premature silting up of large dams, or the severe air pollution of Mexico City.)

By concentrating on the impacts of individual projects, particularly the larger, more visible ones, it is easy for everyone concerned (aid agencies, host governments, environmentalists) to overlook two major perspectives:

First, in the words of Jeremy J. Warford, of the World Bank, and Patricia L. Rosenfield, of Resources for the Future, there is the question of "controlling a massive number of smaller-scale activities which cumulatively, and by an insidious process, may have a much more significant environmental impact."[5]

Second, it is easy to miss opportunities for setting social goals at the outset and planning development comprehensively around them. Thus Erik Eckholm, of the Worldwatch Institute, says we need "another giant step beyond such assessments (of proposed projects) to the incorporation of an ecological perspective into the development-planning process from its inception. A planning exercise with the natural environment's capacity to serve human needs as its reference point would, in many countries, generate a different mix of priorities and projects than those supported by present-day systems."[26]

The Surabaya, Indonesia, case study

'AN AGENDA OF COMMON BUSINESS'

Whatever procedures are used for environmental assessments of development projects, they have considerable potential for inducing more cooperation between governments and more interplay between a government and its citizens—democratization, that is. Even in the United States, with traditions of public participation far surpassing those of most countries, there remains a strong antipathy to citizen involvement in foreign activities. The doors to international clubs are pried open with difficulty.

Yet some small initiatives in the name of international environmental concern have been taken, and they hint at the possibilities. Consider a mixture of existing procedures and proposals for reform:

- The United Nations Environment Program is thrashing out some "principles of conduct" for countries sharing natural resources. Several U.N. agencies are working on a code of conduct for transnational corporations which could cover the use of natural resources.
- Environmentalists have urged the Agency for International Development to make its Environmental Assessments, as well as its Environmental Impact Statements, available for public comment and review.
- It has been suggested similarly that formal procedures be established so that outside nations, especially neighboring nations, could submit comments that would be integrated into the environmental impact statement process or other procedures. Foreign individuals or organizations could be allowed the same opportunities for participation.
- The Toxic Substances Control Act requires the exporter of a toxic chemical to inform EPA, which in turn must notify the importing country that data on the chemical is available or, as the case may be, that regulatory action has been taken.[8]
- The Clean Air Act amendments of 1977 provide for revision of a state implementation plan to control air pollution endangering the public health or welfare of a foreign country. A revision would be prompted by information from an international agency or by a request of the Secretary of State.[24]

The provision, which would not apply to a foreign country unless it gives the United States essentially the same rights, requires that an affected nation be invited to appear at any public hearing associated with a plan's revision.

Do these bits and pieces signal a trend toward greater international participation and cooperation? In a recent comment, the New Yorker suggested that more democratic procedures may evolve among nations because unanticipated events have placed "an agenda of common business in everyone's hands—business that includes the much-discussed tasks of saving the earth's ecosphere from despoliation, husbanding the earth's resources, preventing a large-scale collapse of the world economy, and preventing a nuclear holocaust.

". . . when many wills are required to make decisions together, and no one of them has the power to force all the others into compliance, however much it might like to, democratic procedures do seem almost to recommend themselves . . ."[25]

provides one illustration, with its conflict between the water system's benefits to health and welfare and the disbenefits of crowding induced by the improved sanitation. "The resolution of this conflict," say Cullivan and Careaga, "lies in the ability of the central government to balance the timing, amount, and location of economic and population growth through the implementation of effective land-use and population controls. Such measures are beyond the capacity of any overall program of physical development."[5]

Another example is the Sahel, where, says a World Bank official, water should not be dispensed until there is a range management plan. "If one finances water management systems, one should at the same time organize the users into grazing schemes, ranching cooperatives, or whatever is indicated."

All kinds of considerations might enter the equation of an otherwise successful operation to clear a tropical forest for timber, says Walter Parham, of AID's Office of Science and Technology, in a third illustration. The lumbering operation may be followed by slash-and-burn agriculture. "They would have an inroad. But the government may know that the forest will be cut and burned anyway. Or it may decide it needs the employment, or to cut the flow of money out of the country. The country itself must decide if it wants the forest cut, and whether it will be helpful 10 to 20 years down the road."

A. D. Moddie, a former official of Lever Bros. in India, says there is a need for "new and total ecodevelopmental concepts" and that the prime responsibility for them rests with the "highly qualified international funding agencies and the national planners. Here is scope for them to play an innovative role to match the complexity of the situation . . ."[27]

The NRDC study urges that AID expand its environmental reviews to encompass not merely individual projects but programs which are carried out in several countries or are agency-wide. "Perhaps more importantly," it says, "AID should examine the environmental effects of its (overall) program of assistance to each host country." It says that a generic environmental assessment—together with the economic and social analyses already required—during the preparation of long-term aid agreements and annual country program plans, would provide environmental factor analysis at a much earlier stage of development planning.[12]

"I would like to see AID take the lead among other donors in all this," says NRDC's S. Jacob Scherr.

All these suggestions for earlier, more comprehensive, and more sensitive planning would be greatly facilitated and enhanced if agencies and governments built in extensive procedures for intergovernmental and public participation. (See box on page 7.)

The U.N. Habitat and Human Settlements Foundation, for example, says it advocates an emphasis on public participation because of its "practical role in making the most of scarce resources and building up functional self-reliance."[28]

Footnotes:

[1] Working Paper, Intergovernmental Expert Group on Environment and Development, December 2, 1976, UNEP/IG.4/3.

[2] *Environment Reporter*, September 9, 1977.

[3] "The Global Environment and Basic Human Needs: Trends and Problems," a report to the Council on Environmental Quality, Worldwatch Institute, January 1978.

[4] *World Environment Report*, May 24, 1976.

[5] *Environmental Impacts of International Civil Engineering Projects and Practices*, American Society of Civil Engineers, papers from an October 1977 conference (preprint).

[6] "Environment and Development," World Bank, June 1975.

[7] An interesting example of corporate development—by the Potlatch Corporation in Western Samoa—is reported in "A Forestry Scheme in Samoa," by Paul Shankman, *Natural History*, October 1975.

[8] Public Law 94-469, Section 12.

[9] *The Uncertain Promise*, IDOC/North America with Overseas Development Council, 1977. Or see article by Goulet in *International Development Review*, 1976, No. 3.

[10] Tourism development and the environment is the subject of a forthcoming Conservation Foundation book, *In the Wake of the Tourist*, by Fred P. Bosselman.

[11] *Ecologist*, November 1977.

[12] "Environment, Natural Resources, and Development: The Role of the U.S. Agency for International Development," NRDC International Project, January 1978.

[13] *World Environment Report*, December 5, 1977.

[14] Such activities are greatly encouraged and facilitated by the 1977 addition of Section 118 to the Foreign Assistance Act (22 U.S. Code 2151p).

[15] "Multilateral Aid and the Environment," IIED, interim report, September 1977. (Final report is due in the spring.)

[16] Other reports on World Bank activities and the environment are in *Environmental Science & Technology*, September 1977, and *Environment Reporter*, August 19, 1977.

[17] A *Wall Street Journal* article on Indonesia, November 10, 1977, illustrates the kinds of World Bank failings that can be uncovered in the field.

[18] See "Renewed Controversy Over the International Reach of NEPA," comment in 7 *Environmental Law Reporter* 10205. This article discusses the NEPA cases noted here and provides full citations.

[19] 22 *Code of Federal Regulations* Part 216.

[20] Amendment to Executive Order 11514, issued May 24, 1977.

[21] These were printed in *Environment Reporter*, December 16, 1977, p. 1291.

[22] For example, see "Controlling the Environmental Hazards of International Development," by George D. Appelbaum, *Ecology Law Quarterly*, Vol 5, No. 2 (1976).

[23] *Washington Post*, December 9, 1976. And see *Environment*, January-February 1977.

[24] Public Law 95-95, August 7, 1977, Section 115.

[25] *The New Yorker*, January 23, 1978.

[26] *Losing Ground*, W. W. Norton, 1976.

[27] *International Development Review*, 1976, No. 4.

[28] UNEP/GC/93, February 21, 1977.

Conservation Foundation Letter

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January 1978

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Environment, Natural Resources, and Development: The Role of the U.S. Agency for International Development

Thomas B. Stoel, Jr.
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International Project

Natural Resources Defense Council, Inc.

January 1978

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SUMMARY

In 1977, the President and the Congress provided to the U.S. Agency for International Development a clear mandate to assist developing countries to protect and maintain their environment and natural resources. AID was directed to insure the environmental soundness of its own projects, to make special efforts to protect the land, soil, forest, water and wildlife essential to sustainable development and human well being, and to help developing countries to build their own environmental protection capabilities. "Environment and Natural Resources" was added to the list in the Foreign Assistance Act of major functional sectors which are to be the focus of U.S. bilateral aid.

The need for more effective efforts to protect the environment and to maintain the natural resource base is becoming increasingly apparent to developing country governments, AID and other development assistance agencies. A few countries, such as Haiti and the Sahelian nations, already have suffered ecological disasters where natural systems have collapsed after years of abuse. In many other aid receiving nations, forests and agricultural lands are deteriorating under pressure from increasing demands for food, energy, and materials. Overcutting of woodlands, overcropping and over-

grazing of agricultural lands, and the lack of proper conservation measures are contributing to destruction or decline of millions of acres of productive lands in the developing world with consequent losses of agricultural production and national income. Yet the impact is the greatest upon the rural poor who are the most dependent on natural resources -- the soil, trees, water and wildlife -- for their livelihood and well being.

AID already has underway or proposed several activities responsive to the Congressional and Presidential directives. A number of AID projects seek to protect or maintain the natural resource base of host countries, through soil erosion control, reforestation, rangeland management, and improved irrigation methods. Environmental assessments or impact statements are being integrated into AID project design procedures. Finally, the agency is helping a number of host countries to develop their institutional and informational capabilities with such programs as natural resource surveys using remote sensing data, the development of natural resource management laws, policies, and agencies, and training and technical assistance in resource planning, protection, and management.

Yet the dimensions of the environmental challenges facing developing countries, as well as of their government's

ability (along with other donors) to tackle them, remain ill-defined. The available information is rather limited. In order to assure that AID begins to address these problems systematically and before crises occur, we recommend that beginning in FY 79, AID carry out a thorough review of environment and natural resource problems and institutional capabilities in each host country. The survey would provide a much needed information base not only for further development of AID projects in the Environment and Natural Resources sector, but also for host governments and other aid agencies.

I. Introduction

Since World War II, the natural resources of many developing countries have come under severe pressures. Expanding populations, together with rapidly growing demands for food, energy, and shelter, are taxing land, soil, forests, water, and wildlife throughout the developing world. The deterioration of the natural resource base in a number of poorer countries undermines their capacity to meet the basic needs of their people, and to achieve sustainable development.

A few countries, such as Sahelian nations and Haiti, already have suffered ecological disasters when life-supporting natural systems collapsed after years of abuse. In the Sahel, overcropping and overgrazing made millions of acres of productive, semi-arid lands extremely vulnerable to drought. The dry years of 1968-1974 accelerated the decline of these lands, changing some into deserts and resulting in famine throughout the region.[1] In Haiti, over three-quarters of the country's forests have been leveled over the past fifteen years, primarily to make charcoal for cooking and heating. With the trees removed, groundwater supplies diminished, soil erosion increased, and downstream hydroelectric generators and irrigation canals were clogged with sediment. The destruction of the forests

1/ Glantz, "The U.N. And Desertification: Dealing With A Global Problem," Desertification, Environmental Degradation In And Around Arid Lands, (Glantz, ed., 1977).

may even have affected Haiti's climate. A succession of severe droughts since 1974 triggered a crisis early this year when the Haitian people were faced with serious shortages of food, water, and electrical energy.[2]

Environmental stress is not limited to these countries. A 1976 survey carried out by personnel in U.S. Embassies on population policies and the effects of population growth in other countries found that 43 of the 69 developing nations profiled were experiencing problems with overcropping and/or overgrazing, resulting in serious soil erosion (28 countries) and declining soil fertility (12 countries). In 24 countries, the heavy destruction of forests was found to be hampering food production. A number of these were experiencing water problems due in large part to deforestation; sixteen suffered periodic water shortages and ten increased flooding. Eight of the more arid nations were facing very serious difficulties on irrigated farm lands due to salinization, waterlogging, and siltation.[3]

2/ Montalbano, "Haiti--A Paradise Lost To Starvation, Drought," Chicago Tribune, May 1, 1977, at 18; Ewel, "A Report On Soil Erosion And Prospects For Land Restoration In Haiti" (AID, April 1, 1977); Josephson, "Building The Third World," Environmental Science And Technology 852 (September 1977); Conservation Foundation Letter, "Haiti: A Study In Environmental Destruction" (November 1977).

3/ Paul F. Bente, Jr., The Food People Problem: Can The Land's Capacity To Produce Food Be Sustained? (Paper presented to the U.N. Conferences on Water and Desertification, 1977). The survey was initiated by a circular cablegram from the Office of Population Affairs, Department of State, in late 1975. U.S. Embassies were asked, among other things, to assess the environmental impacts

(footnote 3 continued on next page)

Environmental abuse is both a cause and effect of poverty, especially in rural areas where most of the developing world's poor live. Programs to slow population growth, to improve food production, and to provide new sources of rural employment and energy will ease the burden on the ecosystems of developing countries. However, sustainable improvement in the lives of the rural poor cannot be achieved unless a higher priority is given to the maintenance and protection of the natural resource base. In Losing Ground: Environmental Stress And World Food Prospects, Erik Eckholm writes:

> [R]eform and development efforts will not achieve their aims if they are not also suffused with an ecological ethic that recognizes the conjugal bond between humankind and the natural world from which there can be no divorce. Environmental deterioration requires direct attention in its own right; at the same time, the balance of nature will not be preserved if the roots of poverty, whatever they may be, are not eradicated.4

There is growing awareness of the seriousness of these

3/ (continued) of population growth. Mr. Bente, then a member of the staff of the Council on Environmental Quality, used the still classified responses to compile the composite data for his paper. Our recent requests to the Department of State for the declassification of those portions related to environmental impacts is under consideration and should be granted shortly.

4/ Erik Eckholm, Losing Ground: Environmental Stress And World Food Prospects 24 (1976). Losing Ground, co-sponsored by the United Nations Environment Programme ("UNEP"), is the best overview to date of environmental conditions in developing countries. Eckholm notes that the precise rates and costs of ecological deterioration in one nation or another are generally not available. Yet he argues that in many countries corrective action cannot wait for definite results from scientific studies of natural resource conditions, because these will take too long. Losing Ground 186.

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problems in many developing countries. A number, including Zaire, Indonesia, the Philippines, Gabon, Ghana, Brazil, and Costa Rica, have established ministries or special high-level commissions concerned with natural resource conservation and environmental protection. However, most still lack the informational, technical, legal, and institutional capability for effective environmental regulation and planning. In particular, the ecological consequences of development schemes often are not given adequate consideration, despite the expensive lessons of the past. For example, a major British-financed plan was initiated in the late 1940's to produce groundnuts on 3,000,000 acres of savannah lands in East Africa. The scheme was begun hastily without adequate ecological studies. As a result, there were unanticipated, severe environmental problems, including soil infertility and erosion. By 1951, it was clear that the multimillion dollar project had failed.[5]

A recent instance involves one of Colombia's largest hydro-electric dam projects located on the Nare River. Here there may be a failure to take into account environmental factors outside the project area. A recent study by the World Bank, which loaned some of the $200 million spent so far on the partially constructed El Penol dam, warned

5/ Russell, "The Impact Of Technological Developments On Soils In East Africa," The Careless Technology: Ecology And International Development 570-571 (Farvar and Milton, eds., 1972).

of severe soil runoff from uncontrolled settlement upstream. Unless immediate measures are taken, the dam will rapidly lose its water storage capacity due to sedimentation.[6] Similarly, in other poor nations, new irrigation projects, penetration roads, and factories have resulted in unintended ecological impacts involving significant economic costs and sometimes causing human suffering.[7]

In the past year, the President and the Congress have given the Agency for International Development (AID) a clear mandate to help to protect the environment and natural resources of developing countries. On May 23, 1977, President Carter said: ". . . I am convinced that in the long run, development programs that are environmentally sound will yield the most economic benefits." The President directed the Administrator of AID to ensure full consideration of the environmental soundness of proposed development assistance projects and asked the Administrator to make available to developing countries assistance in environment and natural resources management.[8]

In August 1977, Congress passed the International Development and Food Assistance Act of 1977, which adds "Environment and Natural Resources" to the list of major functional sectors, which are to be the focus of U.S. development assistance.[9]

6/ Lernoux, "Ecological Disaster Threatens Colombia's Hydroelectric Projects," World Environment Report, December 5, 1977, at 3.

7/ See generally Farvar and Milton, supra note 5.

8/ Council on Environmental Quality, "The President's Message On The Environment," The President's Environmental Program, at M-11 (1977).

9/ International Development and Food Assistance Act of 1977, § 113(b), 22 U.S.C.A. § 2151(b)(1)(2) (Supp. 3, November 1977).

It also created a new Section 118 of the Foreign Assistance Act of 1961, as amended, which provides:

> The President is authorized to furnish assistance under this part for developing and strengthening the capacity of less developed countries to protect and manage their environment and natural resources. Special efforts shall be made to maintain and where possible restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially that of the poor.10

This paper describes two pressing environmental challenges to sustainable development in many aid-receiving countries: destruction of tropical forests and deterioration of agricultural lands. While it is premature to evaluate fully AID's response to these challenges, the paper provides examples of proposed and ongoing projects falling within the new Environment and Natural Resources sector. The paper examines AID's efforts to assure the environmental soundness of its own projects and to help other countries to increase their ability to protect and manage their natural resources, and recommends what needs to be done now by AID in the Environment and Natural Resources area.

10/ § 113(a), 22 U.S.C.A. § 2151p (Supp. 3, November 1977).

The President's Environmental Program

1977

B. Economic Development Assistance

The President today instructed the Secretary of State, the Administrator of the Agency for International Development, and other concerned federal agencies to ensure that there is full consideration of the environmental soundness of international development projects which are under review for possible assistance.

In the past, environmental considerations have often been considered a luxury in international development assistance programs. They often have received little, if any, attention in the development planning process. However, the growing body of experience with these programs has shown that adequate attention to environment is essential to the success of many programs, particularly those dealing with agriculture, livestock, fisheries, forestry, and water development.

The President also directed the Administrator of AID to make available to developing countries assistance in environment and natural resources management. Developing countries in general have relatively little expertise in environmental and natural resource management. Provision of assistance in this field can help the nations involved to develop their own expertise and to design environmentally sound projects regardless of the source of funding.

COUNCIL ON ENVIRONMENTAL QUALITY MEMORANDUM TO AGENCY HEADS ON OVERSEAS APPLICATION OF NEPA REGULATIONS

January 19, 1978

MEMORANDUM TO HEADS OF AGENCIES

SUBJECT: Application of the National Environmental Policy act to Federal Activities Abroad

Since the January 6 meeting to discuss the application to federal agency international activities of the National Environmental Policy Act (NEPA), several comments and concerns have been expressed which indicate that further explanation might lead to a better understanding and resolution of the issue.

Incidentally, no date has been set for your comments on this specific issue although we would appreciate your earliest reasoned response. The date for comments on our proposed general regulations circulated December 13, 1977 is January 23, 1978 but on request may be extended to February 6, 1978.

WHY THIS ISSUE AT THIS TIME?

In order to make the process of preparing environmental impact statements more efficient, economical and relevant,

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on May 23, 1977 President Carter issued an Executive Order directing CEQ to reform NEPA procedures. In the course of its work, CEQ identified two concededly difficult and controversial issues of which the subject issue is one. Consequently, we determined it to be advisable to direct agency attention the problem and obtain assistance and advice before proceeding to the task of drafting applicable regulations on the issue. In short, CEQ is responding to a present duty to consider regulatory reform of NEPA and all its related aspects.

REQUIREMENTS OF NEPA

Concerning this issue the operative language of NEPA is:

"The Congress. . .directs that to the fullest extent possible. . .all agencies of the Federal government shall . . .include in. . . major federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on — (i) The environmental impact of the proposed action," etc. Section 102(2)(C)

Therefore, the statutory mandate is to (1) all Federal agencies who undertake (2) major Federal actions which (3) significantly affect the quality of the human environment.

The Act does not define or limit the geographical region of the "human environment" the quality of which is to be considered, and it does require that "all agencies of the Federal government shall. . .recognize the worldwide and long-range character of the environmental problems". Section 102(2)(F).

[illegible]CIAL CONSTRUCTION

[illegible] extent to which NEPA has international application [illegible] been addressed by the courts on several occasions.

[illegible] *Wildnerness Society v. Morton*, [4ERC 1101] 463 [illegible] 2d 1261 (D.C. Cir. (1972), the Court of Appeals for the District of Columbia granted standing to Canadian environmentalists in the Trans Alaska oil pipeline case where alternative routes went through Canada. The court did so because the Canadians' interests in the environmental impact in Canada were within the zone of interest protected by NEPA.

In *Sierra Club v. AEC*, 6 [6ERC 1980] (D.D.C. 1974), AEC and Eximbank were sued to make them comply with NEPA. The AEC prepared an EIS on its overall nuclear export process, essentially settling the case, since AEC was the lead agency. The court assumed that governmental actions abroad were covered by the Act.

Sierra Club v. Coleman, [8ERC 1477] 405 F Supp. 53 (D.D.C. 1975) and 421 F. Supp. 63 (D.D.C. 1976). The Court ordered the Department of Transportation to consider the environmental impacts involved in the construction of a segment of the Pan-American Highway in Columbia and Panama, both as they affected the United States (migration of hoof and mouth disease) and as confined to Panama (effects on Indian culture).

EDF v. AID, (D.D.C. 1975), Involves a suit against AID to make it prepare an EIS on its pest management program. AID settled on terms which were approved by the Court. The settlement specifically contemplated covering local impacts within individual foreign countries.

PRIOR CEQ OPINIONS

CEQ, as the designated agency responsible for implementing agency compliance with NEPA, has been consistent in its interpretation of the Act since 1971. The most recent precedent is a September, 1976 CEQ memorandum opinion from Chairman Russell Peterson (Appendix A) advising all agencies that:

"[W]e advise that NEPA requires analysis and disclosure in environmental statements of signficiant impacts of federal actions on the human environment — in the United States, and other countries, and in areas outside the jurisdiction of any country."

The proposed draft regulations the Council has prepared and submitted to you recognize there are unusual and exceptional circumstances which may be recognized in the application of NEPA to governmental agency actions in other countries.

AGENCY EXPERIENCE

Some agencies for some actions have administratively determined to conform with NEPA requirements for their activities abroad. Examples are:

—the State Department's recent EIS on the Panama Canal Treaties

— the Department of Interior's and Federal Power Commission's EISs on natural gas pipelines and alternatives from Alaska across Canada to the lower 48 states

— NOAA's on its hurricane seeding program

— AID's on its worldwide pesticide program

Of those agencies with a history of implementing NEPA in their activities in foreign countries, the one with the greatest experience is AID. At the request of OMB, the Administrator of AID prepared an analysis of its experience (Appendix B) which concluded:

"[O]ur overall experience is a positive one. We have discovered that developing countries themselves have come increasingly to recognize the inter-related nature of environment and development and to seek to ensure that environmental considerations are adequately addressed in development projects. Further, the practical experience of AID had been that it is possible to undertake detailed environmental analyses of U.S. supported projects abroad and that the results obtained are useful to us, as well as to host country planners, in making project decisions."

AID's analysis rebutted each of four recited "potential negative impacts hypothetically associated with the conduct of environmental analyses."

1. AID has been able to undertake environmental analyses "without strain" on foreign relations.
2. Achievement of the Agency's mandate has not been impaired by the conduct of environmental analyses.
3. U.S. jobs have not been lost due to environmental analyses.
4. Costs have not been excessive.

WHAT IS PROPOSED?

Earlier, reference was made to the fact CEQ's present proposals recognize and make allowance for unusual and exceptional circumstances involved in federal agencies' activities in foreign countries. CEQ does so by limiting the applicability of the standard EIS procedure only to those major activities abroad whose significant environmental impact affect (1) the United States and its trust territories; (2) the global commons, such as the oceans; (3) Antarctica.

For all other major activities having a significant environmental impact outside the United States, the federal agency may, in consultation with CEQ, provide for abbreviated "Foreign Environment Statements whose preparation can take into account such special factors as:

1. Diplomatic considerations
2. Availability of information
3. Commercial competition
4. Commercial confidentiality
5. Extent of agency role in the proposed activity

U.S. STANDARDS ARE NOT BEING IMPOSED ON FOREIGN COUNTRIES

The preparation of a Foreign Environmental Statement would not impose U.S. environmental standards on any other

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country. Even if the federal activity abroad is unlawful in the United States, NEPA does not prevent its being undertaken abroad. What a Foreign Environmental Statement would do is make clear that what the governmental agency proposes to do in another country is unlawful in the United States.

CONCLUSION

Our concern over the environmental effects of U.S. government actions abroad are expressed in the last section of our proposed draft. Summarized they are:

1. We want to insure that if a product is banned or strictly regulated in the United States on health grounds the U.S. agency and other officials are at least aware of this before providing the product to a foreign country.

2. We want at minimum full disclosure before an American decisionmaker takes an action which threatens natural resources of global importance.

3. We want to be sure that the American decisionmaker is aware of what he is doing if his actions, however beneficial to one country, cause a significant adverse effect in another country.

If you have any questions, please bring them to our attention. We look forward to receiving your comments.

/s/CHARLES WARREN
Chairman

COUNCIL ON ENVIRONMENTAL QUALITY DRAFT REGULATIONS ON APPLYING NEPA TO SIGNIFICANT FOREIGN ENVIRONMENTAL EFFECTS

Draft

Section 1508.13 *Human Environment*

"Human environment" shall be interpreted comprehensively to include the natural and physical environment and the interaction of people with that environment. The human environment is not confined to the geographical borders of the United States.

Section 1508.13 *Application of NEPA to Significant Environmental Effects Not Confined to the United States*

(a) Agencies shall fully comply with these regulations insofar as their major Federal actions significantly affect the environment of:

(1) The United States and its trust territories.

(2) The global commons, which consists of areas outside the jurisdiction of any nation (e.g., the oceans).

(3) Antarctica.

(b) Agencies shall comply with the provisions of these regulations pertaining to foreign environmental statements (sec. 1508. ____) insofar as their major Federal actions significantly affect the environment only of one or more foreign nations.

Section 1508. ____. *Foreign Environmental Statement*

(a) "Foreign environmental statement" is the statement required by sec. 102(2)(C) of the Act when a major Federal action significantly affects the environment only of one or more foreign nations. Such statements need only contain the information called for in sections 1502.13-.15.

(b) In developing their implementing procedures for such statements under section 1507.3, affected agencies shall consult with the Council which shall assist the agency in fitting the Act's requirements to the practical considerations of operating in the international context. Among other things these procedures shall:

(1) Establish criteria by which the agency can determine that a foreign environmental statement or portions thereof will not be subject to public comment when such review would be inconsistent with the accomplishment of the agency's statutory objectives.

(2) Take into account special factors which would limit the review period or the required detail of the statement such as:

(i) Diplomatic considerations or the relative unavailability of information;

(ii) Whether the Federal agency role is one limited to passing on proposals developed elsewhere (as opposed to situations where the agency is involved in early planning or joint sponsorship); and

(iii) International commercial competition and confidentiality.

(3) Ensure consideration in foreign environmental statements of:

(i) Activities which are unlawful or strictly regulated in the United States in order to protect public health or safety;

(ii) Activities which threaten natural, ecological or environmental resources of global importance; and

(iii) Activities which may have inadvertent adverse effects on other foreign countries.

Public Law 95-88
95th Congress

An Act

To amend the Foreign Assistance Act of 1961 to authorize development assistance programs for fiscal year 1978, to amend the Agricultural Trade Development and Assistance Act of 1954 to make certain changes in the authorities of that Act, and for other purposes.

Aug. 3, 1977
[H.R. 6714]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

International Development and Food Assistance Act of 1977.

SHORT TITLE

SECTION 1. This Act may be cited as the "International Development and Food Assistance Act of 1977".

22 USC 2151 note.

TITLE I—INTERNATIONAL DEVELOPMENT ASSISTANCE

ENVIRONMENT AND NATURAL RESOURCES

SEC. 113. (a) Chapter 1 of part I of the Foreign Assistance Act of 1961, as amended by section 112 of this Act, is further amended by adding at the end thereof the following new section:

22 USC 2151p.

"SEC. 118. ENVIRONMENT AND NATURAL RESOURCES.—The President is authorized to furnish assistance under this part for developing and strengthening the capacity of less developed countries to protect and manage their environment and natural resources. Special efforts shall be made to maintain and where possible restore the land, vegetation, water, wildlife, and other resources upon which depend economic growth and human well-being, especially that of the poor.".

22 USC 2151.

(b) Section 102 of such Act is amended—

(1) by inserting in the seventh paragraph of subsection (a) "environment and natural resources," immediately after "decent housing,"; and

(2) by inserting in subsection (b)(2) "environment and natural resources;" immediately after "health;".

Title 22—Foreign Relations

CHAPTER II—AGENCY FOR INTERNATIONAL DEVELOPMENT, DEPARTMENT OF STATE

[Reg. 16]

PART 216—ENVIRONMENTAL PROCEDURES

Sec.
216.1 Introduction.
216.2 Applicability of procedures.
216.3 General procedures.
216.4 Responsibilities.
216.5 Environmental assessments.
216.6 Environmental impact statements.
216.7 Public hearings.
216.8 Records and reports.

AUTHORITY: (42 U.S.C. 4332; 22 U.S.C. 2381). 2381).

§ 216.1 Introduction.

(a) *Purpose.* In accordance with the National Environmental Policy Act of 1969 (NEPA) and relevant AID policies, the following general procedures are established. These procedures have been developed to insure that environmental factors and values are integrated into the decision-making process and to assign responsibility within the Agency for assessing the environmental effects of AID's actions.

(b) *Environmental policy.* In the conduct of its mandate to help upgrade the quality of life of the poor in developing countries, AID conducts a broad range of activities addressing such basic problems as hunger and malnutrition, overpopulation, disease, disaster, illiteracy and lack of adequate housing and transportation. As authorized by the Foreign Assistance Act (AA) of 1961 as amended, AID finances or directly furnishes both bilateral and multilateral development assistance through loan and grant programs of technical advisory services, research, training, construction and commodity support. These programs are carried out under the foreign policy guidance of the Secretary of State and in the context of the realities of the differing priorities of the developing countries. Within this framework, it is AID policy:

(1) To ensure that the environmental consequences of proposed AID-financed activities are identified and considered by AID and the host country [1] prior to a final decision to proceed, and that appropriate environmental safeguards are adopted;

(2) To assist in strengthening the indigenous capabilities of developing countries to appreciate and evaluate the potential environmental effects of proposed development strategies and projects, and to select, implement and manage effective environmental protection measures, and;

(3) To identify impacts resulting from its actions upon the environment including those elements of the world biosphere which are the common natural and cultural heritage of mankind.

(c) *Definitions*—(1) *CEQ guideline or guidelines.* Guidelines promulgated by the President's Council on Environmental Quality (CEQ) under NEPA and Executive Order 11514, entitled "Preparation of Environmental Impact Statements" (FEDERAL REGISTER, Volume 38, Number 147, August 1, 1973), and amendments thereto.

(2) *Initial environmental examination.* As used, herein, an Initial Environmental Examination is the initial study of the reasonably foreseeable effects of a proposed action on the human environment. Its function is to provide the basis for a Threshold Decision as to whether an Environmental Assessment or an Environmental Impact Statement will be required. If an Environmental Assessment or an Environmental Impact Statement is required, the Examination will also provide the basis for its preparation. The Initial Environmental Examination should identify and describe where appropriate: (i) The nature, scope and magnitude of any reasonably foreseeable effects of an action or any part of an action on the human environment; (ii) the reasonably foreseeable effects of any such environmental impact on organisms in the biosphere including human life; and, where an Environmental Assessment or an Environmental Impact Statement is required; (iii) reasonable alternatives to the proposed action which will be studied in detail in the Environmental Assessment or draft Environmental Impact Statement. The Initial Environmental Examination will be an integral part of the Project Review Paper or equivalent document which will be circulated to selected Federal agencies for comment, when an Environmental Assessment is to be prepared.

(3) *Threshold decision.* A formal Agency decision which determines, based on an Initial Environmental Examination, whether a proposed agency action is or is not an action which will have a significant effect on the human environment, and, if so, whether an Environmental Assessment or an Environmental Impact Statement is required. This decision is made in the very early stages of activity conception, even before the activity is reviewed for consistency with AID objectives and recipient requests. While it is difficult to inclusively identify all such actions, types to be carefully considered for environmental effects would include those:

(i) Where the impact is localized, but the human environment will be significantly affected;

(ii) Where the impact is likely to be irreversible or highly controversial;

(iii) Which involve a complex of projects, with individually limited but cumulatively considerable effects;

(iv) Which involve a limited amount of money, but which set a precedent for future actions; or represent a decision in principle about future courses of action;

Actions that should be considered in determining "significant effects" include those which adversely affect such aspects of the human environment as air, water, land, flora and fauna, and socio-economic conditions. Special attention should be given to problems involving solid waste, noise, radiation, hazardous substances, energy sources and natural resources development, and in addition, actions which:

(a) Degrade the quality of the human environment;

(b) Curtail the range of beneficial uses of the human environment and its resources and serve short-term, to the disadvantage of long-term, environmental goals;

(c) May have both detrimental and beneficial effects even if on balance the Agency believes that the effect will be beneficial;

(d) Have secondary effects which may be more substantial than the primary effects of the original action.

(e) Are likely to have an effect on any natural or cultural heritage listed by the World Heritage Committee pursuant to Article XI of the "Convention Concerning the Protection of the World Cultural and Natural Heritage," of November 1972.

(4) *Environmental Assessment (EA).* The Environmental Assessment is a detailed study of the reasonably foreseeable environmental effects, both positive and negative, of a proposed action and

[1] In every instance in these procedures the terms "host country" or "host government" or "recipient country" are meant to refer to the country that is both receiving and financially participating in the AID assistance under the terms of the FAA.

Best Available Document

its reasonable alternatives carried out within or affecting specific developing countries as further described in § 216.5 of these procedures. To the extent practicable The Assessment will be developed in close collaboration with the host country institutions and subject to recipient country review.

(5) *Environmental Impact Statement (EIS)*. The EIS is a detailed study of the reasonably foreseeable environmental impacts, both positive and negative, of a proposed AID action and its reasonable alternatives on areas described in § 216.6 of these procedures. It is a specific document having a definite format and content, as required by NEPA and as recommended by CEQ Guidelines, which is circulated in draft form in order to obtain the comment or review by other Federal, State and local domestic agencies and the US general public. The final Environmental Impact Statement takes into consideration the comments received on the draft. The required form and content of an Environmental Impact Statement is further defined in §§ 216.5 and 216.6 of these procedures.

(6) *Negative Determination*. A Negative Determination is a formal written document based on a Threshold Decision that a proposed action is not a major action which will have a significant effect on the human environment and is, therefore, an action for which an Environmental Impact Statement or an Environmental Assessment will not be required.

(7) *Negative Declaration*. A Negative Declaration is an official written Agency decision made by an Assistant Administrator which states that the Agency will not develop an Environmental Impact Statement or an Environmental Assessment for an action which the Agency has identified as being normally covered by these procedures. The decision may be based on (i) overriding considerations such as the provision of disaster relief (ii) the fact that a substantial number of Environmental Assessments or Environmental Impact Statements relating to similar activities have been prepared in the past, or (iii) the fact that the Agency has previously decided to prepare a programmatic Statement or Assessment covering the activity in question.

(8) *Project Identification Document (PID)*. An internal AID document which initially identifies and describes a proposed project. It is a short paper presenting enough information on the project to demonstrate its relevance to Agency priorities and its practical potential.

(9) *Program Assistance Initial Proposal (PAIP)*. An internal AID document used to initiate and identify proposed non-project commodity import programs. It is analogous to the Project Identification Document.

(10) *Project Review Paper (PRP)*. An internal AID document presented during the analytical stage of a project in conjunction with formulation of the Agency's Congressional Presentation. The PRP identifies major project issues and assures that necessary steps can be agreed upon to examine if the project is feasible and to determine the best possible implementation plan for the project.

(11) *Program Assistance Review Document (PARD)*. An internal AID document used for a more detailed review of an approved Program Assistance Initial Proposal under a non-project commodity import program. It is analogous to the Project Review Paper and contains a section which identifies categories of commodities and provides the justification for the proposed AID financing.

(12) *Project Paper (PP)*. An internal AID document which provides a definitive description and appraisal of the project and particularly, the plan of implementation. Project Papers form the basis for a final decision on whether or not to offer AID funding for a project.

(13) *Program Assistance Approval Document (PAAD)*. An internal AID document approving non-project commodity import program assistance. It is analogous to the Project Paper.

§ 216.2 Applicability of procedures.

These procedures apply to all new programs or activities, including those that may arise in connection with on-going projects, for project assistance, research and commodity procurement. Not every AID activity, however, will be a major action significantly affecting the human environment for purposes of these procedures. For example, the following general classes of activities will not normally require the filing of an Environmental Impact Statement or the preparation of an Environmental Assessment:

(a) Education or training programs not designed to result in activities directly affecting the environment;

(b) Controlled experimentation exclusively for the purpose of research which is confined to small areas and carefully monitored;

(c) Analyses, studies, academic or investigative research, workshops and meetings;

(d) Projects where AID is a minor donor to a multidonor project and there are no potential effects upon the environment of the US or areas outside any nation's jurisdiction;

(e) Document and information transfers;

(f) Contributions to international, regional or national organizations by the US which are not for the purpose of carrying out a specifically identifiable project or projects;

(g) Disaster and emergency relief activities;

(h) US institution building grants, as provided for under Section 211(d) of the Foreign Assistance Act.

§ 216.3 General procedures.

(a) An Initial Environmental Examination will be prepared by the originator of a project concurrently with the Project Review Paper or Program Assistance Review Document or earlier. When Project Review Papers or Program Assistance Review Documents are not utilized, the Initial Environmental Examination will be prepared concurrently with the preparation of the Project Identification Document or Project Assistance Initial Proposal or at the earliest appropriate time.

(b) Based on the Initial Environmental Examination, a Threshold Decision will be specifically recommended in the Project Review Paper, Program Assistance Review Document or Project Identification Document and acted upon at the Bureau or Office level concurrently with approval of the Project Review Paper, Program Assistance Review Document or Project Identification Document. If the Threshold Decision is negative (i.e. an Environmental Assessment or an Environmental Impact Statement is not required), the cognizant Bureau or Office will record this decision and such record will constitute a Negative Determination. If the Threshold Decision based on an Initial Environmental Examination is positive (i.e. a significant environmental impact is likely to occur) then the activity is to be evaluated to determine if an EIS is to be prepared pursuant to Section 216.6 of these procedures. When a Threshold Decision based on an Initial Environmental Examination indicates that an Environmental Assessment is required, the procedures of § 216.5 will be followed and the approved Project Review Paper or equivalent document containing the Initial Environmental Examination will be circulated to selected U.S. Federal agencies with relevant expertise, utilizing the list provided in the CEQ Guidelines. Such agencies will be invited to make written comments within thirty days on the Examination and on matters that should be considered in preparation of the Environmental Assessment. Comments received on environmental aspects from reviewing Federal agencies will be forwarded to the originating project office for consideration in the formulation of the design and implementation of the project and the required Environmental Assessment and will form part of the project file when the project comes forward in the Project Paper stage for final approval.

(c) If the Project Review Paper, Program Assistance Review Document or Project Identification Document is approved and the Threshold Decision positive, the originator of the project will prepare, prior to or concurrently with the Project Paper or Program Assistance Approval Document, an Environmental Assessment or draft 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 § 216.6 of these procedures. Final approval of the Project Paper or Program Assistance Approval Document and the method of implementation will include consideration of the Environmental Assessment or final Environmental Impact Statement as well as other required (non-environmental) analyses. If loans or grants for broad sector activities (e.g. river basin

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development, etc.) are proposed, a general or programmatic Environmental Assessment or Environmental Impact Statement consistent with the scope of the proposed loan or grant will be prepared in conjunction with the Project Paper and agreement will be reached with the recipient government that a detailed Assessment will be prepared and considered on each individual project as it is developed and prior to its approval.

(d) Processing and Review Within AID Initial Environmental Examinations, Environmental Assessments and final Environmental Impact Statements will be processed within AID in accordance with the normal AID procedures for other documents. These procedures call for participation in the project review process of technical, legal and country specialists. Environmental Assessments and final Environmental Impact Statements will be reviewed as an integral part of the Project Paper or equivalent. In addition to these normal procedures, Environmental Assessments will be reviewed by the appointed Bureau environmental officer and, periodically, by the Environmental Coordinator, who will monitor the Environmental Assessment process. Draft and final Environmental Impact Statements will be reviewed by the Environmental Coordinator and the Office of the General Counsel.

(e) 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 permits, originating offices of AID will formulate systems in collaboration with the recipient nation(s), to monitor such impacts during the life of AID's involvement in the activity.

(f) 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 when significant new information becomes available. When ongoing programs are revised to incorporate a change in scope or nature, a determination will be made as to whether such change may have an environmental impact not previously assessed. If so, the procedures outlined above will be followed.

§ 216.4 Responsibilities.

(a) As a general principle, responsibilities for environmental decisions and actions will be similar to normal AID organizational responsibilities so that an environmental awareness will permeate the entire organization and environmental considerations will be weighed with others in an integrated manner at each level of responsibility. Thus each AID official empowered to authorize funds will be responsible to the Administrator for implementing these procedures and obtaining and managing the required resources.

(b) In view of the need for an internal and external focal point for environmental matters, the position of AID Environmental Coordinator has been established in the Office of Science and Technology, Technical Assistance Bureau (TA/OST). This person will serve as the principal environmental affairs coordinator for the entire Agency and will provide policy guidance and professional leadership within AID and will serve as chairman of the AID Committee on Environment and Development. The Environmental Coordinator will also be the principal point of contact on environmental affairs with the Council on Environmental Quality, the Department of State, all other Federal agencies and the public.

(c) The head of each Bureau, Mission and major Office will designate a competent officer to act as coordinator, advisor and principal point of contact for environmental matters within his organizational unit. Those officers located in AID/Washington will also be members of the AID Committee for Environment and Development.

(d) The Committee on Environment and Development will provide advice on major issues, policies or procedures having agency-wide implications.

(e) Central technical offices will provide support and advice to AID Bureaus, Offices, and Missions as requested in their respective areas of expertise. The following Offices are expected to be involved most frequently:

1. Office of Engineering (SER/ENG)
2. Office of Agriculture (TA/AGR)
3. Office of Science and Technology (TA/OST)
4. Office of Commodity Management (SER/COM)
5. Office of Health (TA/H)
6. Office of Urban Development (TA/UD)
7. Office of Nutrition (TA/H)

(f) When required by responsible offices, qualified outside contractors may be employed to assist in preparing Initial Environmental Examinations, Environmental Assessments or Environmental Impact Statements.

§ 216.5 Environmental Assessments (EA).

(a) *General purpose.* The purpose of the Environmental Assessment is to provide Agency and host country decision makers with a comprehensive understanding of the reasonably foreseeable environmental effects of proposed actions and their reasonable alternatives so that the expected benefits of development objectives can be weighed against any adverse short or long-term impacts upon the human environment or any irreversible or irretrievable commitment of resources. The Environmental Assessment will be considered by AID prior to final approval of any activity as outlined in § 216.3 of these procedures.

(b) *Collaboration with Recipient 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 recipient countries to the maximum extent possible, in the development of any Environmental Assessments required and obtain agreement of the recipient country to participate in the preparation of any required Assessment and to consider environmental consequences as set forth therein. In some cases, centrally funded Project Papers are prepared and approved prior to country selection. In such cases, prior agreements, collaboration and specific details of any required Assessments must be deferred until a later date. In many recipient countries, neither baseline data for complete Environmental Assessments or monitoring may be available, nor local personnel with the knowledge required to participate substantively in the Assessments. In these cases, Missions should encourage and be responsive to host-country requests for training or technical assistance. When AID unilaterally considers that there is a reasonable risk of significant adverse effects on the environment from an activity proposed to it for support, and where efforts to encourage the incorporation of appropriate safeguards are unsuccessful, AID reserves the prerogative of declining to participate in the activity.

(c) *Content and Form.** The scope and depth of information and data gathered for Environmental Assessments should be similar to that for economic, technical and other analyses required by AID and must be relevant to the specific environmental issues involved.

(1) Environmental Assessments should include or make reference within the same document to a description of the proposed action, a statement of its purposes, and a description of the environment affected, including information, summary technical data and maps and diagrams where relevant, adequate to permit an assessment of potential environmental impact. Highly technical and specialized analyses and data should be avoided in the body of the draft, but, if required, should be attached as appendices or footnoted with adequate bibliographic references and, if difficult to obtain, a notation of where they are available. In addition to a description of the proposed action and the environment affected, the Environmental Assessment

*This section is substantially taken from CEQ Guidelines, Section 1500.8.

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should identify and describe further related activities which are intended to be undertaken in the same general area and of substantially the same nature which are promoted and financed by AID or another US Government agency, or where AID assistance is conditioned upon the recipient country's undertaking further related activities in the same general area and of substantially the same nature. The interrelationships and cumulative environmental impacts of the proposed action and other related activities, as described above, must be presented in the Environmental Assessment. The amount of detail provided in such descriptions should be commensurate with the extent and expected impact of the action, and with the amount of information required at the particular level of decision-making (planning, feasibility, design, etc.). In order to ensure accurate descriptions of a proposed action and its alternatives, site visits should be made as appropriate. Population and growth characteristics of the affected area and any population and growth assumptions used to justify the project or program or to determine secondary population and growth impacts resulting from the proposed action and its alternatives should be identified. It is essential that the sources of data used to identify, quantify or evaluate any and all environmental consequences be expressly noted.

(2) The relationship of the proposed action to plans for land and resources use, policies and controls for the affected area and sectoral or national development plans should be examined. Since AID programs and projects are undertaken only at the request of and in collaboration with the recipient country, there should be no conflict with the objective and specific terms of LDC approved or proposed land use plans, policies and controls, if any, for the area affected.

(3) The reasonably foreseeable impact of the proposed action on the human environment must be assessed.

(i) Identification and quantification of such impacts requires an assessment of the positive and negative effects of the proposed action as it affects the environment of the recipient country or neighboring countries as appropriate. The attention given to different environmental factors will vary according to the nature, scale, and location of the proposed action. Among factors to consider should be the reasonably foreseeable effect of the action on such aspects of the environment as those listed in § 216.1(c)(3) of these procedures. Primary attention should be given in the Environmental Assessment to discussing those factors most evidently impacted by the proposed action.

(ii) Secondary or indirect, as well as primary or direct, consequences for the environment should be included in the Assessment. Many major Agency actions, in particular those that involve the construction or funding of infrastructure investment (e.g., irrigation projects, rural water supply systems, rural access roads, water resource development projects, etc.) could stimulate or induce secondary effects in the form of associated investments, introduction of disease vectors, and changed patterns of social and economic activities. Such secondary effects, through their impacts on human health and existing community facilities and activities, through inducing new facilities and activities, or through changes in natural conditions, may often be even more substantial than the primary effects of the original action itself. For example, the effects of the proposed action on population movement and growth may be among the more significant secondary effects. Such population and growth impacts should be estimated if expected to be significant and an assessment made of the effect or any possible change in population patterns or growth upon the resource base, including land use, water, and public services of the area in question.

(4) Reasonable alternatives to the proposed action including, where relevant, those not within the existing authority of AID should be investigated. The sponsoring Office or Bureau should study, develop and describe appropriate alternatives to the recommended course of action in any proposal which involves unresolved conflicts concerning alternative uses of available resources. A rigorous exploration and objective evaluation of reasonably foreseeable environmental impacts of all reasonable alternative actions, particularly those that might enhance environmental quality or avoid some or all of the adverse environmental effects, is essential. Sufficient analysis of such alternatives and their environmental benefits, costs and risks should accompany the proposed action through the review process in order not to foreclose prematurely options which might enhance environmental quality or have less detrimental effects. Examples of such alternatives include: the alternative of taking no action or of postponing action pending further study; alternatives requiring actions of a significantly different nature which would provide similar benefits with different environmental impacts (e.g., nonstructural alternatives to flood control programs); alternatives related to different designs or details of the proposed action which would present different environmental impacts (e.g., cooling ponds versus cooling towers for a power plant); alternatives that will significantly conserve energy; alternative measures to provide for compensation of fish and wildlife losses including the acquisition of land, waters, and interests therein. In each case, the analysis should be sufficiently detailed to reveal the comparative evaluation of the environmental benefits, costs and risks of the proposed action and each reasonable alternative.

(5) Any reasonably foreseeable adverse environmental effects which cannot be avoided (such as water or air pollution, undesirable land use patterns, damage to life systems, urban congestion, threats to health or other adverse consequences) should be identified. This should be a brief section summarizing in one place those effects that are adverse and unavoidable under the proposed action. Included for purposes of contrast should be a clear statement of how other avoidable adverse effects discussed in this section will be mitigated.

(6) Except for provision of some direct disaster relief and short-term balance of payments or budgetary assistance, AID's activities are normally to provide long-term benefits. However, the relationship between local short-term uses of man's environment and the maintenance and enhancement of long-term productivity should be explored. This section should contain a brief discussion of the extent to which the proposed action involves trade-offs between short-term environmental gains at the expense of long-term losses, or vice versa, and a discussion of the extent to which the proposed action forecloses future options. In this context, short-term and long-term do not refer to any fixed time periods, but should be viewed in terms of the environmentally significant consequences of the proposed action.

(7) Any irreversible and irretrievable commitments of natural or cultural resources that would be involved in the proposed action should it be implemented should be identified. This requires the sponsoring Office or Bureau to identify unavoidable impacts such as those listed in paragraph five of this section and the extent to which the action irreversibly curtails the range of potential uses of the environment.

(8) An indication of what other interests and considerations of US, AID or LDC policy are thought to offset the adverse environmental effects of the proposed action. The Environmental Assessment should also indicate the extent to which these stated countervailing benefits could be realized by following reasonable alternatives to the proposed action that would avoid some or all of the adverse environmental effects. Where cost-benefit analyses of a proposed action are prepared they should be attached and should clearly indicate the extent to which environmental costs have not been reflected in such analyses.

(9) In developing the above points, every effort should be made to convey the required information succinctly, in a form easily understood, giving attention to the substance of the information conveyed rather than to the particular form, length or detail of the Assessment. Each of the above points, for example, need not always occupy a distinct section if it is otherwise adequately covered in discussing the impact of the proposed action and its alternatives--items which should normally be the focus of the statement.

(10) Environmental Assessments should indicate at appropriate points in the text any underlying studies, reports, and other information obtained and considered in their preparation, including any cost-benefit analyses prepared.

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In the case of documents not likely to be easily accessible (such as internal studies or reports), the Environmental Assessment should indicate how such information may be obtained.

(11) To the extent required to obtain a reasoned analysis, each Assessment should be prepared utilizing a systematic interdisciplinary approach which will ensure the integrated use of the natural and social sciences and the environmental design arts in planning and decision-making which may have an impact on man's environment. If required disciplines are not available within AID, appropriate use of relevant US Government and local LDC agencies or the professional services of universities and outside consultants should be made. The interdisciplinary approach should not be limited to the preparation of the Environmental Assessment, but should also be used in the early planning and design stages of the proposed action and in its evaluation. Early application of such an approach should help assure a systematic evaluation of reasonable alternative courses of action and their potential social, economic, and environmental consequences as well as mitigating detrimental effects of the chosen project or activity.

(12) Broad program Assessments may be required 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 or 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 AID Washington and circulated to appropriate overseas Missions, host governments, and to interested parties within the United States. Based upon consultation with the Committee on Environment and Development, the Environmental Coordinator shall recommend to the Administrator the subjects and appropriate preparing offices for such Agency-wide programmatic Assessments. Decisions on the need for programmatic Environmental Assessments on actions relating to a specific country or region will be made by the cognizant Bureau or Office head in consultation with the Environmental Coordinator. To the extent practicable, the form and content of the programmatic Environmental Assessment will be the same as for project Assessments. Subsequent Environmental Assessments on major individual actions will 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.

(13) 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, AID will urge the recipient country to consult with its neighbor(s) in advance of project approval and to negotiate mutually acceptable accommodations.

(14) Environmental Assessments will not normally include material classified or administratively controlled. 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 material shall be governed by 22 CFR Part 9. Those portions of an Environmental Assessment which are not classified or administratively controlled will be made available to persons outside the Agency as provided for in 22 CFR Part 212.

(d) *Consultation and Review.* When Environmental Assessments are prepared on activities carried out within or focused on specific LDCs consultations will be held between AID 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. 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 AID's overseas Missions and interested LDC governments for information, guidance and comment, and will be made available in the US to interested parties.

§ 216.6 Environmental impact statements (EIS).

Environmental Impact Statements (EISs) will be prepared and circulated in accordance with section 102(2)(c) of NEPA, as amplified by the CEQ Guidelines, when major agency actions significantly affect:

(a) The global environment or areas outside the jurisdiction of any nation (e.g., the oceans);

(b) The environment of the United States; or

(c) As a matter of policy, other aspects of the human environment at the discretion of the Administrator.

The content and form of the draft and final Environmental Impact Statement will generally follow Section 1500.8 of the Guidelines, but will take into account the special considerations and concerns of AID, such as those set forth in § 216.5 of these procedures. Circulation of an Environmental Impact Statement 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 via the Missions to affected LDC governments for information and comment. Draft Environmental Impact Statements will be made available for comment to US 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 (see Section 1500.9 (b), (c), (d), and (f) of CEQ Guidelines for details); and notice of the draft Environmental Impact Statements availability will be published in the Federal Register. Cognizant Bureaus and Offices will submit these drafts for circulation via the AID Environmental Coordinator who will have the responsibility for coordinating all such communications with persons outside AID. 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 responsible comments not adequately discussed in the draft Statement will be appropriately dealt with in the final 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 affected LDC governments. Where emergency circumstances or considerations of foreign policy make it necessary to take an action without observing the provisions of Section 1500.11 of the CEQ Guidelines[1], or when there are overriding considerations of expense to the US 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.

§ 216.7 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 hear-

[1] Section 1500.11 of CEQ Guidelines outlines requirements for transmittal of statements to CEQ, minimum periods for review, etc.

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ings, meetings with citizen representatives, and/or written comments on the proposed action.

(a) 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 a notice will be placed in the FEDERAL REGISTER giving the subject, time and place of the proposed hearings.

§ 216.8 Records and reports.

Each Agency Bureau will maintain a list of activities for which Environmental Assessments and Environmental Impact Statements are being prepared and for which Negative Determinations and Declarations have been made and will revise the list quarterly and provide copies to the Environmental Coordinator for transmittal to CEQ. Final Project Papers containing the Environmental Assessment will be forwarded to CEQ as soon as they are available. Copies will also 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 Statements, Assessments, Determinations and Declarations which will be available to the public under the Freedom of Information Act except for actions covered by § 216.6(d)(14) of these procedures.

[FR Doc.76-18997 Filed 6-28-76;3:36 pm]

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Table I. East-West Center Countries: Statistics

Country	1 POP 1976	2 PER CAP GNP 1974	3 Physical Quality Life Index (PQLI)	4 1965-75 PER CAP GNP Growth
Australia	13.8	5330	96	3.4
Iran	34.1	1250	38	7.7
Japan	112.3	4070	98	8.5
New Zealand	3.2	4310	96	1.8
Hong Kong	4.4	1610	88	5.4
Indonesia	134.7	170	50	4.1
Malaysia	12.4	680	59	3.8
Philippines	44.0	330	73	2.7
Republic of China	16.3	810	88	6.9
Singapore	2.3	2240	85	10.0
S. Korea	34.8	480	80	8.7
Thailand	43.3	310	70	4.3
Fiji	0.6	840	83	5.4
Papua New Guinea	2.8	470	34	4.1
Pacific Islands				
Afghanistan	19.5	110	19	1.1
Bangladesh	76.1	100	33	-1.9
Burma	31.2	100	51	0.8
India	620.7	140	41	1.3
Nepal	12.9	100	25	0.0
Pakistan	72.5	130	37	2.5
Sri Lanka	14.0	130	83	2.0
China (PRC)	836.8	300	59	4.6
United States	215.3	6670	96	2.4

Columns 1-4 from "The United States and World Development, Agenda 1977" The Overseas Development Council, Praeger, N.Y.

Country	5 USAID	6 World Bank	7 ADB	8 IDA	9 UNDP
Australia	-	-	-	-	-
Iran	-	0.2	-	-	0.6
Japan	-	0.2	-	-	-
New Zealand	-	-	-	-	-
Hong Kong	-	-	20.0	-	-
Indonesia	49.6	538.5	138.0	-	1.8
Malaysia	-	82.5	46.4	-	0.6
Philippines	54.3	244.7	155.2	-	3.7
Rep. of China	-	0.2	-	0.1	-
Singapore	-	25.0	23.6	-	1.6
S. Korea	5.8	325.0	135.0	-	0.4
Thailand	12.9	147.2	112.1	-	0.8
Fiji	-	17.0	-	-	-
Papua New Guinea	-	-	-	-	0.4
Other Pacific Isl. Except U.S. Poss.	-				
Afghanistan	1.5	-	10.8	35.0	3.0
Bangladesh	26.6	-	21.6	182.1	1.8
Burma	-	-	77.3	37.5	3.6
India	19.9	210.2	-	684.1	9.3
Nepal	2.8	-	16.8	34.0	3.9
Pakistan	106.3	50.4	144.0	107.7	4.6
Sri Lanka	9.6	-	30.0	25.0	1.7

Columns 5-9 from "U.S. Overseas Loans and Grants and Assistance from International Organizations" USAID, Dept. of State 1977. Figures are millions of dollars for FY 1976.

AGENCY FOR INTERNATIONAL DEVELOPMENT

Fiscal Year 1978
Submission to the Congress

Asia Programs

February 1977

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ASIA

The United States interests in the region are political, economic and humanitarian:

-- political in supporting maintenance of stability in the South Asian sub-continent, in Southeast Asia and in the newly independent states of the South Pacific;

-- economic in promoting the growth of mutually beneficial trade and investment relationships;

-- humanitarian by encouraging the developing countries of Asia to undertake policies and programs which foster greater sharing by the majority of their peoples in the benefits of development.

A.I.D. assistance continues to be one of the essential components of U.S. policy in Asia. It:

-- supports our political interests by helping strengthen the forces of moderation in these countries which seek to maintain internal stability while they achieve progressive social change;

-- aids in the growth of U.S. trade and investment;

-- clearly identifies the United States, which in addition to bilateral aid also provides contributions to multilateral financing institutions, as a participant in the multi-donor effort to help Asian countries achieve their development goals;

-- helps focus attention and action on development problems which the United States perceives as particularly important;

-- promotes U.S.-developing country cooperation on international problems such as narcotics control and environmental pollution.

Economic assistance is proposed for nine countries in Asia.

-- Seven countries (Bangladesh, Indonesia, Nepal, Pakistan, Philippines, Sri Lanka and Thailand) will receive A.I.D. Development Assistance, and, except for Thailand, P.L. 480 Assistance (See Program Summary below and P.L. 480 Programs Summary table, p. 9).

PROGRAM SUMMARY
(in millions of dollars)

FISCAL YEAR	Total	Food and Nutrition	Population Planning and Health		Education and Human Resources Development	Selected Development Activities	Other Programs
1976							
Loans	176.9	145.1	16.8		5.0	10.0	-
Grants	51.4	11.3	28.4		8.4	3.3	1/
Total	228.3	156.4	45.2		13.4	13.3	-
Transition Quarter							
Loans	44.3	30.2	14.1		-	-	-
Grants	15.4	5.8	2.0		2.1	5.3	.2 1/
Total	59.7	36.0	16.1		2.1	5.3	.2
1977							
Loans	150.2	100.4	36.8		13.0	-	-
Grants	117.5	79.6	25.4		10.6	1.8	- 1/
Total	267.7	180.0	62.2		23.6	1.8	-
			Population Planning	Health			
1978							
Loans	199.7	119.5	11.7	56.0	8.5	4.0	-
Grants	168.6	109.8	27.4	11.1	12.4	7.7	-
Total	368.3	229.3	39.1	67.1	20.9	11.7	-

-- Two countries (India and Korea) will receive only P.L. 480 assistance (see P.L. 480 Programs).

1/ Indicates non-add ($9.0) million FY 1976; ($2.2) million TQ; ($15.8) million FY 1977 for Indus Basin Development Fund; $.2 million Disaster Relief for Indonesia in TQ.

ASIA

Regional Setting

Poverty is pervasive in the seven A.I.D. program countries and in India. While some countries are poorer than others the general situation is one in which the great majority of Asians live in misery.

-- The population of these countries, the majority of whom live in rural areas, totals one billion and is growing at the rate of about 22 million annually.

-- Despite occasional good harvest years such as occurred in the crop year 1975/76, the forecast is for a 34 million ton deficit in these countries' foodgrain production in 1985/86.

-- One country, India, accounts for 15% of the world's people. Most of the poor people in the non-communist world live in India.

-- Over 730 million people receive less than $200 annual income.

-- Two countries, Bangladesh and Nepal, are among the world's least developed countries.

-- Five countries, Bangladesh, India, Nepal, Pakistan, and Sri Lanka, are among those countries having the lowest per capita incomes which have also been most severely affected by fuel and food cost increases.

The effects of poverty are evident in rural people's lives.

-- An estimated eight million Filipino children in the six months to 14 years age group suffer moderate to severe malnutrition, while in Thailand some 52% to 76% of the rural children age six months to five years suffer from malnutrition.

-- The number of infant deaths that occur for every 1,000 live births in rural areas is 200 in Nepal, 143 in Indonesia, 131 in India, more than 115 in Pakistan and 71 in the Philippines.

-- There is only one physician for each 40 thousand rural people in Bangladesh, 20 thousand in Indonesia, and 12 thousand in Pakistan.

-- The reported incidence of malaria in South and Southeast Asia has increased rapidly from 315 thousand cases in 1966 to over six and one-half million cases in 1975.

-- Only 22% of the rural population in Bangladesh and 27% of the Indian rural population are literate.

-- Only 47% of primary school age children are enrolled in rural schools in Bangladesh, and only 9.0% of secondary school age children (10 to 14 age group) are enrolled.

-- Unemployment statistics, while incomplete for all countries, show that in Sri Lanka the number of jobless workers has doubled from 1966 to 1974, with one out of five unable to find employment.

-- Estimates of the percentages of rural populations served by electricity range from a high of 13% in Thailand to 2.0% in Pakistan and Indonesia.

ASIA

Real poverty also exists in a number of states in the South Pacific.

-- We are currently exploring ways in which we might modestly supplement continuing Australian and New Zealand economic assistance which aids some of these states in meeting their real and pressing development needs.

The rate of development progress in Asia will probably continue to be adversely affected by:

-- Worldwide inflation and recession, which have caused a decline in the prices of region exports and an increase in the prices of vital imports, such as oil and food, which the countries must have for their development. The net effect has been to create serious balance of payments problems in most of these countries;

-- Low levels of foreign investment, including U.S., in South Asia.

U.S. Assistance Objectives

A.I.D. development strategy in Asia embraces two primary long-term objectives for its assistance and that of other bilateral and multilateral donors. These objectives are consistent with the developing countries' objectives:

-- A 3.5% annual growth rate in foodgrain production by 1985 from the current 2.4% growth rate;

-- Replacement-level fertility by the year 2000.

Foodgrain Production

We see the interrelated problems of inadequate foodgrain production and excessive population growth as the key problems inhibiting development in the region.

-- The region's annual foodgrain production growth rate has lagged behind its population growth rate.

-- Asia accounts for 50% of the foodgrain deficit projected for developing countries in 1985.

-- Three (India, Bangladesh and Sri Lanka) of the five countries identified as potentially the largest food deficit countries by 1985 are in Asia.

** The projected food cereals deficit is expected to be more than 10% of national foodgrain demand in these countries.

-- On a per capita basis, Asia was the region in 1973 and 1974 which received the smallest amount of concessional bilateral and multilateral aid to the agricultural sector.

** India, the most populous country in the region, received only 54 cents per capita of this aid during 1973 and 1974 compared to the regional average of 81 cents.

Achievement of the first objective, a 3.5% annual growth in foodgrain production, will substantially reduce dependence on foodgrain imports for the region by:

-- helping to build reserve stocks to offset normal annual fluctuations of domestic grain production due mainly to weather, insects, and plant diseases.

In years of large decreases in domestic production it is foreseen that countries with a reasonable supply of foreign exchange will purchase imports to fill the deficit, while those developing economies which are hard pressed for foreign exchange will require concessional financing or be forced to curtail other imports needed for development programs.

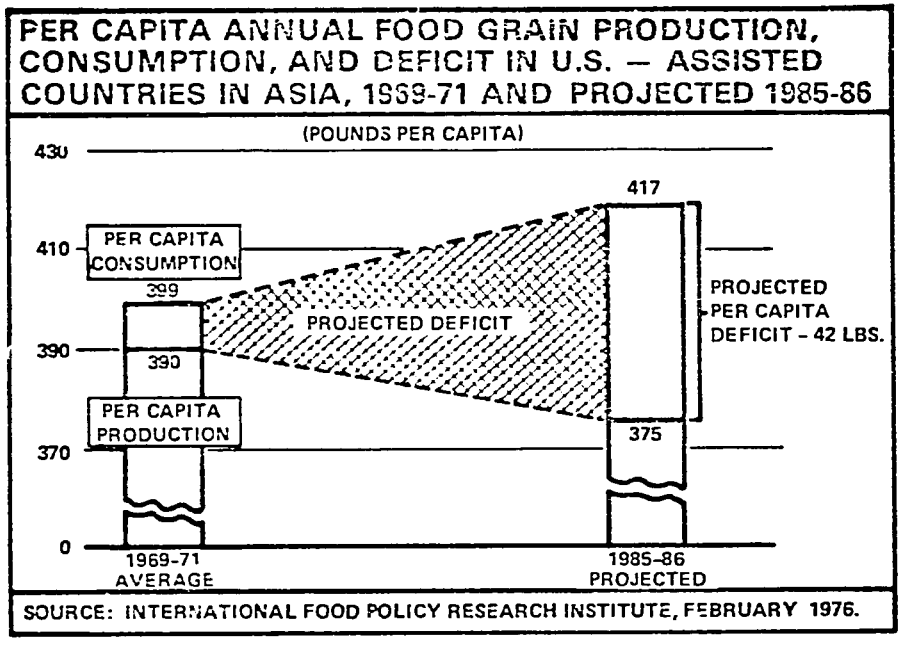
ASIA

Greater food production will also contribute at least indirectly to reduced fertility rates by:

-- increasing incomes;

-- improving nutrition;

-- providing resources for population planning programs.



Population Growth

The average annual population growth rate for the seven A.I.D. program countries, with the addition of India, is 2.2%. At this growth rate their combined populations will total almost two billion people by the year 2000.

Population growth rates must be reduced in order to:

-- avoid disastrous famine;

-- attain an improved economic and social existence for the majority of Asians;

-- maintain political stability in the region.

The goal of achieving replacement levels by the turn of the century, less than 25 years off, is admittedly very ambitious. To achieve this goal, will require that:

-- 86 million couples in the Asian countries where we are supporting population planning programs have access to population planning services;

-- 65% of these couples would have to practice contraception at any one time.

The results from A.I.D. support of population programs in the region thus far are mixed because of the different social, economic and cultural circumstances in each country, the differences in the timing and degree of political commitment to these programs, and differences in the level of financial and manpower resources applied to them.

-- Long term, well organized programs in Korea and Taiwan are now self-financed and have had a dramatic impact on fertility.

-- Preliminary evidence on program accomplishments in Indonesia, Thailand and the Philippines are that birth rates are decreasing.

-- The leadership in Bangladesh has declared that population growth is that country's first priority problem. Although momentum has built slowly since independence, new initiatives by the government are expanding fertility reduction activities and increasing the number of field workers.

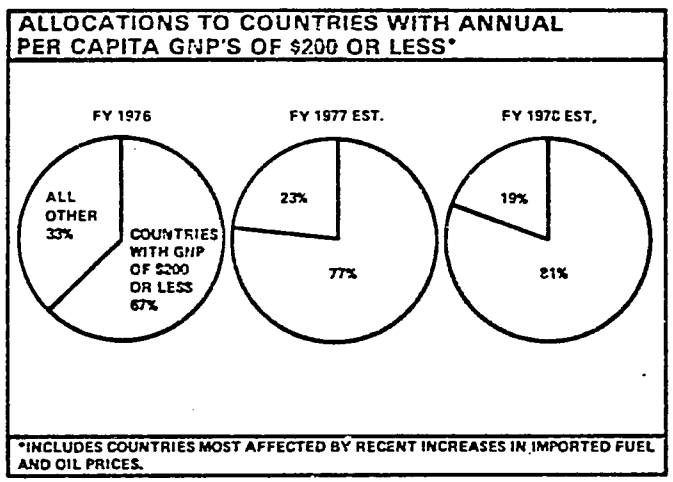
-- Despite significant increases by Pakistan in budget and staff devoted to family planning

coupled with widespread and growing public awareness of the problem - the rate of population increase remains high. In recognition of the need for injecting new vigor into the family planning program, the Pakistan Government is replacing provincial management of the program with Federal direction, is designing a country-wide voluntary surgical contraception program, and is broadening its contraceptive delivery service.

A.I.D. Program Directions in Asia

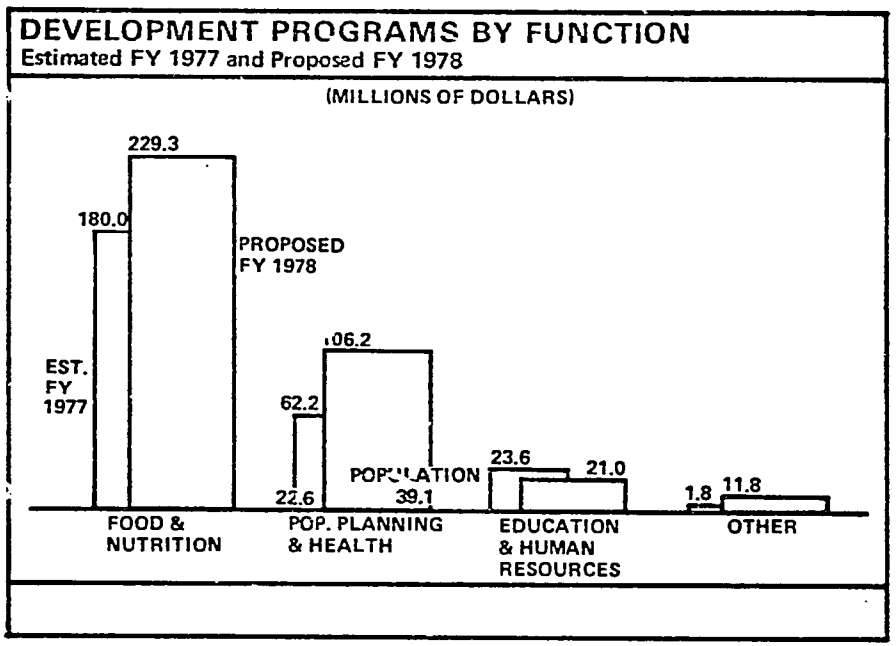
A.I.D. programs in Asia continue to evolve in directions prescribed by the Foreign Assistance Act.

-- An increasing proportion of this aid is going to those program countries with $200 or less per capita incomes and those most affected by imported fuel and food price increases.



A.I.D. has been refining and refocusing its Asian programs to make them more responsive to the needs of Asia's poor majority.

-- 91% of the allocations in FY 1978 will be concentrated in the key sectors, i.e., food production and nutrition, and population planning and health. These allocations are directly responsive to the most pervasive problems of low annual growth rates in foodgrain production, high annual population growth rates and health care available to only a few.



-- There will be continued use of U.S. voluntary agencies as channels for assistance. We expect a change in the focus of many voluntary agency activities from small scale village food production to local level institution building.

-- A new program proposed for the Philippines has as its major objective the integration of women into the development process of the country. A similar

project will begin in Bangladesh in FY 1977.

-- Continued emphasis is being given through a regionally focused program and through programs in Nepal and Indonesia to develop means to provide a minimum practical education.

-- New and ongoing activities in six program countries will help insure that basic health services, including endemic disease control, are available and within the means of all.

-- New ways will continue to be explored in Indonesia, Pakistan and the Philippines to involve the rural masses in planning and implementing local development activities.

-- Greater attention is being given to identifying the rural landless as the poorest segment of the rural poor in certain countries, and to devising ways to improve their economic and social conditions.

The FY 1978 Asia Development Assistance Program

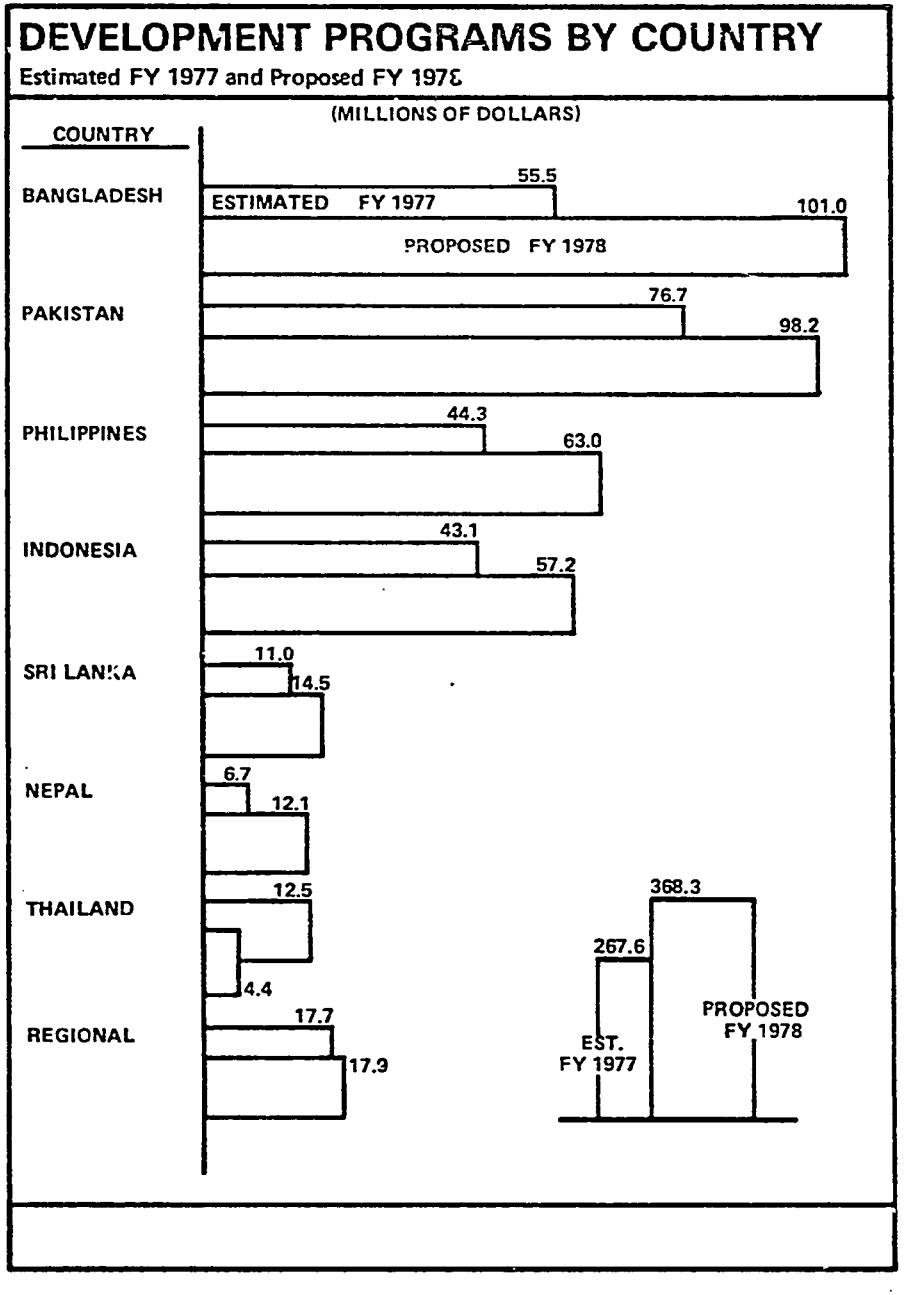
It is proposed that development assistance to Asia be increased 37.6% in FY 1978 from FY 1977.

Food and Nutrition

A.I.D.'s program emphasis in Asia is to provide assistance which will help increase food production for the benefit of the malnourished and the low income small farmer and his family who are the rural poor majority.

Assistance will take the form of:

-- adaptive agriculture research to produce higher-yielding and more disease-resistant foodgrains;



-- an expanded base of low term credit availabilities for the small farmer;

-- creating greater fertilizer production, storage and distribution capacities;

-- rehabilitated storage facilities to better protect foodgrain stocks;

-- expanded and better protected irrigated acreage;

-- new farm-to-market roads;

-- development of fisheries as a source of improved nutrition;

-- provision of economical electric power to rural areas;

-- fortifying basic foods of the rural populations in order to improve nutritional value;

-- developing bases for increasing local agribusiness activities;

-- establishing village level food processing plants to improve the quality and quantity of low cost food;

-- train market town planners and administrators in the design and management of projects to improve the provision of services to the surrounding areas.

Population Planning and Health

Most Asian Governments realize that sustained economic growth and political stability in their countries require a decline in population growth rates. More are coming to realize that, in addition, they must bring fundamental social services to their poor and foremost amongst these services is basic health care.

Population Programs will assist the governments of Bangladesh, Indonesia, Nepal, Pakistan, the Philippines and Thailand provide family planning services by:

-- strengthening the institutional structures which deliver family planning services and information;

-- testing new approaches for the delivery of non-clinical family planning services and voluntary surgical contraception;

-- assuring the reliability and availability of contraceptives.

Basic health care to the rural poor is the basis for programs which will:

-- bring serious levels of malaria under control in Bangladesh, Nepal, Pakistan and Sri Lanka;

-- expand basic rural health services in Nepal, Pakistan and the Philippines;

-- prevent the outbreak of water-borne communicable diseases through the provision of potable water in rural areas of Pakistan and the Philippines;

-- conduct research leading to techniques for the prevention, treatmen and eradication of endemic diseases.

Education and Human Resources Development

A.I.D.'s proposed activities in Bangladesh, Indonesia, Nepal, Pakistan, and the Philippines are an expression of two emphases.

-- In the Philippines, a new project will expand the opportunities for the poor acquiring the basic skills to improve their standard of living by:

** supporting the testing of new low-cost non-formal educational systems;

** revising traditional educational systems to be more responsive to the functional needs of the poor.

-- In all five countries there will be activities to train those who must design and manage development projects by:

** assisting developing country secondary and higher educational institutions to meet the country's needs for development policy makers, project designers, implementers and evaluators;

** financing participant training in the United States and third countries when local institutions are unable to meet these needs.

Regionally focused programs will:

-- provide technical assistance for the development of trade union movements;

-- aid in establishing regional institutions for educational training and research.

A limited number of developing country doctoral recipients from the United States and third countries will be needed to:

-- head the formulation of national and sector development plans and policies within which the development of local projects directed towards the poor will be facilitated;

-- strengthen indigenous educational institutions to produce development program planners and managers in-country;

-- provide the leadership for development-oriented country research activities.

Selected Development Activities

A.I.D. activities in this category address problems which share a commonality in their effects on the achievement of development objectives in Asia. Activities will be undertaken to:

-- develop improved local tax systems to increase the generally limited local revenue base in order to fund additional development activities;

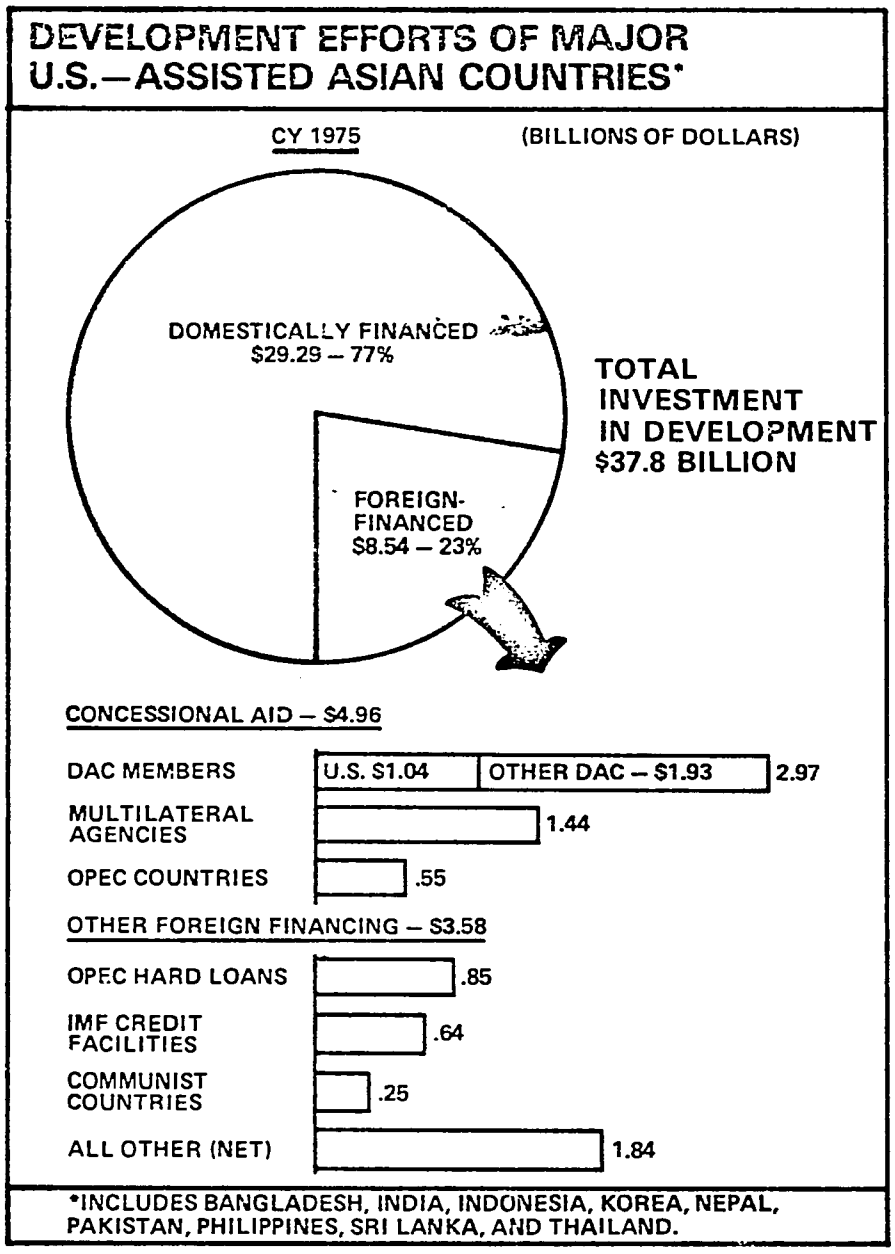
-- promote rural development and employment generation through low-cost labor intensive technology;

-- establish a cooperative system and train rural women in handicrafts through the aid of American voluntary agencies;

-- measure the social and economic impact of development projects on women.

The Development Effort in Asia

The chart below indicates the development effort of the major U.S.-assisted countries in Asia in relation to the foreign financing they receive. Data are for 1975.



P.L. 480 Programs

P.L. 480 PROGRAMS SUMMARY
(In 000MT/$000)

Program	FY 1976* (Actual)		FY 1977 (Estimated)		FY 1978 (Projected)	
	MT	$	MT	$	MT	$
Title I						
Wheat	1,996	290,667	1,402	170,400	1,933	228,100
Rice	813	212,307	495	124,300	415	110,700
Feedgrains	–	–	–	–	–	4,300
Vegoil	98	45,865	135	77,300	159	91,600
Non-food	43	51,909	33	23,100	107	47,300
Title I Total		600,748		395,100		482,000
Title II						
Voluntary Agencies		142,322		114,553		110,567
World Food Programs		15,333		20,133		15,845
Gov't.-to-Gov't.		6,423		–		–
Title II Total		164,078		134,686		126,412
Total P.L. 480		764,826		529,786		608,412

Includes Transition Quarter.

For countries receiving A.I.D. bilateral assistance, the P.L. 480 programs are described in the country narratives. In addition, significant P.L. 480 programs are planned for Korea and India.

Korea - P.L. 480 Programs

Title I

P.L. 480 sales to Korea will:

— meet the understandings of the 1971 Kennedy Commitment which limits the quantity of Korean textile exports to the United States;

ASIA

P.L. 480 PROGRAMS SUMMARY (In 000MT/$000)						
Program	FY 1976* (Actual)		FY 1977 (Estimated)		FY 1978 (Projected)	
	MT	$	MT	$	MT	$
Title I						
Wheat	471	61,803	480	56,600	550	64,900
Rice	228	57,810	45	11,300	45	12,000
Feedgrains	–	–	–	–	40	4,300
Vegoil	–	–	–	–	–	–
Non-food	12	17,774	30	11,200	75	28,100
Title I Total		137,387		79,100		109,300
Title II						
Voluntary Agencies		–		–		–
World Food Programs		245		–		–
Gov't.-to-Gov't.		–		–		–
Title II Total		245		–		–
Total P.L. 480		137,632		79,100		109,300

*Includes Transition Quarter.

-- enable the Korean Government to maintain buffer stocks of wheat to meet an increasing demand for wheat flour;

-- aid in financing planned development activities primarily in the agricultural sector.

The P.L. 480 Title I request for FY 1978 is $109.3 million to consist of 550 thousand tons of bulk wheat, 45 thousand tons of rice, 75 thousand bales of cotton and 40,000 tons of corn.

-- The estimated value of the wheat amounts to 28% of Korea's projected wheat imports for 1978 while the value of the cotton represents 6.3% of the country's estimated total 1978 imports of cotton.

-- The wheat will be milled locally for flour which is used principally for noodles and baked goods.

** A bran by-product will be used as feed in developing the domestic livestock industry.

** The government discontinued its subsidy of wheat prices to consumers in 1975 because of worldwide price decreases. Domestic prices of wheat are now within government guidelines.

-- Between July 1, 1975, and March 31, 1976, Korea purchased 1.2 million tons of wheat commercially from the United States.

-- Corn will be used principally as animal feed to encourage increased livestock production by holding down one of the principal costs of production.

-- Most of the Title I local currency proceeds will be used to supplement the Korean Government's agriculture sector development budget to finance irrigation facilities, develop new seed varieties, increase grain storage, and improve the foodgrain marketing, storage, and distribution system.

-- The proposed P.L. 480 program will not serve as a disincentive to local wheat production which is limited by unfavorable land and climatic conditions.

India - P.L. 480 Programs

Title I

P.L. 480 sales for India will:

-- provide foodgrain toward building-up and maintaining buffer stocks totaling 10 to 12 million tons;

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P.L. 480 PROGRAMS SUMMARY
(In 000MT/$000)

Program	FY 1976* (Actual)		FY 1977 (Estimated)		FY 1978 (Projected)	
	MT	$	MT	$	MT	$
Title I						
Wheat	353	48,845	-	-	500	59,000
Rice	94	25,718	-	-	-	-
Feedgrains	-	-	-	-	-	-
Vegoil	-	-	65	37,200	50	28,900
Non-food	-	-	-	-	-	-
Title I Total		74,563		37,200		87,900
Title II						
Voluntary Agencies		111,565		78,756		79,107
World Food Programs		8,706		6,549		8,405
Gov't.-to-Gov't.		-		-		-
Title II Total		120,271		85,305		87,512
Total P.L. 480		194,834		122,505		175,412

*Includes Transition Quarter.

-- provide grain to the poor distributed through 233,000 government shops at subsidized prices lower than the open market.

The P.L. 480 Title I request for fiscal year 1978 is $87.9 million for 500 thousand tons of bulk wheat and 50 thousand tons of vegetable oil.

-- While India had a record foodgrain crop in 1975/76, substantially due to good weather, the long term growth trend for food production for India has improved only marginally.

-- Experience indicates that foodgrain output will continue to fluctuate from year to year and that local consumption requirements will be met exclusively from domestic production only during years of unusually good output.

-- A buffer stock of 12 million tons will reduce wide fluctuations in consumer and producer prices, distribution availabilities and import costs which have historically followed each monsoon failure and caused much hardship to the poor.

-- India is a major buyer of U.S. commercial wheat. Between May 30, 1975, and June 1, 1976, the United States exported 4.8 million tons of wheat to India.

-- Most of the local currency proceeds from the sale of Title I foods will be used to supplement the Indian Government's efforts to increase the production and distribution of fertilizer, seeds and equipment, improve storage facilities and water management systems, conduct a program of multiple cropping, continue with research to increase crop productivity, and develop new techniques of dry land farming.

-- It is unlikely that the proposed Title I program for wheat, which, in size, represents less than half a percent of India's aggregate foodgrain production and would be only 9.0% of its expected foodgrain imports, would have any effect in reducing grain prices to a level that could be considered a disincentive to Indian farmers.

India - Title II

The India P.L. 480 Title II proposal for FY 1978 is $87.5 million.

-- $79.1 million of this request is mostly for school feeding and maternal and child health programs administered by U.S. voluntary agencies.

** These programs provide high protein supplements to 13 million recipients among the severely undernourished poor.

ASIA

— $8.4 million is for the U.S. share of World Food Program projects in India which provide food supplements to undernourished poor.

Asia Region Resource Flows

RESOURCE FLOWS (In thousands of dollars)			
Program	FY 1976* (Actual)	FY 1977 (Estimated)	FY 1978 (Estimated)
A.I.D.**			
Loans	221,250	150,200	199,690
Grants	66,753	117,467	168,611
Total A.I.D.	288,003	267,667	368,301
P.L. 480*** 1/			
Title I	600,748	395,100	482,000
Title II	164,078	134,686	126,412
Total P.L. 480	764,826	529,786	608,412
Total A.I.D. and P.L. 480	1,052,629	797,453	976,713

*Includes Transition Quarter.
**A.I.D. levels represent actual and estimated expenditures.
***P.L. 480 levels represent actual and estimated value of shipments.

1/ FY 1977 and FY 1978 data represent estimated program amounts rather than estimated shipments.

REGION:

TABLE I

SUMMARY OF PROGRAM BY COUNTRY AND APPROPRIATION
FISCAL YEAR 1978
(In thousands of dollars)

COUNTRY	Total	Food and Nutrition	Population Planning	Health	Education and Human Resources Development	Selected Development Activities	Other Programs
Bangladesh	101,015	83,641	9,060	5,000	-	3,314	-
Indonesia	57,200	38,150	11,400	600	6,500	550	-
Nepal	12,096	8,610	1,303	852	1,331	-	-
Pakistan	98,208	50,840	5,218	40,000	2,150	-	-
Philippines	62,971	34,781	7,690	10,000	4,000	6,500	-
Sri Lanka	14,500	7,500	-	7,000	-	-	-
Thailand	4,405	-	4,405	-	-	-	-
Regional	17,906	5,800	-	3,700	7,006	1,400	-
Total	368,301	229,322	39,076	67,152	20,987	11,764	-

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REGION: ASIA

TABLE Ia

SUMMARY OF PROGRAM BY COUNTRY AND APPROPRIATION
FY 1976, TRANSITION QUARTER (TQ), FY 1977
(In thousands of dollars)

COUNTRY	Total			Food and Nutrition			Population Planning and Health			Education and Human Resources Development			Selected Development Activities			Other Programs		
	1976	TQ	1977	1976	TQ	1977	1976	TQ	1977	1976	TQ	1977	1976	TQ	1977	1976	TQ	1977
Bangladesh	24,200	8,369	55,546	19,800	8,369	48,600	1,600	-	5,796	-	-	250	2,800	-	900	-	-	-
Indonesia	49,500	14,804	43,165	27,900	180	31,860	14,900	14,274	3,405	6,700	200	7,900	-	-	-	-	150	-
Korea	5,800	-	-	300	-	-	-	-	-	500	-	-	5,000	-	-	-	-	-
Nepal	2,900	577	6,742	1,100	180	4,219	1,300	218	1,534	500	179	989	-	-	-	-	-	-
Pakistan	59,000	25,194	76,731	48,600	25,194	45,935	7,600	-	23,178	300	-	7,618	2,500	-	-	-	-	-
Philippines	54,300	6,430	44,276	40,400	630	27,635	13,800	800	16,541	100	-	100	-	5,000	-	-	-	-
Sri Lanka	3,800	-	11,000	3,800	-	6,000	-	-	5,000	-	-	-	-	-	-	-	-	-
Thailand	12,900	612	12,542	8,400	300	7,712	4,100	212	4,030	400	100	800	-	-	-	-	-	-
Regional	9,900	3,717	17,665	200	1,168	8,070	1,800	605	2,752	4,900	1,645	5,943	3,000	299	900	-	-	-
(Non-Add) Indus Basin Development Fund	(9,000)	(2,250)	(15,750)	-	-	-	-	-	-	-	-	-	-	-	-	(9,000)	(2,250)	(15,750)
Total	222,300*	59,703	267,667	150,500*	36,021	180,031	45,200*	16,109	62,236	13,400	2,124	23,600	13,300	5,299	1,800	-	150	-

* Figures may not add due to rounding.

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East Asia and Pacific

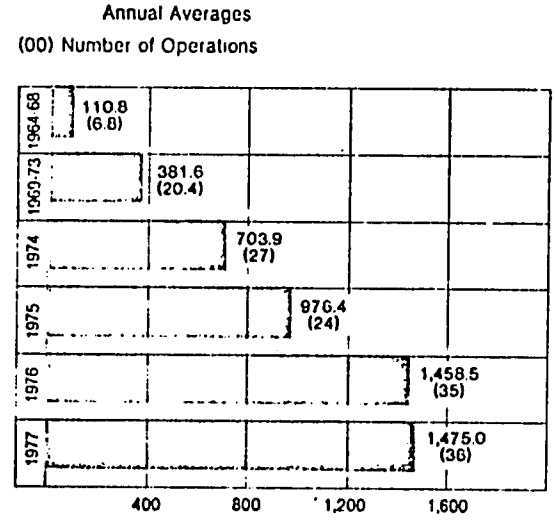
Borrowers, fiscal 1975-77	Population[1] (000)	Per capita GNP 1975[2] (US$)
Fiji	569	1,090
Indonesia	132,112	220
Korea, Republic of	35,280	560
Malaysia	12,308	760
Papua New Guinea	2,756	470
Philippines	42,231	380
Singapore	2,250	2,450
Thailand	41,870	350
Western Samoa	152	320

[1] Estimates for mid-1975.

[2] Due to shifting of the base period from 1973-75 to 1974-76, the GNP estimates shown herein differ from those shown in the Annex of the 1976 *World Bank Atlas*.

Trend in Lending, 1964-77

(US$ millions. Fiscal years)



This area of islands and peninsulas, in which a large majority of the population lives within 80 kilometers of the sea, has experienced rapid economic growth over the last decade. Despite population growth rates of 2% to 3% a year, most countries of the Region have managed to attain annual growth rates of gross national product (GNP) per capita of 4%, and in some countries (Republic of Korea, Singapore) per capita growth has been double that rate. Except for the Republic of Korea and the city-states of Hong Kong and Singapore, and despite rural-urban migration everywhere, most of the population still lives in rural areas and is largely dependent on agriculture. Because of wide variations in soil fertility, the population is spread very unevenly. With increasing population pressure, some of the most fertile areas have the worst poverty problems, the prime example being the island of Java, where 87 million people, nearly a quarter of the Region's population, are concentrated in about 3% of its area.

While agricultural growth has generally been well in excess of population growth, land reserves have dwindled, and most of the remaining land is of lower quality, frequently subject to erosion. As a result, less and less opportunity exists for absorbing additional workers into agriculture at rising incomes. Since growth of the labor force remains very high -3% and above —it is proving difficult for most countries in the Region to provide sufficient new opportunities for productive employment, even at GNP growth rates of 6% to 7%—which most of them are attaining. In its economic work, the World Bank is giving increasing attention to this central problem.

Against this background, it has been an important policy objective of the countries in the Region to maintain their growth momentum

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during the recent years of sharp price fluctuations in international trade and worldwide recession. Specific circumstances in a number of countries are discussed elsewhere in this chapter but, generally, the Region's economies continued to grow significantly in this difficult period. However, with worsening terms of trade and a slowing down, or even stagnation, in real exports, deficits in the current account balance of payments increased greatly in 1974 and/or 1975, and some countries suffered substantial losses in international reserves notwithstanding increased foreign borrowing. In 1976, with renewed growth in the international economy, real exports of all the countries in the Region recovered rapidly, and grew faster than imports. In a majority of the countries, the international terms of trade also improved, current balance of payments deficits were reduced sharply, and international reserves replenished. Although, in some countries, the terms of trade continued to deteriorate, even these current account deficits stabilized, and no loss of reserves occurred. Overall, therefore, the past year was favorable for the Region, with a continuation of recovery in economic growth in all countries, and a sharply improved balance of payments position in most of them. In addition, inflation, a grave problem for all countries during the international stagflation of 1974-75, continued to abate.

Depending on the structure of their exports, the timing, extent, and even direction in which the various countries were affected by international events, varied significantly. As an oil exporter—albeit a small one in relation to the size of its population—Indonesia's exports, in terms of real import capacity, increased greatly in 1973-74. The Government, as well as the state oil company, Pertamina, set out to expand its investment program. But in 1975, Indonesia's import capacity was severely affected by the recession, while a large part of the country's resources had to be used to meet the obligations of Pertamina, which had run into serious financial difficulties. Foreign exchange reserves declined sharply, despite substantial foreign commercial borrowing and suspension or postponement of several large investment projects. By 1976, however, most short-term obligations of Pertamina had been repaid, and both oil and nonoil exports recovered. As a result, net foreign exchange reserves increased by $700 million and, at the end of the year, covered nearly three months of imports. Over the last three years, the economy maintained an average growth rate of 6% to 7%, and the annual rate of inflation gradually declined from over 30% to less than 15%.

For a number of years, Malaysia has been nearly self-sufficient in oil and, in 1976, it became a net exporter. The country suffered substantially from the world recession, but its main raw material exports (rubber, wood, and tin) recovered rapidly in the past year. Thus, while real national income declined in 1975, it rebounded in 1976. Net foreign exchange reserves increased by nearly $1,000 million, but private investment remained depressed.

The Philippines and Thailand suffered from a less favorable export mix, and their terms of trade, therefore, continued to deteriorate in 1976. The effects were compensated for by substantial growth in export volumes. Especially gratifying has been the growth in manufactured exports: for both countries (as well as Malaysia), these now constitute over 20% of total exports. Nevertheless, large current account deficits per-

Lending to Borrowers in East Asia and Pacific, by Sectors
(US$ millions. Fiscal years.)

	Annual average 1964-68[a]	Annual average 1969-73[a]	1974	1975	1976	1977
Agriculture	$ 28.8	$ 88.2	$189.5	$193.0	$ 470.0	$ 522.5
Education	2.4	34.5	38.5	22.5	93.0	83.0
Industry (including DFCs)	14.1	36.7	88.5	285.0	230.0	312.5
Nonproject	—	—	—	100.0	75.0	—
Population and nutrition	—	3.6	—	25.0	—	37.5
Power	29.0	86.2	85.8	147.0	125.0	196.0
Technical assistance	—	2.0	5.0	—	13.0	—
Telecommunications	5.4	19.2	—	—	31.0	—
Tourism	—	—	41.0	—	—	—
Transportation	25.7	103.4	188.6	124.4	342.0	248.0
Urbanization	—	3.2	—	40.0	58.0	52.5
Water supply and sewerage	5.4	4.6	67.0	39.5	21.5	23.0
Total	$110.8	$381.6	$703.9	$976.4	$1,458.5	$1,475.0
Of which: Bank	$108.6	$254.3	$603.4	$972.0	$1,458.5[c]	$1,452.0
IDA	$ 2.2	$127.3	$100.5	$ 4.4	$ —	$ 23.0

Details may not add to totals because of rounding.
[a] Excludes loans of $375 million to Japan and $102.8 million to New Zealand.
[c] Includes $101 million on Third Window terms.

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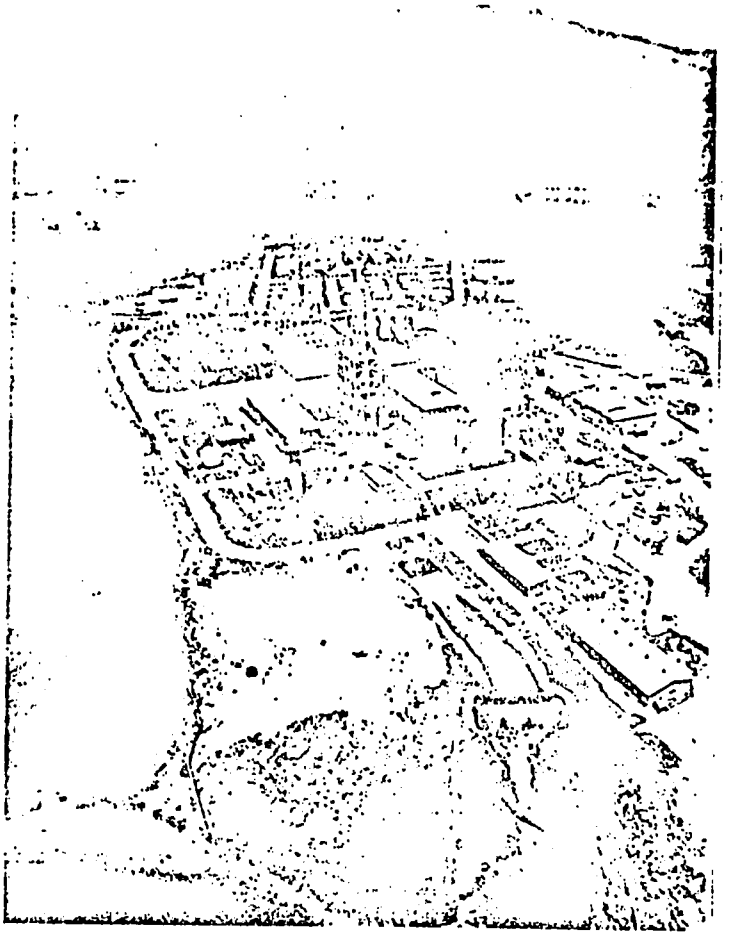
sisted. These were wholly financed by capital imports; reserves, therefore, remained essentially unchanged. The deficit in Thailand was mainly financed by medium-term and long-term borrowing. In the case of the Philippines, some of the borrowing was relatively short-term.

The remaining major World Bank borrower in the Region, the Republic of Korea, which largely depends on industrial exports, was hard hit by the sharp increases in the prices of petroleum, foodgrains, and other imports, and by the international recession. Consequently, it ran substantial current account deficits in both 1974 and 1975. With the recovery in the world economy in 1976, Korea's exports increased by about 45% in volume, and its terms of trade also improved greatly. As a result, the current account deficit declined to about $300 million, and net reserves recovered substantially, while the GNP growth rate, which had averaged 8% per annum, even during the difficult years of 1974 and 1975, rose sharply to 15%.

Assistance to Smallholders

Lending by the World Bank for projects in the Region during fiscal 1977 totaled $1.475 million, including $23 million by IDA, or $16.5 million above the previous year's record total. More projects (36) were financed than ever before. Agricultural lending amounted to $523 million as against $470 million in the previous fiscal year and constituted 39% of the Region's program and 35% of its lending. The dominant theme in all 14 agriculture projects is assistance to smallholders for rice or other food crops, or for tree crops which are an important source of family income as well as large foreign exchange earners. Seven of the projects (totaling $352 million) are concerned with rehabilitation and improvement of regional irrigation systems, but increasing attention is also being given to the needs of farmers dependent on rainfed agriculture, for example, in the Second Rural Development Project in the Philippines and the Transmigration Project in Indonesia.

Transmigration—the organized relocation of people from overpopulated Java to Sumatera and other islands—is an important part of the Indonesian Government's development plan. Official transmigration dates back to 1905. In the 1950s, about 227,000 people (56,000 families) were resettled under the program but, in the following decade, the number dropped to about 197,000. Better organizational arrangements, adequate physical and social infrastructure, and improved agricultural support services are essential for the successful acceleration of the program. The project, assisted by a $30 million Bank loan, will spell out the costs and benefits of settlement in two schemes, provide the means for detailed preparation of other schemes, and investigate the problems of sustained annual cropping on upland soil of poor fertility.



Financing of this 150-megawatt thermal-electric generating unit of the Philippine National Power Corporation on the Bataan peninsula near Manila was assisted by a $22 million Bank loan and a $10 million IDA credit. The increased generating capacity is to meet the growing need for electricity for such purposes as drinking water distribution, pumped irrigation, and power for workshops, cottage industries, and small businesses.

The new settlement at Baturaja is in an area of 60,000 hectares bordering the trans-Sumatera highway in Selatan province on Sumatera. It consists of 10 villages for about 4,500 settler families, who will be provided with housing, water supply, and other facilities. The village centers include a primary school, mosque, community center and market, and a health post, which will dispense primary medical care, provide malaria control, immunization, and environmental sanitation, and teach nutrition and family planning. Each family will be given five hectares of land, including one hectare of Government-planted rubber trees, four hectares of food-crop land, and one draught cow. During the first year of settlement, all settlers will receive food and other essentials in line with the existing Government program.

The second scheme involves upgrading an existing settlement of about 30,000 hectares at Way Abung on the trans-Sumatera highway in Lampung province, where about 12,000 families

have been settled on two-hectare plots in anticipation of irrigation development. Some physical facilities and about half the settler holdings there have not been developed. Crop yields have remained low because fertilizer had either not been available, or its application had not been guided by extension advice. The upgrading includes a construction program affecting 22 villages. Four secondary schools and health facilities, including staff, will be provided, and a network of new and improved roads will be built. Feasibility studies and detailed engineering plans for irrigation facilities will be prepared. Each of 5,000 settler families with upland holdings clearly unsuited for irrigation development will get one draught cow and will be able to grow rubber with a guarantee of at least six years of maintenance.

Evidence of a successful smallholder tree-crop settlement in virgin forest can be found in Papua New Guinea, where the New Britain Smallholder Project was recently completed. The project was partly financed by the Bank through a $1.5 million IDA credit granted in 1969. Each of the 580 smallholder families was provided with eight acres of oil palm and land for subsistence crops. Settlers received subsistence allowances and loans to cover the costs of land clearance and a small house, and were provided with basic social amenities in the village. The farmers now have incomes of about $1,500 a year, or about three times the basic rural wage rate. The project has demonstrated that nucleus estate/smallholder projects are an appropriate basis for expanding the incomes of small farmers, provided they are well managed. Projects such as the Fourth Agriculture Development Project in Papua New Guinea and the Indonesian Nucleus Estates Project follow the same principle.

While all agricultural projects have an extension component, two projects in Malaysia and Thailand have the strengthening of the national extension service as their sole objective. The Bank has already given support to a similar project in Indonesia. Strengthening a national extension service is a long-term task, essential to transferring new technology to small farmers. In Thailand, most land suitable for rice, the major food and export crop, is already in use, and future production increases must come from higher output per hectare. Some of these increases can be brought about through an improved extension service, which becomes even more effective if combined with a greater use of purchased inputs or the application of new research results. As the first phase of a national program, the National Agricultural Extension Project, for which a Bank loan of $28 million was made, will improve extension services in 33 of Thailand's 71 provinces, selected on the basis of agricultural importance and administrative efficiency.

The project provides for an additional 2,800 staff and the strengthening of the organization of the Department of Agricultural Extension. The ratio of extension agent to farm families will be increased from 1 per 4,400 to 1 per 1,000. The project aims at transmitting, through an intensive system of training and regularly scheduled visits, simple, low-cost improvements in agricultural management practices to 2.8 million target farm families. The extension methods evolved gradually from extension components in earlier projects in limited areas, assisted by the Bank. Extension advice will cover the entire production cycle, such as selecting appropriate seed varieties, obtaining institutional credit at reasonable interest rates, maintaining a correct, weed-free plant stand, and selecting and applying appropriate fertilizers and pesticides. Included will be the construction of over 300 extension centers at the provincial and district level, the procurement of vehicles and equipment to enable the extension agents and other specialists to be mobile, and funds for a limited number of training fellowships.

The World Bank, in addition to concentrating its support on increased food production, has turned to a related area—nutrition—in an effort to improve the condition of life of the rural and urban poor. The Government of Indonesia has become increasingly concerned about the prevalence of malnutrition among its population, but past efforts to raise the nutritional level have had only limited success, partly because of lack of coordination with agricultural and other development programs, and partly because of failure to focus on the particular problems of the poor and most vulnerable.

A nutrition project, for which a Bank loan of $13 million has been made, is expected to help the Government prepare the way for a national program by providing additional staff, training, and equipment, and by a modest expansion of physical facilities for the Ministry of Health's Nutrition Research Center. The project will assist in establishing a Food Technology Center at the Bogor Agricultural University, whose principal task will be to improve food processing and storage and rice-drying methods in rural areas, and assess opportunities for food fortification. The project will also finance a pilot project in seven rural districts (about 180 villages) to provide supplementary feeding to some 30,000 malnourished children under three years of age and about 17,000 pregnant and lactating women, immunization of about 100,000 children against infectious diseases, nutrition education to mothers, and extension work on home gardens. Evaluation of the cost effectiveness of the pilot program should provide the basis for expansion into a program on a national scale. The project will attempt the difficult but critical task of determining how customary habits of food preparation and weaning and feeding sick children hamper nutrition improvements. It will have close links with the National Food Crops Extension, the Agricultural Research, the Transmigration, and the Population Projects in Indonesia.

Other Sectors Aided

World Bank assistance for power, water supply, and transportation was second in importance in the Region, totaling $467 million for nine loans. A project of particular interest is the Provincial Water Supply Project in the Philippines. Assisted by a $23 million Bank loan, the project covers the first four years of a long-range water supply improvement program that will benefit about 370,000 people living in six cities on the island of Luzon. In these cities, as in the majority of the 300 provincial towns in the country and in Manila itself, old water systems do not cover the urban area and provide only intermittent service, while the water is of poor quality and is sometimes contaminated. Assistance for water supply projects has been given previously by the Asian Development Bank, the US Agency for International Development, and the Danish International Development Agency. The present project, supported by the Bank, constitutes a fourth group of projects and will finance rehabilitation works, construction of wells, pumps, pipelines, and storage tanks, as well as equipment, vehicles, and engineering services. Feasibility studies for water supply projects in 10 other cities will also be provided, as well as training of Government staff in the design and construction of water supply systems in small communities.

Although Malaysia has a comparatively strong system of formal education, on which the Government spends a high proportion of its budget, educational services are distributed unequally. In particular, poorer states and rural areas lag behind the rest of the country in adequate primary school facilities and trained teachers. The major portion of the Bank's fourth education loan to Malaysia, amounting to $35 million, supports the Government's five-year primary school construction program by financing approximately 4,100 classrooms at about 850 primary schools in seven of Malaysia's most disadvantaged states. It will help establish systematic procedures for school mapping and for planning primary school facilities. This process, beginning at the local level is designed to improve decisions regarding size and location of new schools, consolidation of small schools, and expansion of existing schools. The project should lead to a more equitable access to primary schools and increased returns for investments in school construction by a better allocation of resources.

The Bank continues to emphasize the importance of increasing industrial employment. A special feature of an $82.5 million loan to the Korea Development Bank (KDB) is that KDB will bring out more clearly, in its future loan appraisals, the employment impact of the projects it finances. Another innovative aspect is that $7.5 million of the loan amount will be earmarked for use by the Korea Industrial Leasing Company (KILC), a subsidiary of KDB, for financing small-scale enterprises which have a positive impact on urban employment. With a few exceptions (e.g., hospitals and research institutions), the $7.5 million will be channeled exclusively to enterprises with total assets of less than $1.2 million and projects whose cost per new job created is less than $15,000.

World Bank lending in support of the development of Korea's industrial sector has hitherto been channeled entirely through three Korean development banks. A new initiative was taken in fiscal 1977 when the Bank approved a loan of $80 million directly to the industrial sector for a heavy machinery project. The project is designed to manufacture, at full operation, some 100,000 tons per year of heavy machinery and equipment, primarily for steel mills, power generation, and chemical and petrochemical plants. Manufacturing facilities will be sufficiently flexible and versatile for producing a wide range of other heavy industrial equipment. The project represents a significant step in the implementation of the Government's policy to effect structural shifts to more skill-intensive industries.

South Asia

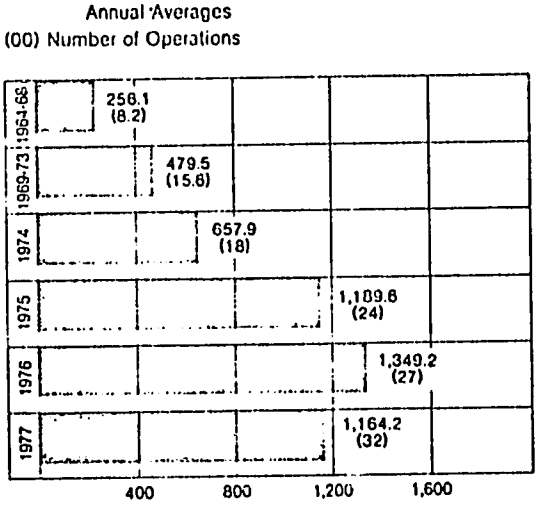
Borrowers, fiscal 1975-77	Population[1] (000)	Per capita GNP 1975[2] (US$)
Bangladesh	78,600	90
Burma	30,170	110
India	608,072	140
Nepal	12,587	110
Pakistan	69,229	160
Sri Lanka	13,603	240

(1) Estimates for mid-1975.

(2) Due to shifting of the base period from 1973-75 to 1974-76, the GNP estimates shown herein differ from those shown in the Annex of the 1976 *World Bank Atlas*.

Trend in Lending, 1964-77

(US$ millions. Fiscal years)



Development in the South Asia Region is handicapped by a heavy density of population in relation to cultivable land, an unfavorable natural resource endowment in substantial parts of the area, and a population which, for the most part, suffers from low levels of literacy and vocational skills, as well as poor health. Viewed against this background, the countries of the Region have achieved much in the past 30 years: in several, food production has increased to keep pace with rapid population growth,[1] and considerable progress has been made in building up industry and developing the institutions of government needed to implement economic development programs.

The economic progress made in fiscal 1976 largely continued during the past year—although at a somewhat reduced pace. Although growth rates were less buoyant than in the year previous, it appears probable that overall growth in output of most of the countries of the Region exceeded the growth in population for the second consecutive year.

Generally favorable monsoons again resulted in good harvests which, in turn, provided the basis for continued industrial expansion and levels of exports which were as large, or larger, than in 1976. Reserves of foreign exchange and food rose substantially.

Despite a generally encouraging record of production, the balance of trade of Bangladesh, Pakistan, and (to a lesser degree) Sri Lanka continued to be under severe pressure. The payments problems of most countries of the Region were alleviated by considerable inflows of for-

(1) Recent statistics from The Population Council show, however, that there has been a 17% reduction in India's crude birth rate (CBR) during the period 1955-74. Pakistan's CBR has dropped 5%, while the CBR in Bangladesh has remained constant.

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eign capital, predominantly from public sources, including assistance from international agencies, particularly the Asian Development Bank and the World Bank.

These broad tendencies in economic conditions for the subcontinent as a whole inevitably mask wide differences in individual countries and regions within countries. For a fuller appreciation of the current economic situation, it is necessary to look more closely at the experience of individual countries.

In fiscal 1977, the Indian economy continued to build on its bright performance of last year. Early in calendar 1977, best estimates were that real gross domestic product (GDP) might rise around 2% on top of the 8.8% growth for 1976. Lower GDP growth in 1977 may be explained by the fact that agricultural production, although the second highest on record, was less than in 1976—a year of exceptionally favorable monsoons. Production of cash crops generally increased, however. Industrial production was also projected to grow—by more than 10%, or twice the increase of 1976, and the highest in more than a decade—as a result of increasing domestic and export demand and generally adequate supplies of power. The country's trade balance also headed for a major improvement in 1977. Exports of manufactures increased considerably, and the total volume of exports was likely to grow about 10%, reflecting the effect of policies of stimulation implemented last year. As a result, foreign exchange earnings were estimated to increase about 16%. With total imports declining somewhat (led by declines in imports of fertilizer, fuel, and foodgrains), the country's trade deficit is likely to be about $1,000 million lower than the fiscal 1976 deficit of $1,500 million. In addition, the net receipt of invisibles is expected to rise by some $300 million, resulting in a balance of payments surplus and an addition to foreign exchange reserves. Though inflation is of some concern again (wholesale prices, which fell steadily between September 1974 and March 1976, in subsequent months were rising at an annual rate of about 10%), the large foodgrain stock, as well as the increased scope for imports resulting from large foreign exchange reserves and further liberalization, should help counter further upward pressure on prices.

The growth in Pakistan's economy during fiscal 1977 was again limited, continuing the trend of the past several years during which natural disasters hampered efforts to increase output. During the past year, heavy rains caused serious flood damage to the cotton crop in the Indus valley. (The Bank responded by approving a $40 million IDA credit to help repair the flood damage.) Nonetheless, the production of foodgrains and sugarcane, which attained record levels in fiscal 1976, may be maintained—or even exceeded—due to good rains, increased fertilizer use, and added availability of water from the Tarbela reservoir. Pakistan, as a result, may attain foodgrain self-sufficiency in the coming year. Growth of all agriculture may be about 2% for the year. Industrial growth, barely positive in fiscal 1976, may be about 4% under the stimulus of recovery in demand, so the overall growth of real GDP may not exceed 4%. Despite limited domestic resources, the Government continued to expand public investments in industry and infrastructure. As a result, the rate of investment is expected to rise to 18% of GDP in fiscal 1977, while domestic saving is estimated to be about 10% of GDP. The resulting gap has put a severe strain on the country's balance of payments, and the current account deficit may be about $1,400 million when the books for fiscal 1977 are closed.

The Bangladesh economy has experienced a marked improvement over the past two years following the initiation of a stabilization program—which included credit restraint and the elimination of deficit financing, combined with some import liberalization—in conjunction with a stand-by arrangement with the IMF. This program was preceded by a 58% devaluation of the *taka*. Bangladesh's stabilization efforts have been successful: food shortages have eased; inflation has been brought under control; exports have expanded greatly in volume (though not as much in value); and balance of payments deficits, although still very large, have been reduced. Good weather was a major factor in the record foodgrain harvest in fiscal 1976; continued favorable weather is likely to increase agricultural production further in fiscal 1977. Manufacturing output may expand by about 7%—somewhat above the growth achieved in fiscal 1976—despite depressed internal demand caused by cautious monetary policies, declines in hoarding, and low rural income. This situation has been improving, and, altogether, GDP in fiscal 1977 is expected to grow at about 4%. Given the many profound political changes of the past six years and the acknowledged constraints on administrative capacity and entrepreneurship, recent progress is a considerable achievement.

In fiscal 1977, Sri Lanka's economy showed signs of recovery after a lapse of two years, caused mainly by drought. Field crop production responded sharply to an adequate amount of rainfall, and the Maha 1977 paddy output (the principal crop, harvested in the spring), alone, has been estimated to be close to total production in all of fiscal 1976. With the exception of coconuts, tree crop production was also expected to increase in the latter half of fiscal 1977, and tea and rubber output for the year showed signs of exceeding the previous year's levels. In addition, tea prices have benefited from a strong export market. Manufacturing output grew little, however, as it has for many years. Assuming that growth in the services sector continues at recent levels, GDP growth in 1977 is likely to be in the 4%-5% range, as compared with growth of 3% recorded in the

previous year. With money supply expanding rapidly due to budgetary deficits and a rise in external reserves, the recent annual inflation rate has been about 10%.

After two years of modest economic growth and rapid inflation, production in Burma increased markedly in fiscal 1976. Weather conditions were again favorable, and the paddy harvest appears to have set a record. According to preliminary estimates, the Burmese GDP increased by 6% in fiscal 1977 and exports rose by 40%. The increase in export earnings, combined with a substantial increase in capital flows, enabled the Government to increase its import of goods for development, much needed spare parts, and raw materials for the industrial sector.

The April 1976 tax reform halted the deterioration in the Government's fiscal position. A substantial rise in current revenue permitted the Government to increase both current and capital expenditures. Reflecting the recovery in GDP growth and the improvement in the Government's financial situation, the annual rate of inflation has decreased from more than 30% in 1976 to about 10% in the past year.

In fiscal 1976, Nepal's economic situation improved markedly, led by a substantial increase in foodgrain and cash crop production. That improvement continued into 1977. Production of various manufactured goods also increased. Growth in exports was not as rapid in fiscal 1977 as in the previous year, however, and Nepal's trade balance in fiscal 1977 may not be as favorable as in the 12 previous months.

Increasing Food Production

The Bank's principal concern is with the fundamental problems which determine the welfare of the people of the South Asian Region in the longer run. The Bank and IDA have sought, in fiscal 1977, to respond to the underlying development needs of the South Asian countries through a variety of activities. A program of economic and sector missions in every country of the Region has been designed to broaden and deepen understanding of countries' problems and development opportunities, as well as provide an improved basis for lending. Bank and IDA lending to the Region was $1,164 million in fiscal 1977, down $185 million from fiscal 1976 amounts, in large measure because of a more limited availability of IDA resources. The number of projects assisted rose to 32, or five more than in fiscal 1976.

While the lending programs of both the Bank and IDA in South Asia have continued to serve a broad range of activities and sectors, particular attention has been directed to the agriculture and rural development sector in keeping with the principal concerns of governments in the Region. Continuing the emphasis of recent years, lending for agriculture in South Asia grew in relative importance during fiscal 1977, accounting for half the number of projects (16 out of 32) and nearly 39% of the amount financed ($451 million out of $1,164 million) in the Region. Projects assisted by the Bank and IDA concentrated on increasing food production, especially of foodgrains. These projects aim to accelerate growth by making better use of existing resources, for instance, through command area development and improved extension services to help farmers improve yields in irrigated areas. In India, IDA lending supports a comprehensive strategy to improve agricultural yields with the following elements: seed production, groundwater development, provision of credit, the up-

Lending to Borrowers in South Asia, by Sectors
(US$ millions. Fiscal years.)

	Annual average 1964-68	Annual average 1969-73[1]	1974	1975	1976	1977
Agriculture	$ 25.2	$108.1	$150.0	$ 400.1	$ 345.5	$ 451.0
Education	5.2	4.7	—	—	12.0	15.0
Industry (including DFCs)	40.8	77.1	110.0	367.5	170.0	250.0
Nonproject	91.0	109.0	235.0	290.0	350.0	75.0
Population and nutrition	—	4.3	—	15.0	—	—
Power	25.7	42.0	—	—	283.0	150.0
Technical assistance	—	0.8	—	—	7.5	3.0
Telecommunications	6.6	50.3	20.0	57.0	—	80.0
Tourism	—	0.9	—	—	—	—
Transportation	51.2	71.3	100.1	60.0	114.6	70.0
Urbanization	—	—	35.0	—	—	49.0
Water supply and sewerage	10.4	11.0	7.8	—	66.6	21.2
Total	$256.1	$479.5	$657.9	$1,189.6	$1,349.2	$1,164.2
Of which: Bank	$ 71.0	$ 86.5	$112.0	$ 269.0	$ 260.0[2]	$ 394.0[3]
IDA	$185.1	$393.0	$545.9	$ 920.6	$1,089.2	$ 770.2

Details may not add to totals because of rounding.
[1] Excludes $222 million of commitments to Bangladesh which replaced commitments originally made to Pakistan.
[2] Includes $195 million on Third Window terms.
[3] Includes $24 million on Third Window terms.

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grading of extension services, and research planning through both national-level and state-level action programs.

In fiscal 1977, four state-level agricultural development projects in India, whose key component is a reorganized and strengthened system of agricultural extension and adaptive research, were assisted with IDA funds. The strengthened extension system emphasizes concentration of effort, systematic and regular training, close supervision of staff at all levels, and a fixed schedule of visits to farmers' groups. Initially, the message carried by extension agents stresses improvements in basic agricultural practices that are known to have significant impact on yields but which cost little in addition to extra labor input. This approach is especially well attuned to the needs of small farmers, and the experience gained, so far, indicates that small farmers have benefited—as have larger ones.

The agricultural extension service in the western Terai region of Nepal will also be strengthened as a result of a $9 million IDA credit, designed mainly to add to the productivity of small-scale farmers by introducing a first stage of a groundwater development program for irrigation. Under the project, deep tubewells and storage reservoirs will be installed and constructed, thus relieving the major constraint—water—to agricultural productivity growth in the area. Irrigation and drainage networks will also be constructed. Credit will be made available to farmers so that they can finance the costs of additional agricultural inputs required to make best use of an assured irrigation water supply, and a staff of agricultural extension workers and technicians will carry out intensified agricultural extension and training programs. A revamped agricultural extension service involves—as in the Indian examples—new methods of demonstration, strict adherence to a schedule, and concentration on important practices for the major crops. Some 4,500 farm families will benefit.

Some 4.7 million people in the Indian states of Karnataka, Madya Pradesh, and Rajasthan will be aided by three IDA credits, totaling $74.1 million, which assist the financing of dairy development. Through an integrated program, milk production will be greatly increased, and the beneficiaries, most of whom farm less than two hectares or are landless, will be able to have larger cash incomes and higher living standards.

Lending in Other Sectors

Increasing concern with the condition of the urban poor has led to an expansion of the Bank's efforts to contribute to the alleviation of poverty in South Asian cities. There were four urban development projects in fiscal 1977: slum upgrading, benefiting almost a quarter of a million poor in Madras, urban transportation in Bombay, and water supply projects in Nepal and Sri Lanka.

The Bank and IDA also continued to help the countries of the Region expand and modernize their basic economic infrastructure with credits or loans for telecommunications and power in India, port facilities in Burma, and railway modernization in Pakistan. The $150 million power project in India is also important to the continued development of the agricultural sector; it well help meet the demand for power arising partly as a result of the country's large rural electrification and irrigation programs.

Nonproject credits declined from a total of $350 million in fiscal 1976 (to India, Bangladesh, and Pakistan) to $75 million (a credit to Bangladesh) in fiscal 1977. The Bangladesh Fifth Imports Credit continues the approach of the Fourth Imports Program Credit (it became effective in late 1975), which contained provisions for an "action program" to upgrade the efficiency of the country's important jute and cotton industries; the latest credit adds a similar "action program" for the pulp and paper industry. In view of the efforts which the Government has committed itself to undertake to improve disbursed to these industries. As compared with performance in these three industries, at least half the proceeds of the fiscal 1977 credit will be the previous credit, the list of industries eligible to import under the credit has been reduced in order to permit concentration on priority industries.

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USAID

Environmental Actions | Bureau for Asia | CY1977

Country	Project & Number	FY	Threshold Decision	Comment
Bangladesh	1. Agricultural Inputs (0035)	77	ND 1/5/77	
	2. Rural Electrification (0021)	77	EA 11/22/76	
Indonesia	3. Agriculture Development, Planning & Administration (0265)	77	ND 8/12/77	
	4. Agricultural Research (0198)	77	ND 7/77	
	5. Assistance to Agricul. (0189)	77	ND 9/13/77	
	6. Kabupaten Provincial Planning and Management Training (0237)	77	ND 8/31/77	
	7. Northern Sumatra Regional Planning (0246)	77	ND 5/23/77	
	8. Provincial Area Development Program I (0264)	77	ND* 9/7/77	
	9. Rural Electrification (0267)	77	EA 7/6/77 (concur Jakarta 9676)	
	10. Technical Assistance/Consulting Services (0249)	77	ND 10/26/77	
	11. Science & Technology (0266)	78	ND 3/18/77	
Pakistan	12. Improved Crop Estimating (0418)	76	ND 5/23/77	
	13. Fortification of Flour (0404)	77	ND 11/21/77	
	14. Population Research & Development (0411)	77	ND 11/21/77	
	15. Rural Roads (0409)	77	EA 11/22/76	~~Under review~~
	16. Rural Clean Water Supply I & II (0406, ~~0425~~)	77,~~78~~	EA 8/12/77	
	17. Rural Electrification (0408)	78	EA 7/6/77	
Thailand	18. Artificial Fish Propagation (ØPG)	77	ND 8/10/77	
	19. Lam Nam Oon On-Farm Development (0272)	77	EA	Cable concurrence

Country	Project & Number	FY	Threshold Decision	Comment
Sri Lanka	20. Agricultural Base Mapping (0045)	77	ND	9/26/77
	21. Mahaweli Basin Development Stage II (0042)	77	EA	Completed 9/77 Sent to EC 10/77
	22. Malaria Control (0043)	77	EA	Completed 8/77 Sent to EC 9/77
	23. Amparai Irrigation & Area Development I (0046)	78	EA	Completed 9/77 Sent to EC 10/77 (projected dropped)
Philippines	24. Bicol Integrated Area Development II (0310)	77	EA*	(see narrative)
	25. Crop Protection (o288)	77	ND	1/3/77
	26. Population Planning II (0277)	77	ND	5/77
	27. Small Scale Irrigation II (0301)	77	EA	12/28/76
	28. Agro-forestation (0305)	78	EA	10/26/77
	29. Barangay Water (0291)	78	EA	11/30/77
	30. Bayanihan Barrio Schools (0293)	78	ND	10/26/77
	31. Cooperative Marketing (0300)	78	ND	10/26/77
	32. Fisheries Education Development (0296)	78	ND	10/27/77
	33. Nonconventional Energy (0294) Energy Exploration & Development	78	ND	10/27/77
	34. Rural Electrification/Bridge Financing (0321)	78	EA*	(see narrative)

Integrated Bicol Assessment Includes:

1. Bicol Integrated Rural Development (0303) - FY78
2. Bicol Integrated Area Development III (0289) - FY78
3. Bicol Integrated Area Development II (0310) - FY77 (separate EA done 9/77)
4. Bicol Health, Nutrition & Population (0319) - FY79

In CY 77, the Asia Bureau carried out 34 actions.

20 Threshold Decisions were Negative Determinations.

14 Threshold Decisions were Environmental Assessments.

Of 20 ND's, one (#8) is conditional. Specific projects have not been selected, but if an illustrative list accurately depicts sub-projects to be carried out, an EA will not be necessary.

Of 14 EA's determined in CY77, four have been carried out and passed on tb the EC. Of those four, one (#23) has now been dropped as a project. Another (#24) was done as a discrete project but will also be integrated into an overall EA of four Bicol projects listed at the bottom of page 2. With the completion of these four EA's (#21-24), the host country governments have been reviewing the assessments and we are awaiting their response.

All projects listed as EA's for the Philippines are in the process of being carried out. The EA on Rural Electrification will cover all phases of this project back to its origin in 1972.

On the remaining EA's, we are in the process of contracting for services for Indonesia. Candidates are being reviewed for the five remaining EA's in Pakistan, Bangladesh, and Thailand.

In addition two projects for which EA's were determined in CY76 have not yet been acted upon. One was Malaria Control (0034) in Bangladesh; it now appears that this project has been dropped from consideration. The second, Sederhana Irrigation (0252) in Indonesia, will be carried out by the consultant now being selected.

ENVIRONMENTAL PROTECTION LEGISLATION IN THE ESCAP REGION

The attached table was compiled from the replies to a questionnaire distributed by ESCAP to its member nations in late December 1976. The questionnaire was designed to elicit information concerning the current status of environmental law in the ESCAP region. The results of the questionnaire were examined by an Expert Group Meeting convened in December 1977 to evaluate the status of environmental protection legislation in the region and to determine ways and means to assist individual governments towards formulation and enforcement of such legislation. An analysis and synthesis of the total response is being undertaken by ESCAP in conjunction with an ESCAP-sponsored Intergovernmental Meeting on Environmental Protection Legislation as recommended by the 32nd session of ESCAP.

EXCERPTS OF RESPONSES TO ESCAP QUESTIONNAIRE IN RESPECT OF ENVIRONMENTAL PROTECTION LEGISLATION IN THE ESCAP REGION

Country	Institutional Setting	Legal Setting	Environmental Impact Assessment	Selected Other
Australia	1. Federal: Aust.Env.Council (CEQ-type); Dept.Env., Housing & Community Dev.; 2. State: env.offices; some env. functions in other depts.	1. Federal Env.Prot.Act 1974 (NEPA-type) 2. Env.Law Branch in Atty.Gen. Dept., legal assistance to public on env.issues of nat. concern	1. EIA required of new dev.projects 2. EIS and public hearings; consideration Minister 3. Projects must have sig.effects on env. and involve constitutional power	1. Education: env.prot. component of courses at all levels 2. Fishing: Fed.Fisheries Act, 1952 3. Forestry: Fed.Forestry & Timber Bureau, Dept. Primary Industry; state agencies and legislation; coordination thru Aust. Forestry Council
Bangladesh	1.National:Env.Poll.Control Board:coordinates inter-ministerial activities; responsible for policy; Directorate of Env.Poll. control under Ministry of Local Govt. and Rural Dev. & Cooperatives.	1. Env. Poll. Control Ordinance 1977 2. Consultations with env.experts, administrators, and law makers concerning introduction of env. laws.	1. New dev.projects processed by Min. of Planning 2. No public input; no requirement for consideration of EA	1. Forestry: Forest Act of 1927; rules and procedures, Act.no. 23,1973; Forest Dept.
Cook Islands	1. Director of Conservation	1. Conservation Act 1975 2. Use of traditional means of discussion and negotiations to settle disputes affecting [illegible] and env.	1. No formal/legal mechanism 2. General govt.policy that anything affecting env.be considered in decision-making	1. Preservation of traditional culture strongly encouraged
Fiji	1. Diversified responsibilities in various Ministeries; e.g., Ministry of Agric. Fish. and Forests	1.No specific env.legislation; various statutes	1. No formal/legal mechanism 2. e.g., Ministry of Marine, Fish & Forestry must satisfy Director of Lands of non-disadvantageous effect of any dev. in C.Z. before foreshore lease is issued.	1.Forest Act 1953 2. Native rights on native lands a problem for enforcement of various statutes.
India	1.Constitution: Article 48A "the State shall endeavor to protect and improve the environment and safeguard the forests and wild life of the country. 2.4th-5-year plan:"--necessary to introduce the env.aspect into our planning and development"	1.Guidelines and executive instructions in selected dev.sectors 2.Persuasion usually employed instead of litigation	1. No formal/legal mechanism; however authorities must consider env. implications of dev. projects, e.g., new individual ventures must assess env.hazards and review steps to adhere to accepted env. standards. 2. Public view considered by appropriate departments.	1.Indian Standards Institution developing env. standards 2.Water (Prevention & Control of Pollution) Act 1974; intensive effort underway. 3.Forestry: State Forest Depts; "working plans"; Inspector-General for Forests; Indian Forest Act 1927 and various State Forest Acts;

EXCERPTS OF RESPONSES TO ESCAP QUESTIONNAIRE IN RESPECT OF ENVIRONMENTAL PROTECTION LEGISLATION IN THE ESCAP REGION

Country	Institutional Setting	Legal Setting	Environmental Impact Assessment	Selected Other
India (continued)	3. Union: Committee on Env. Planning & Coordination; policy advisory role. 4. State: some state committees and Dept. of Env. 5. No separate env. Ministry; env. affairs responsibility of various departments.			3.(continued) needs of fuel, fodder and local peoples' rights are enforcement problems.
Indonesia	1. Constitution:Preamble (Art.33, para 3): "land and water and the natural resources therein shall be controlled by the State and utilized for the greatest welfare of the people"; env. policy entrusted to People's Consultative Assembly thru President. 2. 1973-1978 5 yr. plan: "Indonesia's natural resources must be utilized in a rational manner--(so) that the human env. is not damaged and future generations are accounted for"; Env.Dev. Plan incorporated into Nat.Dev. Plan. 3. National Comm. on Env.;subcomm.: Human Settlement, Nat.Res. Manage, Poll.Cont., coordination and implementation of Nat.Env. Policy; responsibilities in various Depts.	1. Nat.Comm on Human Env.-subcomm.on env.legislation submits bills to House 2. National standards	1.EIA by Nat.Comm.on Human Env. in conjunction with Nat.Planning Board 2.Consideration of public view expressed via protests or media 3. Review of dev.projects by House	1. Crash program on marine pollution 2. Center for Env.Law and Problems at Univ. Padjadjaran 3. Comprehensive CZM legislation under study 4. Forestry: Dept.Agriculture, Directorate Gen.of Forestry; control by local officials; Basic Act. No. 5 of 1967, various Govt. Regs.; shortage of enforcement personnel & facilities outside Java is obstacle to enforcement.
Pakistan	1. Env.& Urban Affairs Div.,Ministry of Housing & Works; formulates env.policy. 2. Proposed Env.Prot. & Improvement Agency; would formulate policy; also Env.Prot.Council (CEQ, NEPA arrangement?)	1. None 2. Ministry/Division of Law suggests improvements to env.legislation	1. No formal/legal mechanism for EA incorporation in planning; local authorities resp.for dev. planning. 2. EIA by Env. & Urban Affairs Div.; responsibility to be transferred to PEPIA. 3. Press review.	1. Forestry: Provincial Forest. Depts. have responsibility for planning/regulating exploitation of forest resources; Forest Act of 1927; provincial enactments; increase in pop., adverse socio-econ. conditions exerting press. on forests problems for enforcement.

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EXCERPTS OF RESPONSES TO ESCAP QUESTIONNAIRE IN RESPECT OF ENVIRONMENTAL PROTECTION LEGISLATION IN THE ESCAP REGION

Country	Institutional Setting	Legal Setting	Environmental Impact Assessment	Selected Other
Pakistan (continued)				2. National Parks, Wildlife Sanctuaries and Game Reserves appears to be most advanced at present
Papua New Guinea	1. Constitution; 4th Goal: "PNG's nat.res.& env. to be conserved and used for collective benefit of us all, and be replenished for the benefit of future generations"; 2. Office of Env. & Conservation; primary policy body; Ministry for the Environment; initiating responsibility primarily with provincial govts.	1. Env. & Conservation Policy formulated 2. Presently weak and scattered legislation among many agencies 3. Env.Planning Bill in draft stage; also Env.Contaminants Act to establish standards, penalties and enforcement procedures; Conservation Areas Act	1.Env.Planning Bill will require EA at planning stage; review by Office of Env., public and Nat.Exec.Council--incorp. of econ.considerations also apply to policy initiatives; 2 ad-hoc EA ongoing - a hydroelectric installation and a Cu mining dev.;	1. Conservation, customs and traditions will be incorporated in law with enforcement at village level 2. Clan groups wishing to lease land for dev.must first lease to Dept.Nat.Resources; thus govt.control 3. Forestry: Office of Forests, Dept. of Primary Industries; env. restrictions, present legislation allows landowners to deal directly with timber co.; conflict of interest of DPI one obstacle
Philippines	1. Preamble and Art.on Gen.Provisions:"The Nat.Assembly, taking into account, conservation, ecological and dev.requirements of the nat.res.shall ---" 2.National Env.Prot.Council; coordination policy; env. quality standards; develops legislation (CEQ-type); Nat.Poll. Control Comm.(EPA-type) Environmental Center of the Philippines. 3. Representation by lawyers of different agencies before a lead agency, the Dept. Nat. Res./Nat Env.Protec. Council, in the preparation of the Env.Policy, the Env.Code and EIS guidelines. 4. Env.considerations incorporated in national economic plans.	1. Presidential decree 1121 (1977); Nat.Env.Prot. Council 2. No legal imperative to include env.considerations in nat.planning 3. Presidential decree 1151: EIS required; supervised by NEPC 4. 45 govt. lawyers involved in env.matters.	1.EIA, EIS required (NEPA-type) (pending); draft released; public hearings	1.Presidential decree 1151; env. education at all levels; media publication of env.matters. 2.Forest Dev., Dept.Nat.Res.; management plans required by operators; P.D.389 & 705; enforcement obstacles include lack of tech.pers.capable of identifying a prob., overlapping of enforcement functions among agencies.

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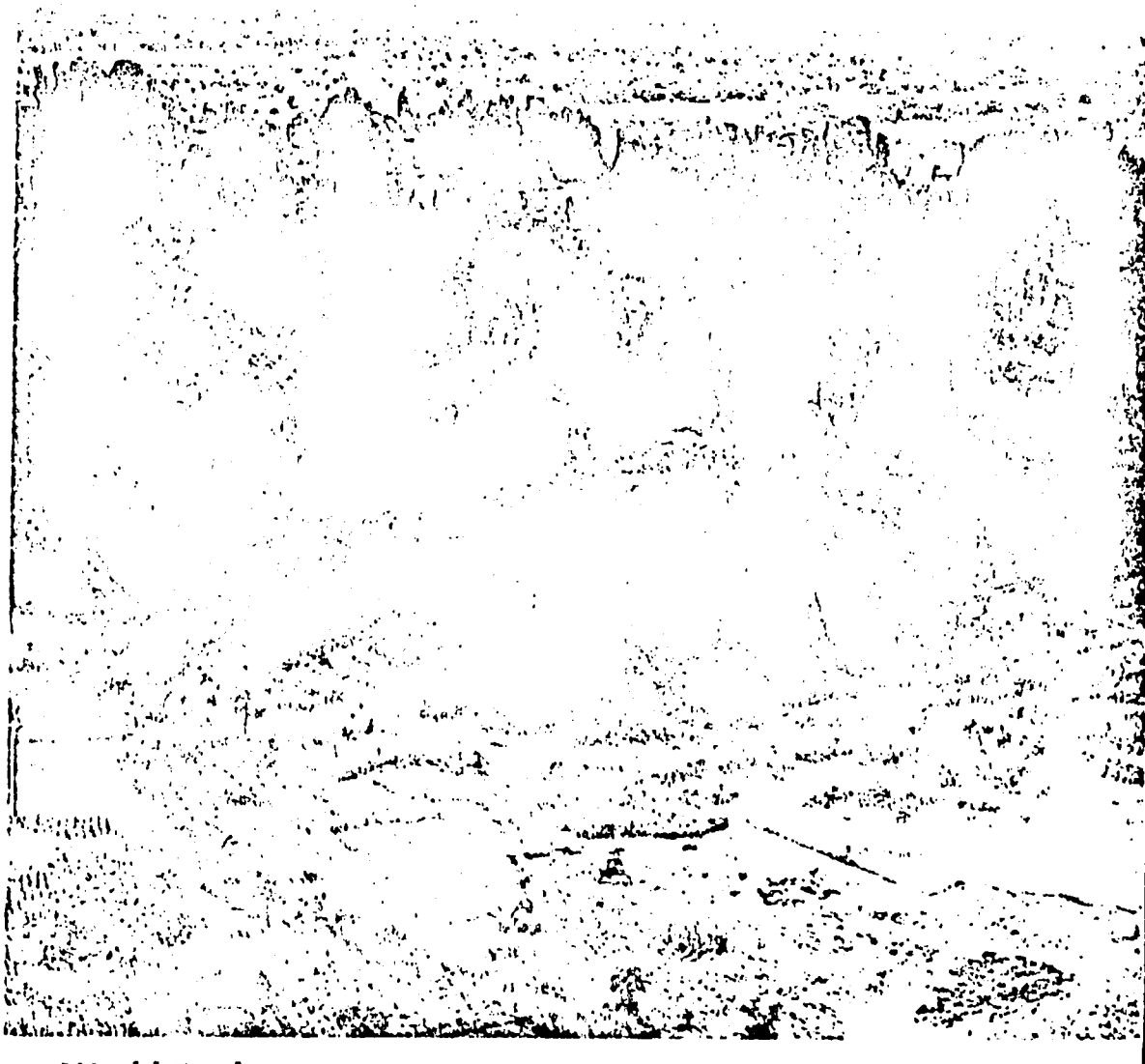
EXCERPTS OF RESPONSES TO ESCAP QUESTIONNAIRE IN RESPECT OF ENVIRONMENTAL PROTECTION LEGISLATION IN THE ESCAP REGION

Country	Institutional Setting	Legal Setting	Environmental Impact Assessment	Selected Other
Singapore	1. Ministry of Env.; policy dev. of legislation and enforcement responsibilities.	1. None 2. 1 lawyer in Ministry of Env.	1. No formal /legal mechanism; env. aspects considered in dev. planning	1. Accel. depreciation over 3 years for investment in water poll. abatement facilities and for new industrial and community undertakings. 2. Vehicle emissions measured
Sri Lanka	1. Responsibility for env.probs. resides in respective relevant national and local agencies; suggested legislation emanates from agencies. 2. Nat.Comm.on 'Man and the Biosphere'; Nat.Sci.Council Statutory Working Comm. on the Env., Nat.Comm. on Intergovt. Hydrolog.Prog.; coordination responsibilities.	1. None; increasing recognition of imp.of assessing env.effects of new projects.	1. No formal/legal mechanism; mass media views considered; env.aspects generally low priority.	1. Env.education introduced at primary & secondary level 2. No legally prescribed penalties for most polluters 3. Forestry:Forest Dept., Min. of Agric. & Lands; State Timber Corporation-harvesting long-term forestry management/development scheme; obstacles to enforcement include shortage of food and poverty of rural people, shortage of timber.
Thailand	1. 1974 Constitutional reference to env.probs., also 4th 5 yr plan 2. National Environmental Board; formulate policy (CEQ-type); Nat.Env.Prot.Comm.; establish env.standards (EPA-type)	1. Nat.Env.Act 1975	1. No formal/legal mechanism.	1. Main obstacles to env.prot. are low public/media interest/commitment, no public forum, fragmented legal approach

Environment and Development

Carpenter



World Bank
June 1975

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SUMMARY AND CONCLUSIONS

International development assistance has always attempted to address problems of the human environment—the principal focus being the poverty, disease, hunger, and illiteracy associated with the lack of economic development. Worldwide concern, however, has steadily mounted over other aspects of environmental problems—those which emerge as undesirable secondary effects of the very processes of development itself. These aspects of the problem were articulated and documented in considerable detail at the 1972 United Nations Conference on the Human Environment. The Stockholm deliberations led to the development of a U.N. Action Plan and to the establishment of the U.N. Environmental Fund for providing "financing for environmental programs envisaged in the Plan."

In 1970, the World Bank Group[1] established the post of Environmental Adviser "to review and evaluate every investment project from the standpoint of its potential effects on the environment." In the 30-month period between July 1, 1971, and December 31, 1973, the Bank Group has reviewed 434 loans and credits from the environmental viewpoint. Of these, 275 revealed "no apparent potential problems." For 135 projects, the environmental problems which were identified could be handled by Bank Group staff; the remaining 24 projects required special studies by outside consultants.

The Bank Group has now accumulated considerable experience in dealing with environmental concerns. This report reviews its approach and the experience which has been gained. Among the main lessons derived from the experience are the following:

1. Environmental problems have a cumulative impact. If remedial action is taken only at a later stage, its cost would be considerably higher.

2. The Bank Group's experience so far suggests that the additional cost attributed to the environmental and health safeguards incorporated into projects has ranged from zero to 3 percent of the total project cost. The high end of the range applied where precautionary measures were added to projects already well advanced. The additional costs were generally kept low by incorporating environmental standards in the developing countries appropriate both to their current stage of development and the requirements of the project.

[1] *The World Bank Group includes the International Bank for Reconstruction and Development (popularly known as the World Bank), the International Development Association (IDA), and the International Finance Corporation (IFC).*

3. Concern with the environment has resulted in progressive incorporation of environmental safeguards in technology. This is particularly so in industry, a sector in which environmental issues first attracted attention. Incorporation of environmental technology makes it difficult to separate environmental and nonenvironmental costs in the processes in which this development has occurred.

4. In the initial stages of the development of what may be called environmental technology, the emphasis was on the treatment of pollutants. The Bank Group's experience has underscored the need to treat environmental problems as being multifaceted and interrelated.

5. The project-by-project approach has pointed to a number of sector-specific environmental problems, and sectoral guidelines have been prepared that could help improve project designs with regard to their impact on the environment and health.

6. In evaluating various costs and benefits involved in alternative ways of dealing with environmental considerations, the Bank Group's experience so far has shown quantification of the relevant tradeoffs to be particularly difficult.

For the future, the Bank Group intends to continue its project-by-project approach. The lessons learned so far provide helpful guidance for the course to be followed. In determining and dealing with the impact on the environment of the projects financed by it, the Bank Group will adapt the standards of protection to the circumstances of the country, and incorporate those environmental and health measures that are considered essential in any particular case. Should international agreements be reached in certain environment areas, the Bank Group will ensure that its project financing is consistent with their terms. It will also help to bring to the attention of its member governments information, guidelines, instruction materials, technical data, etc., on environmental impact analyses available from public and private organizations concerned with environmental affairs. In those countries in which there are no adequate laws, rules or regulations governing environmental matters, the Bank Group can be expected to encourage and advise on promulgation and implementation of appropriate legislation.

The Bank Group will be prepared to consider lending for "environmental" projects (a term which can be applied to a great variety of projects, including air and water pollution control, control of erosion, solid wastes disposal, reforestation, and pest and disease vector control), where the project in question otherwise satisfies the Group's normal project criteria.

Best Available Document

INTRODUCTION

Much of the effort to raise the standard of living in the developing countries involves deliberately improving the natural environment. Constructing roads, dams, airports, irrigation and sewerage systems, power plants, and industrial facilities frequently results in ecological problems, because the consequences for the environment were not adequately considered in project planning or implementation, or because the information necessary to forecast the eventual impact on the environment was inadequate. Also, where adverse ecological consequences are forecast, effective steps to prevent or minimize the damage may sometimes not be taken because data on cost-effective safeguards or on economically competitive project alternatives are inadequate. Although the magnitude of the loss in ecological values varies, there is a real cost to society over the long run.

In recent years, many warnings have been issued in many regions of the world—in both developed and developing countries—that deterioration in air, water, soil, and other natural resources threatens the quality of the environment and of life, including human life. The urgency of such warnings is now considered by many conservation groups, scientists, and government agencies to be especially acute.

The trend towards degradation of the biosphere is global in its dimensions and consequences; it can be reversed only through comparably widespread recognition of the danger and the need for international cooperation in dealing with it. There are encouraging signs in both of these directions. Resolutions of the U.N. General Assembly in 1968, 1969, and 1970 underlined the importance of taking environmental factors into account in economic and social development planning. The International Strategy for the Second U.N. Development Decade, adopted in 1970, declares that "governments will intensify national and international efforts to arrest the deterioration of the human environment and to take measures towards its improvement, and to promote activities that will help to maintain the ecological balance on which human survival depends." The first U.N. Conference on the Human Environment, held in 1972 at Stockholm, led to the development of a U.N. Action Plan and to establishment of the U.N. Environmental Fund for providing "financing for environmental programmes envisaged in the Plan."

Definitions

Although the terms "environment" and "ecology" have received much use in recent years, there is no universally accepted definition of either. In this paper, "environment" is used to describe *the total setting for economic development activity*; the term refers not only

to the naturally occurring milieu (the ecological systems which surround and collectively support man), but also extends to the sociocultural milieu which man has created to adapt to the demands and challenges of his naturally occurring surroundings. "Ecology" is used to refer to the *relationship between organisms and their environment*, including most especially the man-environment relationship.

Types of Environmental Problems

Environmental problems may be divided into three categories related to their magnitude: global, regional, and local.

Global problems pertain to the biosphere, affecting nearly all countries. Into this category fall the most widely discussed and threatening problems, including, for example, those caused by persistent pesticide residues which through the actions of wind, water, and living carriers find their way into the biosphere beyond the country in which the chemicals were applied. Other examples of global problems are the burning of fossil fuels, affecting the carbon dioxide balance and the sulphur dioxide loading of the atmosphere, and the particulate content of the stratosphere; the pollution of the oceans from land sources, oil spillage, or ship dumping on the high seas; and man-influenced changes in global climatic patterns.

Regional problems result from biophysical linkages among a group of countries but have little effect beyond the members of the group. A typical example is the effect of river basin development on riparian countries, upstream or downstream.

Local problems are confined within the boundaries of a particular country; for example, the extirpation of a wildlife resource, the creation of an aesthetic blight, or the eutrophication of a lake from fertilizer runoff or discharge of domestic sewage.

Thus, environmental problems differ in their dimensions. They may also differ in the amount of time they take to become visible. For example, while a global problem may eventually result from the gradual buildup of carbon dioxide in the atmosphere over a long period, the effects of persistent pesticides can be seen more immediately. Another variant related to timing is the degree of certainty. The greater the time-span for the cause-effect relationship to be observed and understood, the greater the uncertainty as to its manifestation, but the continuation of presently observable consequences is far more certain to be perceived.

Two other variables may be noted: magnitude and reversibility. Magnitude cannot easily be compared, because effects are of different types, occur in different places, and affect different aspects of life systems. Reversibility concerns the possibility of returning an ecological system to its former state. For example, a lake in an advanced state of eutrophication is virtually irreversible; the extinction of a species is absolutely so. On the other hand, it is possible to end pollution from particulate matter in the smoke of an industrial plant and to restore the ambient air quality. The dimensions of time, certainty, magnitude, and reversibility combine to produce the dimension of urgency.

The environmental problems of the developing countries can be divided into two more categories: effects of poverty, and effects of economic development.

Under conditions of poverty the biophysical environment often exhibits the ravages of long years of mismanagement (overgrazing, erosion, denuded forests, surface water pollution, etc.). Not merely the "quality" of life but life itself is endangered, for it is often very difficult and sometimes impossible for the environment to renew its life-supporting capabilities. Developing countries assign the highest priority to finding solutions to problems of this nature. Here the principal concern is to rehabilitate the environment that has gone through a long period of deterioration.

The other set of problems accompanies the process of development itself. Agricultural growth, for example, calls for construction of irrigation and drainage systems, clearing of forests, use of fertilizers and pesticides—all of which have environmental and health implications. Similarly, the process of industrialization could well result in the release of pollutants and in other environmental problems related to the extraction and processing of raw materials.

In sum, developing countries are now beginning to be concerned with two different types of environmental problems: In the first type, these nations have to alleviate poverty; while in the other, they have to seek ways to prevent the environmental deterioration often associated with development. The first task is considerably more difficult than the second, but the second could also become difficult if the present concern for the environment is not translated into action. The Bank Group is concerned with both aspects of the problem. Some other policy papers have addressed themselves to the problem of poverty and the Group's approach to it;[1] this paper is concerned primarily with how environmental problems arising with development can be mitigated by taking precautionary measures.

[1] Agricultural Credit, Land Reform, and Population Policies and Economic Development.

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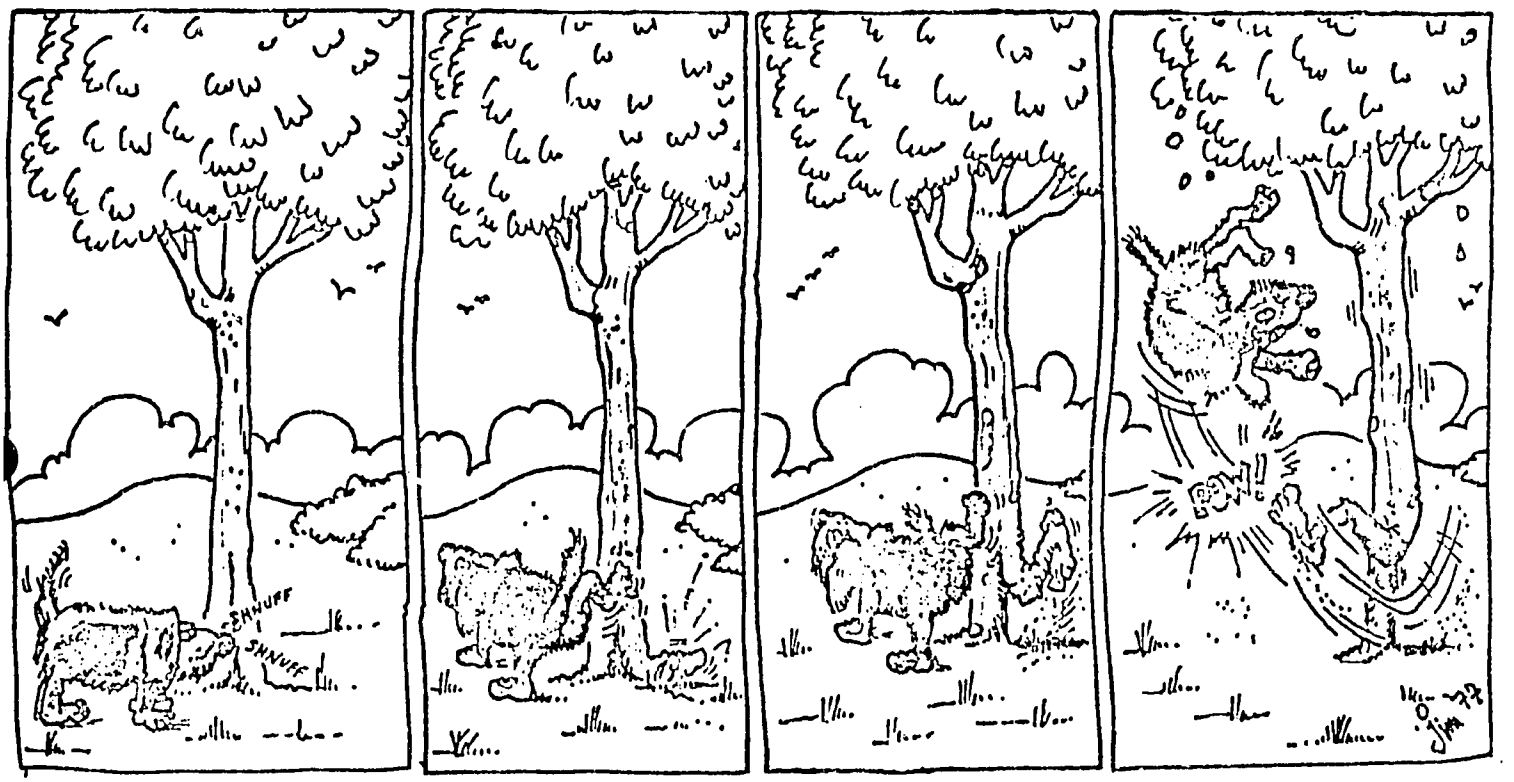
ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT



-ecological impacts-

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PR-6

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CHAPTER 1

OVERVIEW AND CONCLUSIONS

The Book and its Audience

Although the focus of this book is environmental assessment, its central message is that the process itself should be replaced. If environmental concerns are largely dealt with as a fixed review in reaction to an independently designed policy, we argue that laudable economic enterprises will suffer and critical environmental constraints will be violated. We offer, as an alternative, the process of adaptive environmental management and policy design which integrates environmental with economic and social understanding at the very beginning of the design process, in a sequence of steps during the design phase and after its implementation. That argument is directed to senior administrators and policy-makers who are responsible for the design of mechanisms and processes for dealing with developmental issues.

At the same time, however, we recognize that in many countries environmental assessment is practiced as a reactive review process. Even in that mode, the goal of

environmental protection can be more validly and effectively achieved by the application of different concepts, procedures, and techniques than those commonly used. We describe these methods in some detail, directing our analysis to those with operational responsibility for doing environmental assessment and for communicating the results to senior administrators.

Because we are speaking to these two audiences, not all chapters will have equal interest to all readers. Some concentrate on broad conceptual issues, some on fundamental procedures and some on non-technical but still detailed descriptions of techniques. The final chapters provide specific examples of five case studies. As an aid to the reader, therefore, we have provided a reader's guide and tabular summary of points inside the front cover of this book.

This present chapter is designed for both audiences. It presents a broad overview and summary of the book--the issues, concepts, procedures and techniques. Since it is written as an extended executive summary meant to stand largely alone, the themes and framework of analysis presented here will be repeated throughout the remaining chapters in greater detail.

In this summary we will treat five themes. The first is a brief encapsulation of present practice, presented in a rather exaggerated way for emphasis. The second provides a background that describes how present assessment practices have evolved. The third concerns the issue of uncertainty

and the problem it now presents. The fourth presents a view of stability and resilience of systems that provides a perspective or concept that points to resilient or robust policy design criteria that differ from the traditional. The fifth and final topic reviews the processes and techniques that have emerged from our experience in dealing with specific problems of environmental policy design and assessment. Together, this set of issues, concepts and techniques defines our approach.

Myths of Environmental Management and Assessment

Perhaps the best way to introduce what adaptive environmental management and assessment is, is to indicate what it is not. Below we discuss twelve "myths" of present management and assessment. However much these appear as "straw-men," they are still inherent in present practice. Most of us have subscribed to at least one or two at some time or another.

Myths of Environmental Decision

The first set of myths concerns policy design and decisions.

Myth #1: *The central goal for design is to produce policies and developments that result in stable social, economic and environmental behavior.*

Stability is a two-edged sword. If our knowledge of objectives and structure is complete, then design should indeed minimize the chance of the unexpected. But what we know of social, economic and environmental behavior is much less than what we do not know. Therefore the opportunity to benefit from change and the unexpected should be part of the design goal.

Myth #2: *Development programs are fixed sets of actions that will not involve extensive modification, revision, or additional investment after the development occurs.*

Program goals change and unexpected impacts trigger corrective actions that result in progressively greater economic and political commitments to make further corrections if the initial ones are not successful. Thus, present decisions have <u>future decision consequences</u> as well as direct environmental ones, and these subsequent induced decisions often generate greater environmental impacts than seemed possible originally.

Myth #3: *Policies should be designed on the basis of economic and social goals with environmental concerns subsequently added as constraints during a review process.*

We must ride with/ecological forces as much as with social and economic ones. Unless all are incorporated at the very beginning of the design, opportunities to achieve social goals are lost and subverted. The design will be more costly and the benefits too sensitive to the unexpected.

Myth #4: *Environmental concerns can only be dealt with appropriately by changing institutional constraints.*

That might ultimately be necessary, but constraints are more often perceived than real. If one agency has policy and management responsibility and one research or assessment responsibility, there may be nothing to stop the latter from developing a policy design process that provides alternatives for comparison and priorities for research. Such a capability can often provide an interface of communication between those responsible for the research and those responsible for decisions and management.

Myths of Environmental Assessment

This second set of myths concerns the details of how assessments are done.

Myth #5: *Environmental assessment should consider* *all* *possible impacts of the proposed development.*

The interesting question is rather: what does the fact that it is impossible to foresee all (or even most) of the impacts imply for the structure of the basic development plan and assessment research?

Myth #6: *Each new assessment is unique. There are few relevant background principles, information, or even comparable past cases.*

It is true that each environmental situation has some unique features (rare animal species, geological formations, settlement patterns, etc.). But most ecological systems face a variety of natural disturbances and all organisms face some common problems. The field of ecology has accumulated a rich descriptive and functional literature that makes at least some kinds of studies redundant and some predictions possible. The same is true for economic, social, and physical aspects of the assessment.

Myth #7: *Comprehensive "state of the system" surveys (species lists, etc.) are a necessary step in environmental assessment.*

Survey studies are often extremely expensive yet produce nothing but masses of uninterpreted and descriptive data. Also, they seldom give any clues as to natural changes that may be about to occur independently of development impacts.

Environmental systems are not static entities and they cannot be understood by simply finding out what is where over a short survey period.

Myth #8: *Detailed descriptive studies of the present condition of system parts can be integrated by systems analysis to provide overall understanding and predictions of systems impacts.*

The predictions from systems analysis are built up from an understanding of causal relationships between changing variables. Descriptive studies seldom give more than one point along each of the many curves that would normally be used to express such critical relationships. In short, what a complex system <u>is</u> <u>doing</u> seldom gives any indication of what it would do under changed conditions. Again, the interesting question is: what are the assessment, monitoring, and policy implications of the fact that even comprehensive systems models can make predictions only in sharply delimited situations?

Myth #9: *Any good scientific study contributes to better decision-making.*

The interests of scientists are usually quite narrow and geared to a particular history of disciplinary activity. There is thus no guarantee that in a scientific study the appropriate variables or processes will be measured, or that information will be collected on the proper spatial and

temporal scales to address management questions. The research necessary for adaptive assessment and design must be focused through policy concerns.

Myth #10: *Physical boundaries based on watershed areas or political jurisdictions can provide sensible limits for impact investigations.*

Modern transportation systems alone produce environmental impacts in unexpected places. Transfers of impacts across political boundaries lead to a wide range of political and economic reactions from the other side. A narrow study that fails to recognize at least some of these impacts and reactions will provide inadequate and misleading information for the decision maker.

Myth #11: *Systems analysis will allow effective selection of the best alternative from several proposed plans and programs.*

This assertion would be incorrect even if systems models could produce reliable predictions. Comparison of alternative policies can only occur if someone places values on the results of each alternative. Rarely is this an explicit part of environmental assessment.

Myth #12: *Ecological evaluation and impact assessment aim to eliminate uncertainty regarding the consequences of proposed developments.*

Attempts to eliminate uncertainty are delusory and often counterproductive. The appropriate concept for both assessment and policy design is a recognition of the inevitability of uncertainties and the resulting selective risk-taking.

The above shortcomings of present assessment practice are in part the consequence of the sudden and recent broad perception that environmental issues are important to the health of societies. These shortcomings emerged as an urgent response to apparent crises, and before providing suggestions for an alternative, it is useful to explore this historical background.

Background to Present Assessment Practices

It is commonplace now to perceive limits--limits to growth, to resources, to climatic and environmental stability. Although the general perception of the importance of those limits is relatively new, mankind has always been confronted by them. There have always been problems of resource depletion, environmental contamination and poverty. Moreover, industrial man's history, by and large, has been one of successful resolution of these problems, at least in the short term. In recent years, however, they seem to have taken the shape of crises; perhaps because the problems are ours and not our fathers'; more likely, because our perceptions and methods, having once helped, now hinder.

The present approach to environmental concerns was very much colored by a rather sudden shift of public awareness in the industrialized nations. What was once the concern of a minority became the concern of the public at large. The problems were not that qualitatively different from those of the past. But in the past they were largely local and often transient. Solutions often emerged by simply waiting--next year's weather for crop production could well be better. And where this was not the case, there was often "somewhere else" that provided a way out--an unexploited resource, an unsettled piece of land, a new river to dam. In seeking elsewhere for solutions, the knowledge and technological devices needed could evolve at an easy pace. It required more innovation of spirit than innovation of technique for the Young Man to Go West.

With the "elsewheres" becoming gradually scarcer, however, alternatives had to be sought in new knowledge and technology rather than in new places. In so doing the scale and intensity of impact inevitably grew, eventually triggering that sharp shift of public awareness.

The past solutions however, provided little experience with ways of dealing with the environment. In most instances the goals of economic and social advance were most promptly achieved by subduing nature. The present protective response was therefore natural. In the face of limits now so suddenly perceived, time at least could be bought by protection of the

environment and regulation of its use. The response is, therefore, largely reactive. Regional developments or policies are still designed within an economic context and only reviewed after the fact for their environmental consequences.

There has now been enough experience with this approach to suggest two major difficulties. First, the fundamental properties of any development or policy are set very early in the design stage. If problems arise because the original context was too narrow, any fundamental redesign is extremely difficult unless extraordinary pressures are mobilized. The consequence is to guarantee confrontation as different groups identify clear conflicts with their own interests. Confrontation and public debate are essential dimensions to the development of policies. But if the issues emerge only because the design phase was unnecessarily limited, economic enterprises offering legitimate social benefits can be halted and opportunities for husbanding and enhancing man's natural endowment can be subverted.

The second major difficulty with the present protective and reactive response is that it makes the practice of environmental assessment arbitrary, inflexible and unfocused. Each issue is often dealt with as if it were unique; as if the environmental consequences could be separated from the social and economic ones. And yet the major environmental impact of a pipeline, for example, often occurs not along

the route itself but at distances remote from it, as human settlements experience an acceleration of economic and population pressures. Such environmental effects induced through social forces are rarely considered. And the reverse is true. Deleterious social and economic impacts can be induced through ecological forces that, if recognized early, could at times be turned to man's benefit rather than simply subdued to any end.

The result of simple reactive assessment is therefore intolerable. How can we know what to measure for base line information or assessment if the detailed character of the policy or development is not revealed until it has largely crystallized? The tendency is to measure everything, hence producing the indigestible tomes typical of many environmental impact statements. More time and effort are spent in measuring what is, rather than in projecting what is likely to be, or could be made to be. Static and confused description replaces anticipation and clear prescription of alternatives.

But enough experience has now accumulated to begin to develop and implement an alternative approach. Systems ecology, in partnership with the physical sciences, has now matured to be capable of producing succinct representations of key elements of ecological and environmental systems. The resulting models mimic not simply static properties, but the dynamic ones that shift and change through the

influence of natural and man-induced influences. They can serve, alone or combined with similar economic representations, as a kind of laboratory world for the development of alternative policies and for the exploration of their impact.

The systems sciences have evolved methods of optimization that, with care, can point towards general policies that better achieve objectives by working with, rather than against, the rhythm of ecological and economic forces. There are techniques to deal with uncertain information, with mobilizing available data of partially known processes, and with the formulation of objectives that are less sensitive to the unexpected. All these lie at the heart of developing policies that recognize and benefit both economic and environmental realities. Finally, decision theory provides a few theoretical hints and some practical experience in ways to explore decisions in the face of uncertainty and conflicting objectives.

This set of descriptive and prescriptive techniques provides the skeleton for policy design which can integrate economic, ecological and environmental understanding. What's more, this integration can commence at the very beginning of the design process. But techniques alone are not enough. The best of techniques, unless guided by a clear vision of the fundamental issues and by a concept that gives them form can turn solutions into larger problems. We argue that the fundamental challenge is not simply how to better mobilize

known information. Rather, it is how to cope with the uncertain and the unexpected. How, in short, to plan in the face of the unknown. It is to that generic issue that we now turn.

The Issue of Uncertainty

The design of policies or economic developments implies knowledge--knowledge to develop alternative policies, and knowledge to evaluate their relative consequences. And indeed a significant part of the contents of this book is how to deal with qualitative and quantitative data, how to use this knowledge of fundamental processes to construct models that can serve as "laboratory worlds" for the testing and evaluation of intrusions, developments, and policies. How, in short, to better reduce uncertainty. But however intensively and extensively data are collected, however much we know of function, the domain of our knowledge of specific ecological and social systems is small when compared to our ignorance.

Thus, one key issue for design and evaluation is how to cope with the uncertain, the unexpected, and the unknown. It seems a common plea that too little is known of the structure and behavior of ecological systems. That can lead to the syndromes of living dangerously ("who cares how

birds and bugs are affected--jobs and income are more important") or living safely ("nothing must be done until we know more"). But man has always molded the environment and been molded by it, and we will argue that more is known of ecological systems than is generally appreciated or used. Nevertheless, there is still uncertainty.

At the same time, there is growing unease about the economic systems with which ecological systems are linked. The unexpected increases in oil prices which have touched so many aspects of national economies have the same flavor as the unexpected appearance of a new crop pest after successfully controlling the original pests with insecticide. There is sufficient knowledge to anticipate both events, but both come as surprises. And, being unexpected, they are ignored in the original design of policies.

Even the ultimate objectives of environmental policies and developments are uncertain. A renewable resource industry might have an initial priority objective of stabilized employment over the short term which then shifts to a major concern for environmental standards, then to diversity of opportunity, and then back to simple long-term economic objectives. A design which assumes objectives are certain can rapidly foreclose options if those objectives shift.

Man has always lived in a sea of the unknown and yet has prospered. His customary method of dealing with the

unknown has been trial-and-error. Existing information is used to set up a trial. Any errors provide additional information to modify subsequent efforts. Such "failures" create the experience and information upon which new knowledge feeds. Both prehistoric man's exploration of fire and the scientist's development of hypotheses and experiments are in this tradition. The success of this time-honored method, however, depends on some minimum conditions. The experiment should not, ideally, destroy the experimenter--or at least someone must be left to learn from it. Nor should the experiment cause irreversible changes in the environment. The experimenter should be able to start again, having been humbled and enlightened by a "failure." And, finally, the experimenter must be willing to start again.

There is now increasing difficulty in meeting these minimum conditions. Our trials are capable of producing errors larger and more costly than society can afford. While the individual parts of a nuclear plant, for example, can be tested to the point of failure, the full integrated system cannot. Moreover, when this integrated system is viewed as not just an engineering one, but one that links engineering, ecological and social aspects as well, then the variety of unexpected events--from coolant failure to sabotage--and the scale of the consequences make trial-and-error truly a way to live dangerously.

Moreover, even when errors are not, in principle, irreversible, the size of the original investment of capital and of prestige often makes them effectively so. This behavior has its roots in a very human characteristic of industrial man: We do not like to admit and pay for our past mistakes; we prefer to correct them. And the consequence of correcting an inflexible plan is often increasing investment, increasing costs for maintaining and controlling the system, and progressive foreclosure of future decision options. Retreat from error is difficult for three reasons: because of the scale and consequence of possible "irreversible" physical changes; because changes in expectations for future returns make familiar goals politically or economically unacceptable; because reserves of capital and trust are lost, and the governed rise up against the governors, forcing them to invest in order to satisfy basic constraints newly perceived.

But the search for a solution should not replace trial-and-error with some entrapping attempt to eliminate the uncertain and the unknown. That could only result in tighter monitoring, regulation and control based upon an illusory assumption of sufficient knowledge. Rather, the direction lies in the design of policies and economic developments that can allow trial-and-error to work again. Efforts to reduce uncertainty are admirable. Much of this book concerns just that. But if not matched by an equal

effort to design for uncertainty and for obtaining benefits from the unexpected, the best of predictive methods will only lead to larger problems achieved more quickly and efficiently. This view is the heart of adaptive environmental management--an interactive process with techniques that not only reduce uncertainty but also benefit from it. The goal is to develop more resilient policies.

The Resilience of Systems

Our concept of resilience emerges from a very specific understanding of the structure and behavior of ecological systems (Chapter 2). It seems to have a counterpart in the behavior of institutional systems. The way a system responds to a planned or unexpected disturbance depends on its stability properties. One view, implicit in many of man's past efforts to manage, assumes the world is globally stable. That is, no matter how large the disturbance, the system will recover to its original stable condition, once the disturbance is removed. This is a view of a Benign Nature that can comfortably accommodate any scale of trial-and-error. In this view, "big" is truly necessary for the economies of scale to be achieved.

A contrasting view implies a high degree of instability of ecological systems. They are fragile and caught in a

natural rhythm of small-scale extinctions. They persist because of diversity in structure and over space. Outside sources provide the source of recovery. This view of Ephemeral Nature naturally leads to "small-is-beautiful" and to concentration on the need for spatial variety, diversity of opportunity and fine-scaled, local autonomy.

But the burden of examples and of analysis leads to a combination of both these extremes. Natural systems often have more than one stable mode of behavior. As long as variables like population density, amount of nutrients or even level of unemployment stay within a certain range, small disturbances can be absorbed. Quantities might change but qualitative behavior does not. Small disturbances can be introduced incrementally, particularly if no apparent danger signal appears. Then one additional increment can "flip" the system across the boundary into a totally different mode of behavior. A river can become an open sewer, or the economy of a nation can suddenly begin to prosper. In this world, the prudent manager would be wise to view nature less as benignly forgiving than as a Practical Joker.

The small-is-beautiful theme can still operate much as before with a more focused sense of optimal spatial scale, and a recognition of the need for a balanced dependency on outside forces. But "big-is-necessary" can also be accommodated; one only must be more cautious. Thus if boundaries exist separating "desirable" from "undesirable," then the

task is to carefully control the variables to keep them well away from the dangerous boundary. In addition, the boundary itself may be made less permeable; the strength of the guard-rail can sometimes be more critical than the characteristics of the highway. To do this effectively, big might well be necessary as the only way to gain sufficient knowledge of the boundary, to monitor the distance to it, and to institute control procedures to maximize that distance.

The goal of maximizing the distance from an undesirable region is within the highly responsible tradition of engineering for safety, of nuclear safeguards, of environmental and health standards. It works effectively if the system is simple and known--say, the design of a bolt for an aircraft. Then the stress limits can be clearly defined, and the bolt can be crafted so that normal or even abnormal stresses can be absorbed. The goal is to minimize the probability of failure. For bolts this approach has succeeded. The probability of failure of nuclear plants, for example, is extremely small. But in parallel with that achievement is a high cost of failure--the very issue that makes trial-and-error as now practiced so dangerous. A fail-safe design is emphasized and encouraged at the price of a safe-fail one.

One additional view of stability is needed. The three views--of Nature Benign, of Nature Ephemeral, and of Nature the Practical Joker--have been described thus far in three

steps of increasing reality and comprehensiveness. In each case, however, they implicitly presumed that the rules of the game were fixed. But ecological, and for that matter, economic, institutional and social systems are not static nor completely determined. Variability and change are the rule and provide the next step toward reality.

Chance events dominate some ecosystems. Fire, rather than being a disaster, is the source of maintenance of some grassland ecosystems. Shifting patterns of drought determine the structure of some savannah systems in Africa. In addition, the variables themselves can move, through internal forces, from one stability region to another. That is one of the lessons described in the case study of forest pest management discussed in Chapter 11. There, we see that periodic insect outbreaks can be triggered by chance patterns of weather, by dispersal of moths from other areas, or by the natural growth of the forest. Populations increase explosively from low stable numbers to high. While the high numbers are stable for the insect, the forest cannot absorb this level of defoliation. The forest dies back, regeneration occurs and the clock is started again. Such large swings and movements between stability regions directly contribute to forest renewal and the maintenance of diversity.

Hence the variables of natural ecosystems do not reside in one stability region far from boundaries. Locally, species may even become extinct, to be reinstated through

contributions from other localities. Hence the variables are moving continuously and the stability boundaries are continually being tested. There is an internal monitoring of boundaries.

And now the central issue: not only do the variables shift and move, but so do the boundaries between stability regions. In ecosystems, this "stability landscape" owes its features to natural selection which works on the variability that naturally occurs. The reason boundaries exist where they do is because they are periodically tested.

This dynamic pattern of the variables and of the basic structure lies at the heart of coping with the unknown. However much we may be sure of the stability landscape of a physical system, rarely will we know the societal or ecological stability landscape in any detail. Policies often attempt to reduce variability within these partially known systems, either as a goal in itself or as an effort to meet standards of safety, health, or environment. That constricted variability in turn may itself shift the balance of natural, cultural, or psychological selection so that stability regions will contract. Paradoxically, success in maximizing the distance from a dangerous stability boundary may cause collapse because the boundary may implode to meet the variables. Hence if surprise, change and the unexpected are reduced, systems of organisms, of people and

of institutions can "forget" the existence of limits until it is too late.

This final view is of Resilient Nature, where resilience is a property that allows a system to absorb and utilize (or even benefit from) change.

But, of course, a different perspective of the generic issue, even with a concept to give it form, is not enough. Flowing from that must be some effort to design and test specific procedures and techniques that allow at least one step to be taken in harmony with this perception.

Procedures and Techniques

Our recommendations for a specific procedure and a range of techniques come from our particular experience with a number of studies concerning renewable resource problems in different national settings: renewable resource management and disease control in Venezuela and Argentina; range and wildlife management in the United States; developmental and oceanographic problems in Europe; ecological process studies in the USSR; renewable resource and pest management systems in Canada.

We provide five specific case studies (Section II) so that examples of the results of applying these methods can be exposed. The first is a detailed example of the lessons

learned in developing and evaluating policies for a problem of forest pest management. This one has gone furthest in coping with existing management questions, validating alternative modeling techniques, and generating management alternatives and evaluating their consequences. It has resulted in agencies of two Canadian provinces adopting the approach for the setting of research priorities and the development and evaluation of management options. The second case study is an example of an analysis of new procedures to enhance and manage fish stocks in North America, in which adaptive management approaches are proposed that provide one way to reduce uncertainty as an integral part of the policy design. It has gone furthest in affecting and modifying a proposed new development to enhance fisheries populations. The third is an example of the results of one of the intensive five-day workshops (whose details will be described shortly) that resulted in a preliminary but broad assessment of the consequences of development in a high alpine region of Europe. The fourth is a modeling and policy analysis of a major regional development in a sparsely population region of Venezuela involving hydro-electric, forestry, and agricultural development. The fifth and final example deals with the impacts of oil shale development in the western United States on wildlife populations.

In each case the purpose was to develop a set of alternative policies or plans and assess their environmental, economic, and in some cases, their social consequences. At first thought, therefore, the process we recommend would seem more appropriate for environmental management than for assessment. Before addressing that question in the next section, however, we shall compare our recommendations with two alternative procedures in common practice.

At one extreme is the approach of having a small core planning staff contract out parts of the study--the hydrological analysis, vegetational or wildlife survey, and so on. Integration occurs on receipt of the contracted reports. But two difficulties emerge. First, the contracted pieces typically drift further and further from the question posed, and, since the study is not linked with others throughout, useful integration of the pieces becomes very difficult. Second, it is unlikely that a small core planning team will have sufficient breadth and depth of knowledge to identify those key elements or processes that deserve analysis. To cover themselves, there is a natural tendency to wish to measure everything they can think of. Typically these are static quantities, both environmental and economic, or the more obvious physical processes. But the problems are not static; they are not simply physical; their behavior comes from the integration of the parts and not just from the parts themselves. As a result, much of the information

gathered is unnecessary, while key items are ignored entirely. The cost is unnecessarily large, and the product incomplete.

At the other extreme is the large interdisciplinary team that attempts to develop the integration missed in the above approach by mobilizing most of the expertise within one organization. In order to avoid bureaucratic growth, sometimes a task force is established for the duration of the study only with staff provided from a number of existing institutions. Such large teams, however, have a high financial, organizational and emotional overhead attached to them. We suppose this could be overcome by appropriate organizational techniques, but the common experience is that it is not. Anarchy and fragmentation often occur. Separation of the team from the policy-maker is common and internal goals evolve that have more to do with persistence of the team than with the original purposes.

In contrast, the process we have evolved depends on a small core group of two or three analysts and one or two support staff. The core staff should have experience in two or three of the disciplines involved--for example forestry, fisheries, economics, or ecology. At the same time their prime experience should be in integrating information and coordinating people. In our case the integration comes from application of systems techniques--e.g., computer modeling of dynamic systems, mathematical analysis, optimization, utility analysis, and communication.

The coordination comes from the development of a series of steps each of which is initiated by a workshop that brings together key cooperators for short, intense periods of interaction. The periods between the workshops are spent in consolidation; the core group refining the model(s), developing initial alternative policies, analyzing data; the collaborators collecting and integrating data and information both on behavior of the system and on goals of the project. The workshops that define the sequence of steps are the heart of the approach (Chapters 3 and 4). They provide a series of sequential targets, maintain integration while minimizing organizational and emotional overhead, and allow involvement of a wider spectrum of key actors than is normally possible. The policy-maker, busy as he is, is involved at key points for short periods.

Each workshop draws upon up to twenty specialists, the choice depending on the particular stage of the process. The first workshop is critical, for it is then that the problem is defined and focused. It is essential to have all prime "actors" present at that time--scientists, managers and policy people. The policy people and managers provide a balance to the scientists' penchant for exquisite detail and excessive resolution. The scientists provide the rigor and understanding of fundamental physical, ecological, and economic forces. During such a workshop, impact categories are classified, key information needs defined, alternative

actions described, and the framework and crude working version of a computer model developed. Even if, through lack of expertise, facilities, or time, a model is not developed, the techniques of organizing elements in preparation for a formal modeling effort are themselves of fundamental value. The point is that, at the very beginning of the study, all elements--variables, management acts, objectives, indicators, time horizon and spatial extent--are jointly considered and integrated. Even the crude model that is developed at this stage can be a powerful device to explore the significance of unknown relationships. By testing alternative extremes, priorities can be established for data and for scientific and policy analysis.

That first workshop is followed by a period of consolidation. The model is further refined and tested by the core group. Some of the attending specialists assume responsibilities for collecting detailed information on both scientific and policy questions. Subsequent workshops further define management objectives, construct alternative policies, and explore uncertainties. Some involve only scientists when the goal is critical scrutiny of underlying assumptions. Some largely involve managers, when the issue concerns operational feasibility. Some involve only decision makers, when the purpose is to assure relevance and understanding. In every instance a period of consolidation follows each workshop.

One key technique makes it possible to set this process in motion. And that is the ability to abstract the essential properties of at least some ecological and environmental systems and represent them in a model that mimics behavior over time for a variety of conditions. By essential, we mean those properties that retain the minimal natural behaviors that must be retained in order to be responsive to the management questions. The models, therefore, are not designed for general scientific purposes but for very specific management ones. Hence, they attempt to be both parsimonious (and hence tractable) and realistic (and hence useful).

Our professional experience is ecological and environmental. But it is obvious that at least regional economic systems can be treated in the same way and integrated with the ecological and environmental systems. Because this integration occurs in the very first step in the analysis, it is possible to achieve designs that work with rather than against natural forces. In so doing, more opportunity is provided for less costly and intrusive economic developments and even for the enhancement of natural systems rather than simply their protection. We provide examples of this together with others incorporating simple social phenomena such as human demographic and market processes. More complex social behaviors are well beyond the state-of-the-art and are better dealt with as they are now--through public dialogue.

Hence the models developed in the workshop process focus on one or more of the ecological, environmental, economic, or simple social forces underlying many developmental problems. They provide a credible "laboratory world," whose existence makes it possible to mobilize a set of techniques for prescription and evaluation; techniques to allow the following:

--generation of a range of alternative objectives;

--design of effective policies to achieve alternative objectives;

--generation of indicators (social, economic, resource, and environmental) of relevance for decision;

--evaluation of each policy in terms of the behavior of the indicators over space and time;

--partial compression of indicator information to facilitate screening of the most appropriate policies;

--communication and interaction between and among those who design, chose, and endure policies (staff, decision-maker, and citizen).

The particular techniques chosen to represent or model the dynamics of a system need not be numerical simulation models. Beyond the constraints set by expertise, the characteristics of the problem in part suggest the technique chosen. There are three key characteristics: (1) the number of variables, management actions, and spatial elements; (2) the level and generality of understanding of underlying

physical, ecological, and economic processes; (3) the amount and quality of data. No matter what combination of these any specific problem has, there is a technique available.

Our exploration of techniques covered a range from non-quantitative cross-impact matrices, to "qualitative" modeling techniques that generate dynamic changes over time without data on magnitude, to simple simulation methods, and finally to fully detailed large simulation modeling techniques.

If the level of understanding of processes is low, and data are scarce, all of these techniques seem to perform equally well or poorly. But even in scarce data situations, there is usually more understanding of processes available than is generally recognized. And there are techniques available that organize and focus understanding of processes even in the face of scattered data. If these techniques are used, then we have found simple or complex simulation models to be clearly superior in predictive capacity, responsiveness to questions, and relevance of results (Chapter 5).

Even if we have a satisfactory dynamic model, however, one further step is helpful. Such models are complex. They are so difficult to understand that many are tempted to play computer games with them in a blind, undirected exploration. But there are ways to simplify these models so that we can understand the essential behavior. The structure of such

a model can be analyzed to reduce the number of variables and interrelations to those that are key determinants of the qualitative behavior. Often a simplified set of equations can then be devised that is used to provide a depth of understanding that is enormously useful as a guide to intuition and judgment. Alternatively, topological or graphical representations can sometimes be designed to achieve the same purpose in a form more readily understood by non-mathematicians (Chapter 6). All these techniques provide the means to give informed direction to our search for policies and impacts, and to convey more effectively our understanding to the decision maker.

Before a model can be used as a laboratory world to test the consequences of alternative policies, its degree of credibility must be explored. Note that no model--mental or mathematical--is "true." But degrees of credibility and usefulness can be defined not, as is often done, by attempting to tune parameters to fit a given set of historical data. Rather, the effort should be directed to <u>invalidate</u> and not validate the model (Chapter 7). That is in harmony with the scientific method where only falsification, not proof, is possible. Invalidation requires information from extremes of behavior that can then be compared with model predictions for similar extremes. Those data on extremes come from natural experiments that have been historically recorded--for example, the extreme weather that occurs in some

particular geographical region or has occurred at some past time. Further information on extremes comes from the behavior of the target or similar systems that have been subjected to management by man. The more robust the model at these extremes, the more confidence can be placed in its behavior under newly designed policies.

That leads to the final set of methods, which use this laboratory world to develop, explore, and evaluate alternative policies (Chapter 8). They concern the formulation of objectives, the definition of indicators, and the touchy job of evaluation.

There may be many ways of attempting to achieve a given objective. For example, maximum sustained yields from a fishery can be reached by controlling fishing effort through manipulation of open fishing days or by setting catch quotas. The role of the model at this point becomes the generator of those indicators which best match the objective. Because costs and benefits arise in many forms, the manager usually needs a large number of indicators. One necessary step then becomes the compression of this massive amount of information to a comprehensible form. There are several ways this can be done. We prefer indicator compressions that are graphical because of the breadth of their comprehensibility. The relative merits of alternative management actions can be evaluated using the indicator output from the model. Both formal and informal evaluation techniques

are useful here but in either case, they are only used to point out policies that should be more thoroughly explored. The object is not to derive some mythical "optimal" policy, but rather to compare and combine alternative policies in order to illuminate the range and nature of available choice.

Methodologies are only parts of the process, however. Communication holds these parts together. The thick volumes which characterize the products of many impact assessment programs are an inefficient and ineffective way to communicate results. There are other ways to present the information, in which the level of detail and attention required are determined by the user (Chapter 9). The resulting reports, graphical summaries and audio-visual materials become, with the workshops, an integral part of the study allowing interaction and adaptive modification throughout.

That, then, completes our summary of the issue, concepts, procedures, and techniques. In closing this chapter, we discuss not their merit or lack of it, but whether it is at all practical to implement them in the face of present institutional realities.

The Problem of Implementation

For Developed Countries

To those conditioned by North American approaches to environmental assessment, the above process would seem too inclusive since assessment is viewed as a passive reaction to an independently developed proposal. Such a proposal is generated according to guidelines and is then reviewed by an informed panel. Certainly the modeling techniques, at least, would be useful in forming a judgment. But, we would argue, the other techniques and the procedures themselves would make a qualitative improvement to even this reactive model of assessment.

In order to properly assess something, there has to be a yardstick against which performance is measured. And that yardstick is some alternative policy or development. One clearly is the "no-policy" world. If that is the only alternative then confrontation between no development and development is encouraged. But other explicit policies would provide a richer menu of alternatives that would sharpen and focus response to a proposal and would suggest specific modifications. Once there is a requirement for such alternatives, if only for internal comparison by the

assessment panel, then assessment is in the game of policy design. At that point all the procedures and techniques described above can apply.

Despite the breadth and depth of such an adaptive assessment approach, the cost is small. An experienced core group of two or three analysts and two support staff could comfortably undertake one major assessment a year, together with perhaps four to six preliminary "rough cut" assessments. Each, of course, would draw heavily on available expertise within the agencies concerned with the problem. Hence the benefit is not only the assessment itself but a growing body of experience within agencies. In nearly every instance existing data, however scarce, are sufficient to begin, since we argue that the design of a data collection program for monitoring or baseline information must follow and be integrated with the approaches described here, rather than precede them. A modest budget is necessary to mobilize and organize existing data, but typically, this can be managed within the cooperating agency. At most it is a one man-year effort. Similarly, computing budgets can be as small or large as facilities and expertise warrant. The resource in scarce supply is rarely money; it is expertise and experience in the techniques and procedures described here. If such is available or can be developed, the costs are an order of magnitude less than those typical in North American impact assessment efforts.

For Developing Countries

When a new approach, such as the one put forward in this book, appears, it is useful to examine it from different viewpoints. Here an attempt is made to focus on some aspects that seem particularly relevant from the developing countries' point of view. Moreover by adopting that perspective the lessons for industrialized countries might, paradoxically, emerge more vividly.

Problems are perceived very differently in developing countries, and there is in addition often a high within-country cultural diversity. Because of these differences, developing countries can sometimes more easily explore new ways of looking at problems and new solutions. An example is the perception of eutrophication in Southeast Asia. There, high nutrient loads, abundance of algae, and aquatic weeds like water hyacinth are considered desirable in rice fields, fish ponds, and even in some natural water bodies. They are viewed as a resource and an enhancement factor of the production process, rather than as a nuisance. Also, it was not coincidental that a totally different way of measuring socio-economic growth in global models was originated in developing countries. In the Latin American World Model this was life expectancy at birth. Differences in the perceptions of the problem made it necessary to look for alternative solutions.

In this book, a non-traditional perception of the behavior of ecological systems is presented. We link this with the potential richness of perceptions emerging from the present cultural diversity on our planet. This variety is prized because it is not yet possible to decide whether one, some, or many perceptual frameworks, or paradigms, are necessary in order to cope with different problems in different regions of the world. It is likely that new and evolving paradigms will be needed. And it is also likely that some of these will originate in developing countries, and modify and enrich the views presented here.

Too often in the past, socio-economic development and environmental quality have been perceived, or construed, as if they were quite opposite, or antagonistic concepts. The conceptual framework proposed here is not only absolutely compatible with the dynamic concepts of development and the rational use of natural resources, but it also tends to promote the generation of self-reliant and endogenous approaches to the environmental problems; approaches appropriate to local conditions, needs, and socio-economic structures.

For any one management or developmental objective, there are usually many alternative ways for implementation. We emphasize that it is essential to generate and consider a wide range of alternatives, a need that is critical in the developing countries' situation. Inadequate search for

alternatives can make the plans and projects fail utterly because of lack of adaptation to the local realities. This is evident in tropical agriculture, where there are many examples of attempts to introduce temperate zone, capital-intensive technologies. And more important than alternatives for implementation, the generation of alternative objectives, or goals, is viewed as a fundamental process.

The emphasis throughout the book upon permanent and inherent state of change of ecological systems suggests a richness of qualitatively different behavior modes that might be an appealing concept for the developing countries. It is often shown that attempts to force classical stability or constancy may lead to a shifting in behavior into undesirable modes. But changes need not be catastrophic. By the same token, an explicit search could be made to discover desirable stability regions. Strategies might then be devised to move the environmental or socio-economic system from an undesirable condition to more desirable ones.

Developing countries, perhaps more than others, are in a permanent state of change. Although it is an open question whether the perceived goal is always the desirable one, in most cases in the developing countries it is good to move away from the present state. Thus, developing countries, having no vested interest in constancy, might find the concepts of resilience, of managing with uncertainty or even managing uncertainty itself appropriate and suggestive. The

concepts might also have an influence upon the socio-economic theories, approaches, and strategies of national, regional, and global development. For instance, the concepts emphasized in the book might help to understand how some decisions and strategies reduce the stability region of a system, showing how some policies lead to a narrowing of the set of future options. So, even though the set of case studies utilized as examples in the book pertains to a small class, the implications of the approach impinge upon a much wider set of problems.

It seems clear that any approach which attempts to deal explicitly with uncertainty would be of particular relevance for the developing countries. Considering the needs for rapid socio-economic development, the existence of a large unexploited portion of natural resources, and the availability of technology for wide scale projects, the uncertainties involved are not only great, but often of a qualitatively different nature than in developed countries. This fact, coupled with the great vulnerability of major segments of the population, suggests that the explicit consideration of uncertainties is a fundamental concern of developing countries.

While it might be argued that some of the techniques presented here are not universally adaptable, the main emphasis throughout is on an overall approach to the problems. This is why a range of techniques, from the simple and naive

to the more sophisticated ones, has been explored. The choice and usefulness of a particular technique depend very much upon the particular situations and available resources. As an example, even the simplest approach to the first steps in the workshop procedure has proved to be very valuable in re-identifying the relevant issues, promoting integration among disciplines, and producing a more global and coherent view of the problem and its solutions within a group of experts in a regional planning project. This happened with a two-day workshop in the Bermejo River basin in Argentina. Thus, the relevant question is not whether the approach presented here is the best possible one, but whether one can do better than the traditional ones.

The approach presented is particularly useful in helping to make fast decisions in situations of incomplete data and great uncertainties. All of the techniques discussed are accessible at a moderate cost, and some are very cheap. For a fixed budget, whatever its size, the approach can allow a substantial saving in terms of data collection, in the sense that the emphasis is put upon collecting only the relevant data, without following the traditional massive data collection procedure.

Finally, it is important to emphasize the value of the workshop procedure (one of the cores of the approach) in terms of its efficiency for mobilizing and organizing scarce critical resources (expertise, funds, time). Besides, it has a high

demonstration potential, thus encouraging institutional flexibility and the dissemination of integrated views about the relevant issues.

Conclusions

We have attempted, in this overview, to present the issue of uncertainty that underlies the major resource and environmental problems facing mankind. The concept of resilience, in which the different distinct modes of behavior are maintained because of, rather than despite variability, is suggested as an overall criterion for policy design. The more that variability in partially known systems is retained the more likely it is that both the natural and management parts of the system will be responsive to the unexpected. The very process and techniques we recommend, while aimed in part at reducing uncertainty, are designed as a changing adaptive process of policy design. It is that combination of the issue, the concept, and the process and techniques that makes for adaptive environmental assessment and management.

Although we see assessment as an integral part of management, in some countries these are viewed as separate activities. As a consequence we will separate our detailed

conclusions into those most relevant for management and those most appropriate for assessment. First, the recommendations for adaptive management:

(1) Environmental dimensions should be introduced at the very beginning of the development, or policy design process, and should be integrated as equal partners with economic and social considerations, so that the design can benefit from, and even enhance, natural forces.

(2) Thereafter, during the design phase, there should be periods of intense focused innovation involving significant outside constituencies, followed by periods of stable consolidation.

(3) Part of the design should incorporate benefits attached to increasing information of unknown or partially known social, economic, and environmental effects. Information can be given a value just as jobs, income and profit can.

(4) Some of the experiments designed to produce information can be part of an integrated research plan but part should be designed into the actual management activities. Managers as well as scientists learn from change.

(5) An equally integral part of the design are the monitoring and remedial mechanisms. They should not simply be post hoc additions after implementation.

(6) In the design of those mechanisms there should be a careful analysis of the economic trade-offs between structures and policies that presume the unexpected can be designed out (fail-safe) vs. less capital expensive mechanisms that monitor and ameliorate the unexpected (safe-fail).

There are also specific recommendations for the techniques of environmental assessment, some of which are summarized here:

(1) Structural features (size, distribution, age, who connects with whom) are more important to measure than numbers.

(2) Events at one place can re-emerge as impacts at distant places.

(3) Monitoring of the wrong variable can seem to indicate no change even when drastic change is imminent.

(4) Impacts are not necessarily immediate and gradual; they can appear abruptly some time after the event.

(5) Variability of ecological systems, including occasional major disruptions, provides a kind of self-monitoring system that maintains resilience. Policies which reduce variability in space or time, even as an effort to improve environmental "quality," should always be questioned.

(6) Many of the existing assessment methods (e.g., cost-benefit analysis, input-output, cross-impact matrices, linear models, discounting) assume none of the above occurs, or at least, that none is important. All should be used with caution.

CHAPTER 1

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Principles and Procedures

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CHAPTER 1

WHAT IS THE PROBLEM?

1.1 The Environmental Impacts of Human Actions

1.1.1 Environmental Changes: Natural and Man-Made

In the late 1960s and early 1970s, governments, international agencies and many specialist and citizen groups became deeply concerned about the fact that human actions produce environmental changes, some of which seriously degrade the quality of man's life. While both the biogeophysical and the social-cultural environments have undergone more or less continuous change during the last several thousands of years, it is both the rapidity and the potential irreversibility of recent trends that have caused concern. As populations and the scale of human technology increase, the risk of producing unplanned degradations of the quality of human life becomes greater. It is therefore prudent for mankind to strive for an improved capability of anticipating the effects of human actions, and their potential impacts upon the health and well-being of mankind. This volume attempts to provide in simple terms a description of procedures for assessing potential environmental impacts and for applying that knowledge in appropriate decision-making processes.

Even in the absence of man, the natural environment undergoes continual change. This may be on a time-scale of hundreds of millions of years, as with continental drift and mountain-building, on a time-scale of tens of thousands of years, as with the recent Ice Ages and the changes in sea level that accompanied them, on a scale of hundreds of years, as with the natural eutrophication and siltation of shallow lakes, or over a period of a few years, as when a colony of beavers rapidly transforms dry land into swamp. Some of these natural changes are irreversible (e.g., eutrophication of a lake) while others are cyclic (e.g., the annual climatic cycle) or transient (e.g., droughts).

Superimposed on natural environmental changes are those produced by man. Even as a hunter-gatherer, man's use of fire modified some natural environments. Then with the domestication of animals and the introduction of agriculture, the effects of his actions became more widespread,especially as large human settlements came into being. The rate increased with the development of industry as muscle power was replaced by energy derived from fossil fuels until during the last few decades, human impacts have reached an unprecedented intensity and affect the whole world, due to a vastly increased population and higher consumption per head.

Human intervention has become of geological magnitude (e.g., through deforestation; regional agricultural development; strip mining; the erection of dams in large river systems) and has also become of global concern (e.g., through the rising consumption of fossil fuels and consequent increases in the atmospheric CO_2 concentrations; the release of chemicals which might perturb the stratospheric ozone layer. In addition, there are proposals to develop new technologies with environmental effects which are not yet fully perceived (e.g., wide-scale ocean basin mining; transport of large ice masses to arid shores).

Man's increasing control of his environment often creates conflicts between human goals and natural processes. In order to achieve greater yields or for other purposes, man deflects the natural flows of energy, by-passes natural processes, severs food chains, simplifies ecosystems, and uses large energy subsidies to maintain delicate artificial equilibria. In some cases, of course, these activities may create, or may be necessary to maintain, surroundings that man considers desirable, as for example, aspects of the European countryside, which are entirely "man-made" but reflect careful husbandry during many generation. Nevertheless, conflicts often arise between strategies that maximize short-term gains (e.g., 5-year yields of food) and those that maximize long-term benefits (e.g.,

50-year sustained yields). The former often require a penalty of irreversible environmental degradation. Disagreements between economists and ecologists hinge largely on their differing perspectives of time; in general, 5-10 years is considered to be a long period by economists but a short period by ecologists. Little account is taken in economic calculations of, for example, slow soil deterioration, depletion of an aquifer, or accelerated eutrophication of large water bodies.

Because natural biogeophysical environments fluctuate with time, we are unable easily to distinguish changes brought about by man. Take, for example, the built-up area for a new settlement which is being sited, as is often the case, on complex terrain. This is likely to change the physical environment in many ways. But, in order to understand these changes, it is necessary to know what the conditions would have been like if no development had taken place. It is not easy to measure exactly the present condition, far less to assess the significance of past trends and to project these accurately into the future. In Appendix 1, the problems associated with data gathering and interpretation are considered in some detail.

1.1.2 Environmental Impacts and the Stage of Technological Development

Perceptions about environmental impacts can be rather different in developing countries than in industrialized countries. Where poverty is widespread and large numbers of people do not have adequate food, shelter, health care, education and old age security, the lack of development may constitute a greater aggregate degradation to life quality than do the environmental impacts of development. The grinding and pervasive proverty in the underdeveloped poor nations has been spoken of as the "pollution of poverty" while the widespread social and environmental erosion in the developed nations has been characterized in its advanced state as the "pollution of affluence." While it is clear that decisions will and should be made based upon different value judgments concerning the net cost-benefit assessments about environmental, economic and social impacts, we do believe that the

aggregate sum of such decisions will be better if the process of environmental impact assessment is addressed formally.

In developing countries an especial challenge is to stimulate development processes at the local level. If such a process can be inaugurated broadly, the fruits of development may reach more of the segments of the population than do the large, centralized schemes. Better adapted development projects and programs are apt to engender broader public support and cause less undesirable social displacement than a few large centralized projects. Where the development processes can be focused on programs that can be sustained in large part with renewable local resources and broad public support, this is to be encouraged.

The emerging recognition that local sources of energy can be better utilized, that materials can be recycled more effectively and that some pollution problems can be alleviated or largely avoided by prudent, locally scaled activity form a basis for encouraging wider use of such objectives in development activities, both in industrialized and developing nations. The term "ecodevelopment" has been used to describe this approach (UNEP, 1973, pp. 135-137). Environmental impact assessments should be required for developments of this type as well as for large centralized projects.

1.1.3 Some Examples from Developing Countries

It is clear that each region and local area should make the best use of land and other natural resources, without causing damage or deterioration by, for example, laterization, erosion, desertification, or the spread of water-borne diseases like typhoid fever, dysentery, schistosomiasis and hepatitis. Shifting cultivation, which is a common practice in many parts of the humid tropics, may be used as an illustration. This practice is ecologically acceptable whenever it allows adequate time for the forest regeneration cycle, permitting the maintenance of soil fertility. In the past, natural factors (cultural taboos, traditional ways of life, disease and wars) kept the system in balance. However, with

modern medicine and new social values, the rate of population growth has increased, the ratios of land area to population have decreased and the original balance has been disturbed to such an extent that the cycle of cultivation does not allow for proper restoration of soil fertility. In many cases, there is not even a recovery period, and extensive areas have become overgrown with secondary vegetation and have become unsuitable for agriculture.

Failure to take account of social structure may also have implications which are of major significance. These effects may be manifest in several ways. The maintenance of particular institutions and traditions is dependent upon the life style of a community and once that life style is changed, for example by a resettlement programme, the prevailing social organization will be undermined and traditions will be lost. If a community continues some of its long-standing activities after development, the viability of a project may be affected. Certain types of traditional agricultural practice may adversely affect agricultural development, for example, by inducing soil erosion with a consequent loss of production. Finally, development may lead to the adoption of new life styles which generate social stress or have major impacts on the environment. For example, "advanced" agricultural techniques utilizing high-yielding cereals and energy subsidies have disrupted traditional village structure because of changes in the distribution of wealth and the value patterns. The people thus displaced have migrated from the villages into urban slums or into the hills. In the cities, the immigrants have magnified the problems of waste disposal, water supply, housing shortages and unemployment. In the hills, they have cut the forest to harvest and sell the wood and to clear new land for cultivation; these marginal lands, on steep slopes, have been cultivated without regard for soil-conservation techniques, and rapid erosion threatens even their limited productivity; in addition, associated changes in water-flow and siltation rates endanger the continued usefulness of dams constructed in these watersheds (Soemarwoto, 1974).

Environmental problems in the developing world are clearly linked to unbalanced development. The simple transfer of the techniques now employed in the developed nations may not be the best way to alleviate these problems.

1.1.4 Some Examples from Industrialized Countries

Planning and management of land and water still present major problems in the industrialized countries, for example in urban sprawl, highway and airport development, the maintenance of the quality of lakes and estuaries, and the preservation of wilderness areas.

Many of these problems are associated with the massive and mounting demands for energy and water by industry and a consumer society: these problems are present only in embryonic form in the less-developed countries. The high farm yields of industrialized agriculture are based on very large energy inputs (Pimental et al., 1973); and shortage of water - once regarded almost as a "free good" - is likely to cause serious problems for industry in many parts of Europe and the U.S.A. In the United States, for example, where the energy consumption has been doubling every eight or ten years, the projected cooling-water requirement for 1980 is about half of the normal run-off of the country. Even though 95% of this water is returned to the streams, its quality is not the same. Its higher temperature decreases the amount of dissolved oxygen and therefore the capacity of the streams to assimilate organic matter. This condition favours the development of decay food chains that further deplete the oxygen pool, and disturbs the stability of aquatic ecosystems.

The production of novel chemicals has introduced new environmental hazards and uncertainties. The addition of large amounts of biodegradable substances (nitrates, phosphorus-containing detergents, etc.) to the environment has accelerated the eutrophication of rivers and lakes, where these chemicals or their breakdown products accumulate. Non-biodegradable chemicals may be less conspicuous but more dangerous. Some are concentrated as they pass through food chains and endanger the health of man and his domestic animals, as well as that of numerous other species of wildlife.

Crisis episodes like the 1952 London smog attract much attention but long-term exposure to moderate degrees of pollution may be a more serious threat to human health and may have effects on human behaviour before physical ill-health can be recognized (WHO, 1972). It is right to emphasize effects on human health and well-being but other significant effects should also be taken into account. Acute or even chronic human toxicity is only one part of the pollution problem; pollutants also have implications for the long-term maintenance of the biosphere. The short-term problems are much the simpler, and are amenable in part to narrowly compartmentalized pragmatic solutions. Long-term effects of pollutants are insidious, chronic and often cumulative. Ecologists must ask what effects these pollutants have on the structure of natural ecosystems and on biological diversity, and what such changes could mean to the long-term potential for sustaining life. The belief, held by some, that pollution, especially air pollution, is the most important index of the "quality of the environment" is much too narrow. Many other forms of environmental degradation are of equal or greater long-term significance.

Development and re-development are taking place not only in the Third World but also within industrialized societies, with significant social ramifications in both cases. The situation in rural areas with long-established cultural patterns is similar in many respects to that in developing countries. Development may disrupt traditional ways of life, may inadvertantly offend prevailing cultural practices and may affect social cohesion, resulting in breakup of the communities. In urban areas, development may also cause substantial social stress. Urban motorways, for example, may sever established communities and may blight surrounding neighbourhoods.

During the remainder of this century, man will use as much of the earth's natural resources, and tap as much energy, as he has during the whole previous course of human evolution. Rapid economic expansion is likely to continue over the next few decades, although the growth of population and the consumption of materials

will have to be greatly reduced in the longer term. The real question is whether mankind can channel this fantastic circulation of resources in ways that will better serve the needs of humanity (Ridker, 1973) while respecting ecological processes. In this context, the developing art of technological forecasting ("futures research") may possibly be of value in anticipating the possible adverse effects of new technologies (see Farvar and Milton, 1972), and (just as important) in being ready to exploit the new opportunities that result from advancing technology but creatively and with due concern for environmental restraints. Futures research may help both developed and developing countries to "leap-frog" over many intermediate stages of development, either of particular technologies or of society itself. It is important, however, not to underestimate the conservatism of human societies and the great social stresses that are produced by rapid technological change.

1.2 Responses of Society to these Environmental Changes

Although the widespread concern about the human environment that culminated in the UN Conference on the Human Environment in Stockholm in 1972 is of relatively recent origin, there is a long history of practical responses to various kinds of environmental insults. Although some early agricultural societies appear to have perished because of problems of erosion and salinization, others developed highly productive terraced agriculture. Terracing, contour cultivation and many other measures have been adopted for a long time to conserve soil and water.

The burning of coal was recognized as a major cause of air pollution in London as early as the fourteenth century, and its use, importation and transport were regulated in various ways. Sometimes, capital penalties were imposed for producing "pestilential odors". From the fifteenth to the early twentieth centuries, various commissions and committees pronounced on the evils of air pollution, and William Blake (1757-1827) castigated England's "dark Satanic mills". But it was the great expansion of the chemical industry in the nineteenth century that lead

to the setting up of the Alkali Inspectorate in 1863 and the first comprehensive legislation to control the emissions from factories. Control of domestic fires did not come until much later. It required the "smog" of 1952 which led to 4,000 deaths in London to bring this source of air pollution under effective control with the Clean Air Act of 1956.

Water pollution control commenced somewhat earlier. As the great towns of England grew in the early years of the nineteenth century, the death rates from water-transmitted fevers rose dramatically. The great sanitary reforms initiated by Edwin Chadwick in 1842-43 led to the Public Health Act of 1848, a landmark in the provision of safe water in cities.

Early in this century in North America, many measures were introduced to control erosion by water and wind. Somewhat later, integrated resource surveys were initiated. In 1912, President Theodore Roosevelt embarked on a series of proclamations designed to set aside land for national parks, preserving wilderness areas and natural ecosystems. Increasingly, too, the possible adverse environmental impacts of water-resource and highway development were recognized and steps were taken to investigate their importance during the planning stages of such enterprises.

But after World War II, government activities became more complex while both government and industrial enterprises increased greatly in scale and number. No longer could the public entrust the preservation of environmental quality to mission-oriented agencies, to industries motivated by profit, or to regulating agencies charged with the evaluation of single-factor risks, like air or water pollution, which are relatively easy to quantify. Some mechanism was needed to ensure that all major development proposals by government and industry were subjected to an examination of their total environmental consequences. Although regulations of one kind or another devoted to this objective have now been introduced in many countries, the first comprehensive legislation was the National Environmental Policy Act (NEPA) of the United States, enacted on January 1, 1970. (See Appendix 2).

It was this legislation that the terms "environmental impact assessment" and "environmental impact statement", that form the subject matter of this book, were first used officially. The objective is to analyse and assess the environmental impacts of what we call "Actions". (See Section 1.4 and Chapter 2, particulatly Fig. 2.1.)

Because of the long lead-times involved in most major projects, many of the early environmental impact assessments in the United States were examined long after completion of the engineering and economic assessments. As a result, many environmental impact statements were presented to decision-makers as adversary documents. This situation is now changing. As indicated in Chapter 2, the proper time for detailed consideration of the environmental and related social aspects of new proposals is very early in their formulation, in parallel with, and integrated into the engineering and economic assessments.

1.3 The Scales of Interest in Environmental Impact Assessments

The effects of large regional developments (power stations, dams, highways and the like) should be considered on three time-scales.

(a) During construction, the environment is disturbed by heavy earth-moving equipment, temporary work camps and roads. For the local inhabitants, the quality of life is degraded by the production of dust and noise as well as by social upheavals.

(b) Upon completion of the development, grass and trees may be planted, and roads may be paved. But there is no doubt that a new environment has been created as a consequence of the flooding of a valley, diversion of a river, relocation of traffic routes or the routine releases of air and water pollutants.

(c) Over a period of several decades, the development may attract secondary industry, may cause significant increases in population, and may generate a whole series of unanticipated human activities.

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After 50 years, when the original structure is perhaps obsolete, the regional environmental modifications are likely to be far more substantial than the originator of the project ever imagined.

Admittedly, the effects of some legislative proposals (e.g., plans to ban the sale of pesticides) cannot be sub-divided so conveniently into such discrete time-frames.

Environmental management strategies that include estimates of long-term impacts undoubtedly challenge the traditional decision-making process. The political and economic bases for action are tuned to the immediate and short-range influences of the market-place. Here, cost-benefit analyses are based on interest rates related to present-day costs of investment capital, modified to account for uncertainty and risk and thus with a time-scale of 10-15 years. Economic systems aim to maximize gains over the short-term; ecological considerations suggest ways to minimize liabilities over the long-term.

In addition to the time scales described above, several space scales should be considered:

(a) the immediate surrounding, e.g., inside a factory fence or inside an area designated for pesticide control;

(b) the region, e.g., downstream of a large dam or tall chimney;

(c) the continent and the world.

This book focuses on the process of impact assessment within single jurisdictions. The institutional and methodological considerations associated with large-scale and even global assessments require separate treatment. See, for example, the publication SCOPE 10, Environmental Issues (1977).

1.4 Biogeophysical and Socioeconomic Impacts

In some jurisdictions the term "environmental impact assessment" is used very broadly to include the whole range of social and economic impacts. Elsewhere social impact assessment and economic analysis are seen as being quite distinct from environmental impact assessment, in the orgainzations involved, professionsl skills used and methodological approaches.

No matter how the terms are used, it is important to recognize that impacts on ecosystems, biogeochemical cycles and the like are intimately related through complex feedback mechanisms to social impacts and economic considerations. The social impacts of any project that involves environmental changes should be studied in close association with studies of biosphere impacts.

1.5 The Prediction Problem

When a project or program is undertaken, it sets in motion a chain of events that modifies the state of the environment and its quality. To illustrate, a major highway changes the physical landscape which may, in turn, affect the habitat of some species, thus modifying the entire biological system in that area. The same highway affects land values, recreational habits, work-residence locations and the regional economy. These various factors are inter-related, so that the net result is difficult to predict. A confounding factor is that if the project were not undertaken, the environment would still be subject to:

(a) great variability, e.g., due to the daily and annual astronomical cycles and to variations in weather and climate;

(b) irreversible trends of natural origin, e.g., the eutrophication of lakes, long-term trends in the conposition of soils;

(c) irreversible trends due to a combination of natural and man-induced factors, the latter originating elsewhere, e.g., the transport of atmospheric pollution from central Europe to Scandinavia might contribute as much as or more than the output of an industrial enterprise planned for Norway or Sweden.

One of the problems for the assessor, as indicated schematically in Fig. 1.1, is to identify the various components of environmental changes, due to the interacting influences of man and nature:

Fig. 1.1 implies no value judgment of whether the environmental change is good or bad. However, at some stage in the assessment or the decision-making

process, such a judgment must be made. We will return to this question later.

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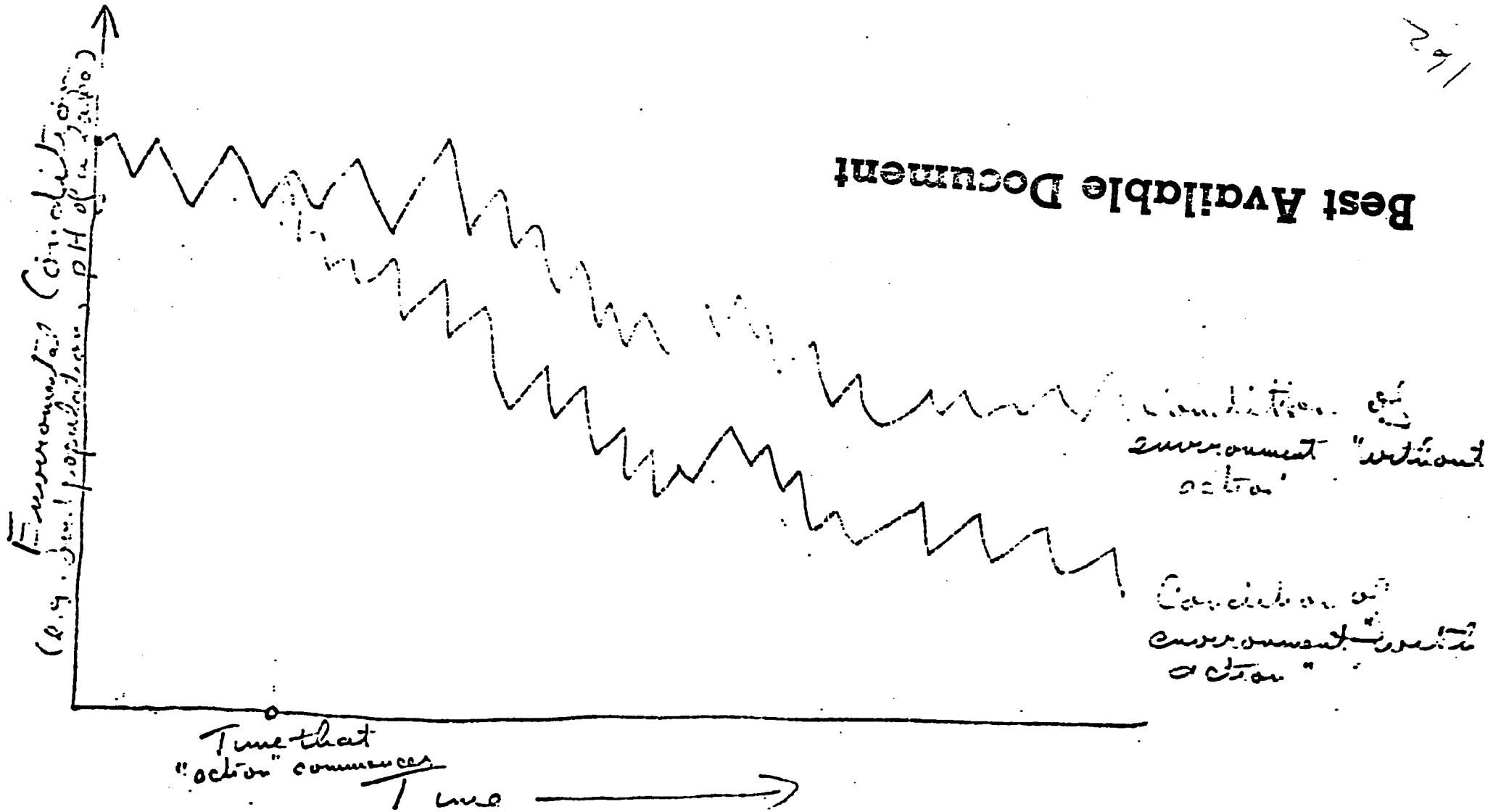

Figure 1.1. Conceptual framework for assessing environmental ~~impacts~~ changes. The reference condition is the "without-action" condition, ~~and, because of naturally occurring changes, is not necessarily the present condition.~~

1.6 Definitions

This book is about environmental impact assessment, which is defined as an activity designed to identify and predict the impact on the biogeophysical environment and on man's health and well-being, of legislative proposals, policies, programs, projects and operational procedures, and to interpret and communicate information about the impacts.

A number of terms have been used in English-speaking countries to distinguish between environmental changes and the harmful and/or beneficial consequences of such changes. In one approach, a man-induced change is called an "effect" while the harmful and/or beneficial consequences of an effect are called "impacts". In some cases, of course, an impact could be beneficial to some citizens but harmful to others.

Another convention is to use the term "impact" to denote only harmful effects. In still other countries, the words "effects" and "impacts" are synonymous. In that case, reference is made to a change/effect/impact in terms of its nature, its magnitude, and its significance.

We shall try to be consistent in the following chapters, maintaining the distinction that a "change" can be natural and/or man-induced, that an "effect" is a man-induced change, and that an "impact" implies the application of value judgment to decide upon the significance of an effect. However, we have no objection to other terminologies.

The remainder of this book is organized as follows. Chapter 2 identifies the basic administrative procedures. Chapter 3 describes the components of an environmental impact assessment while Chapters 4 and 5 describe existing methodologies. A number of examples and related topics are included in the Appendices.

Hereafter the acronym EIA will be used for the phrase environmental impact assessment.

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APPENDIX

D Quantitative Methods of Analysis

I. METHODS OF ANALYSIS

INTRODUCTION

This section will discuss three terms that are used in connection with analyses of programs in both the public and private sectors: cost–benefit analysis, cost–effectiveness analysis, and decision analysis. There is no universal agreement on specific definitions of these terms; the definitions presented here are used only to provide a basis for discussing quantitative methods of analyzing environmental decisions.

This Appendix raises and discusses a number of important technical issues involved in formalized quantitative methods of analysis. Many of the difficult analytical issues discussed here are relevant to the programs of many government agencies and are not peculiar to EPA. The methods described may be helpful to decision makers though they will often be difficult to use in a simple fashion. It should be noted that Chapter 2, Section A of the report examines the use and value of explicit analyses in decision making and concludes that evaluations should be done quantitatively, when possible and warranted, but that even where the difficulties of quantification prove insurmountable, more qualitative approaches are still likely to be helpful to decision makers.

A. COST–BENEFIT ANALYSIS[1]

Cost–benefit analysis is a procedure for comparing the costs and benefits of alternative policies. This procedure relies on specialized techniques

[1]This section relies heavily on the discussion in Peskin and Seskin (1975:1-29).

and principles, most of which are derived from economic theory. Its purpose is to aid in the fundamental task of allocating the economy's scarce resources among alternative uses so as to enhance allocative efficiency. But allocative efficiency is only one of the considerations that policymakers take into account in evaluating proposals. For example, considerations of equity and political acceptability are also relevant and sometimes decisive.

For purposes of a cost-benefit comparison, the benefits of a proposal are defined to be the amount that people would be willing to pay for the proposal's results.[2] For example, conceptually the benefits from air pollution abatement would include the amounts people would be willing to pay for all the effects associated with cleaner air. These effects might range from lower cleaning costs and lessened plant damage to improved human health and more frequent sunny days. Some of these benefits are amenable to straightforward quantification and monetization, while others pose both conceptual and practical difficulties. These difficulties can render comprehensive benefit analysis a complex undertaking.

It is generally agreed that a useful concept of costs in a cost-benefit framework is that of opportunity costs.[3] Opportunity cost refers to the value foregone in employing a resource in one activity rather than in its best alternative use. For example, when a water pollution control program is undertaken, resources (such as the labor and materials needed to construct a sewage disposal plant) must be diverted from other uses. The value of the foregone production and consumption that results from this diversion of resources represents the opportunity cost of the control program. In addition, there may be undesired environmental, economic, or social effects that are not fully captured as part of the opportunity cost of the control program. A complete cost analysis should attempt to define these effects clearly and take them into account.

B. COST–EFFECTIVENESS ANALYSIS

For some environmental decisions, the objective may be taken as given. In such cases the policymaker can use cost–effectiveness analysis to determine the least-cost ways of achieving the set of objective. The basic

[2]A detailed discussion of the concept of benefits and its related topics can be found in Section II.B of this appendix.

[3]The opportunity-cost concept, as well as other related topics are also discussed in Section II.B of this appendix.

difference between cost-effectiveness analysis and cost–benefit analysis is that cost–effectiveness analysis takes as given the level of beneficial outputs (objectives) whereas cost–benefit analysis can be used to examine a range of beneficial results in order to ascertain the level at which net benefits (benefits minus costs) is greatest. For example, cost–benefit analysis might be used to look at the costs and benefits of various pollution standards in order to find the "optimal" economic standard for emissions from mobile sources. A cost–effectiveness analysis, on the other hand, might be used to look at the least-cost methods of achieving pre-specified emission standards.

Thus, as defined here, cost–benefit analysis and cost–effectiveness analysis are not two different approaches to the same problem. Rather each is a procedure that can be applied to a distinct set of problems. Furthermore, it might be argued that cost–benefit analysis can be used to address higher-order questions than cost–effectiveness analysis. Where cost–effectiveness analysis can be used to ask: what is the least-cost means of attaining a desired emissions standard (assuming "costs" can be unambiguously compared); cost–benefit analysis can be used to ask: what is the most economically efficient standard in the first place?

C. DECISION ANALYSIS[4]

Environmental decisions are made under conditions of uncertainty. This uncertainty may be concerned with the abundance and distribution of chemicals in the environment; the rate of diffusion of such substances in the atmosphere, water, or soil; the impact of changes in environmental quality upon human health and other organisms; the values that should be attached to possible outcomes of a decision, e.g., how to value certain health benefits or the cost assessments of yet unproven technologies; and the effectiveness of implementing a particular decision. These and other uncertainities are inherent in the problem of deciding what environmental policies to choose. Decision analysis is a technique designed to make these uncertainties explicit thereby subjecting them to discussion, debate, and modification.

Decision analysis does not supplant or make unnecessary other methods of analysis such as cost–benefit analysis or cost–effectiveness analysis. Rather, decision analysis should be looked upon as a technique for incorporating uncertainty into these other forms of analysis.

The application of decision analysis to a problem follows a well-

[4]A general discussion of decision analysis can be found in Howard (1966).

defined sequence of steps. The first step is called the "deterministic phase." In this phase, the decision to be made is defined, i.e., the analyst poses the question: what is to be decided? Possible alternative actions are identified. The possible outcomes for each alternative action are analyzed. These outcomes are often difficult to describe, since this part of the analysis may include many elements—for example, health effects, climatic impacts, reproduction cycles of insects—that are not, in fact, completely known. Nevertheless, in this phase of the analysis, such variables are treated as if they were known accurately so that calculations can be performed to indicate how outcomes are affected by a particular decision. The values placed upon the chain of events leading from decision to outcome are assigned by the analyst. This part of the analysis is similar to a properly done cost–benefit analysis. The same problems occur in both, e.g., how to compare the value of inherently incomparable considerations such as cost of pollution abatement and public health. The deterministic model can be used to perform a sensitivity analysis to examine how the values attached to certain outcomes vary with changes in poorly known variables. In this part of the analysis, the impact of uncertainty is evaluated quantitatively. Sensitivity analysis can pinpoint those variables for which better information would be important and can also identify variables that are unimportant to the decision despite the fact that they are inexact.

The second phase of decision analysis is called the "probabilistic phase." During this phase of the analysis data are gathered on all important variables and encoded in the form of probability distributions (Howard 1966). This is probably the most controversial part of decision analysis, since the translation of poorly understood data, scarce information, and scientific opinions into probability distributions often depends on considerable subjective judgment. The advantage of decision analysis is that it forces these judgments to be made openly and subjects them to discussion. On the other hand, decision analysis is often sufficiently complex to require computer calculations and there are many who fear that this can mask the fact that subjective judgments entered in the formulation of the problem and in the assignment of important probability distributions. It should be kept in mind, however, that it is better to have a method that deals explicitly with uncertainty than to hide uncertainty in computations that carry an air of certainty unwarranted by the data.

Methods to encode knowledge, even vague knowledge, into probability distributions for use in decision analysis are treated in several references.[5]

[5]See, for instance Spetzler and Stael von Holstein (1972).

The third phase of decision analysis is known as the "informational phase." After the problem has been formulated, the sensitivities determined, and the knowledge encoded as probability distributions, an analysis is made comparing the expected cost of obtaining more information (on matters having broad probability distributions, i.e., those that are particularly uncertain) with the expected value of the additional information.[6] The analysis can show whether it is worth purchasing more information or whether the decision should be made with the data at hand.

D. STANDARD QUANTITATIVE METHODS AND EPA DECISIONS

It should be apparent from the above descriptions that these three methods of quantitative analysis have a potential use (and, in some cases are used) for decision making at EPA. However, each procedure, taken alone, may be inadequate for the policymaker's purposes. In part, this inadequacy arises because of weaknesses associated with the current use of the individual techniques. For example, traditionally, all three quantitative methods often neglect the distributional aspects of policy decisions. In addition, to a greater and lesser degree, the techniques are associated with difficulties in the presentation and consideration of nonmonetary and incommensurable effects. Furthermore, only decision analysis customarily treats uncertainty explicitly. Finally, it is seldom the case that marginal or incremental analyses are undertaken.

II. IMPORTANT ISSUES IN ANALYSES TO SUPPORT EPA DECISIONS

Chapter 2, Section A of the Committee report discusses general aspects of the type of analysis that could improve environmental decision making at EPA. This section of the appendix will consider in more detail some of the important issues that arise in applying these techniques to environmental decision problems.

A. STRUCTURING THE PROBLEM

Most policy decisions made by the EPA have diverse social effects: on human health; on environmental and ecological conditions; on social

[6]The advantage of probability distributions is that they can be combined in various ways to permit each "expert" and each source of technical information to make an explicit input to the problem, (see Section II.E.2 of this Appendix).

attitudes. Many of these effects having lingering consequences that may affect future generations. Prudent decision making must balance, at least informally, all these considerations.

In most cases EPA decisions depend on a mixture of scientific, engineering, legal, political, and economic issues. The issues are complex and multifaceted, and their analysis requires the contributions of scientists, engineers, lawyers, politicians, and social scientists. In order for these diverse contributors to work together effectively, the decision problem at hand should be structured. The structuring of the decision problem can be thought of as an organized approach to:

- explicitly stating the objectives of the decision;
- identifying feasible alternatives;
- understanding the physical, chemical, medical, and ecological processes or systems;
- obtaining and organizing data;
- evaluating (quantitatively, to the extent possible) the consequences of the various alternatives;
- exploring potential problems in implementation;
- indicating and examining the degree of uncertainty associated with the alternatives; and
- presenting the information in a coherent form to facilitate decision making.

When a decision problem has been properly structured, those who have specialized talents will be able to contribute their knowledge in a constructive way.

B. BASIC CONCEPTS AND DEFINITIONS

1. Benefits and Costs

Decisions made by the Environmental Protection Agency usually involve benefits derived from enhancement of environmental quality. For example, the benefits associated with an EPA action improving water quality might include improvements in human health; reductions in water treatment costs for industrial water users; increases in sport and commercial fishery yields (for given levels of labor and capital); improvements in water recreation opportunities; reductions in household costs associated with water hardness; and increases in aesthetic values of water, based on its appearance, taste, and odor. The common element of each of these items is that it has the potential of increasing general welfare.

The costs of environmental policies normally include direct monetary expenses (operating and maintenance as well as capital) divided into private and governmental (federal, state, and local) expenditures. Such costs can represent net decreases in economic output available for all purposes other than implementing the proposed policy and are often termed "opportunity costs." At the same time, there may be additional costs in the form of undesired environmental, economic, or social effects (for example, adverse effects on land use, energy consumption, or local unemployment) that are not completely captured by the standard definition of "opportunity costs." All of these types of costs have the potential of decreasing general welfare.

In evaluating a proposed action or project, it is customary to begin by listing both anticipated benefits and costs in their most natural, or convenient, units. However, identifying the benefits and costs may be only the beginning. The policy analyst may then attempt to quantify the benefits and costs, and if possible, determine values for them.

2. The Willingness-to-Pay Concept

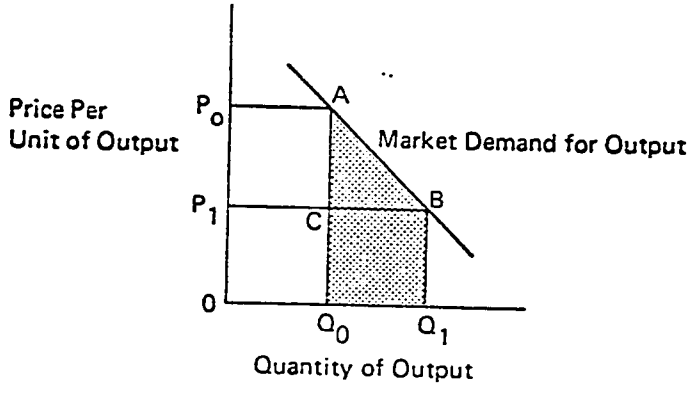
The value of the results (benefits) of any government program, or of the products of any private enterprise, can be measured by the amount that the beneficiaries are willing to pay for them. In the same manner, the cost can be measured by the amount that the beneficiaries would be willing to pay for the products that the resources used by the program could have produced if they had been employed in their most valuable alternative use. (This is the basis of the concept of opportunity costs.) On both the benefit and the cost side of an appraisal, willingness-to-pay—which is shorthand for the amount that people would be willing to pay—is a fundamental concept.

Sometimes the estimation of willingness-to-pay presents no problems. This is the case when the outputs are sold and where there is reason to believe that all people who are willing to pay the established price do so and thereby obtain the quantity of the good or service that they find worthwhile. In this case, which is typical of privately produced and sold goods and services, the price is an adequate measure of willingness-to-pay. Furthermore, the prices of the resources used to produce any good or service are an adequate measure of their opportunity costs, since these resource prices reflect the value of the commodities that those resources could have produced if otherwise employed. Thus, in an economist's model world, prices measure the extra utility (or satisfaction) a consumer obtains from a unit of the good or service, as well as the cost to society of producing another unit of a good or service. When markets function well

prices are often suitable measures of the benefits and costs of the final goods and services associated with environmental decisions.[7]

Returning to the water quality example above, such benefits as reduced household costs associated with water hardness are by definition "priced" and described directly in monetary units. On the other hand, increased fishery yields are most easily described initially in terms of pounds of fish. Pricing the increased fishery yield does not pose any great conceptual problems, since markets exist that can provide relevant data. In other cases, however, it may be difficult to quantify the effects in the first place, much less to estimate the willingness-to-pay for them.[8]

[7]It should be noted that prices as measures neglect "consumer's surplus"—a surplus benefit that arises whenever a consumer is charged less for a good or service that he would be willing to pay for it. This concept is illustrated in the figure below:



Assuming the normal demand-output relationship, additional program output will be consumed by users as the unit price of the output falls (from P_0 to P_1). If, as a result of the program, output is increased by an amount Q_1-Q_0, the total value of this additional output to users is measured by the entire shaded area. This is a larger amount than would be reflected by the market prices alone. It is the sum of the market price times increased quantity (represented by the rectangle CBQ_1Q_0) plus the consumer surplus for that increase (represented by the triangle ABC). However, the omission of consumer surplus is not significant for most social appraisals because a minor change in the output of a marketed commodity will cause only a small change in its price, indicating that the (positive or negative) increment in quantity is valued by consumers at just about the market price. If a substantial change in quantity is expected, this argument fails, and the estimation of the social value of the change becomes much more difficult.

[8]This is particularly true with respect to two classes of effects common to most environmental actions: health effects and aesthetic or psychic effects. The first class will be discussed in Part C of this appendix. With regard to evaluating aesthetic or psychic effects, present state-of-the-art often limits the analyst to a simple listing of the nature of the effects It should be noted that in the context of pollution abatement and other environmental issues, such intangible effects may represent the most important categories of benefits and costs.

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One reason for this difficulty is that many effects come under the category economists term "collective" or public goods. Collective or public goods usually affect a large number of individuals simultaneously and, in most instances, each individual has little choice over the amount or quantity of the goods and services consumed.[9] The simultaneity and lack of divisibility usually preclude a market for the goods and services in question. For example, improvements in air quality associated with air pollution control programs most often affect large numbers of people over wide geographical areas. It is difficult to conceive of distributing the benefits of improved air quality on an individual basis. Furthermore, it is unrealistic to expect that these benefits will be valued in a market for clean air. Thus, the policy analyst must develop some other method for obtaining values for these effects, i.e., the analyst must devise schemes to deduce what individuals would be willing to pay for these types of benefits if the individuals were assessed for them.

Another factor that hampers the valuation of benefits associated with environmental actions is that many are difficult to predict or quantify. Furthermore, even in cases where the benefits can be predicted or quantified with some degree of accuracy, current market conditions may not be adequate for estimating values for them. For instance, in the water quality example, benefits were associated with increased recreation opportunities. However, attempts to value these benefits must first grapple with the problem of predicting the extent of the increased opportunities. Moreover, the current market demand for such recreational opportunities may provide a poor basis for estimating demand and willingness-to-pay for a new recreation site.[10] In such cases, other more elaborate estimation techniques may be needed.

3. *Valuation of Employed and Unemployed Resources*

Returning to the water quality example, suppose that the environmental program leading to the water quality improvement also results in the

[9]The most common example of a public good is national defense.

[10]A related issue concerns the interdependence between willingness-to-pay and the distribution of income. That is, the policy analyst must recognize that the amount people are *willing* to pay depends, in part, on their *ability* to pay. Thus, the value attached to project benefits given one distribution of income, can be appreciably different than the value of the same project benefits given another distribution of income. In addition, if the project itself significantly alters the distribution of income, the analysis is further complicated. In particular, the extent of the distributional impact on incomes must first be evaluated. Hence, the policy analyst is faced with a somewhat paradoxical situation. Although the valuation of benefits using willingness-to-pay must be thought of as dependent on the distribution of income, any specific valuation of benefits must be based on assuming that a particular distribution of income is given.

construction of lodging and eating facilities around the lake. The question is: how should the policy analyst evaluate these secondary effects of the water quality improvement? The answer to this question depends in large part on the employment conditions in the economy. If the economy is assumed to be fully employed, there may be little basis for considering the increased restaurant and hotel activity as significant secondary benefits. This follows from the fact that in a full-employment economy, there are essentially no idle resources. Hence, construction of hotels and restaurants necessitates the diversion of resources from another sector of the economy and some other activities must be foregone or, at least, reduced. Thus, under fully-employed conditions, there is a presumption that secondary effects involving resource use will not generally represent significant additions to aggregate welfare.[11]

If the economy is experiencing significant unemployment—nationally or regionally—or if there are obstacles to resource mobility, the valuation of secondary effects will be different.[12] Then the additional resources used because of the water quality improvement will not be simply transferred from alternative employment. Thus, in the example above, if the restaurant and hotel construction employs resources that would have otherwise been idle, then this would represent a significant secondary effect. Moreover, it should be considered an increase to aggregate welfare and, hence, a benefit in the evaluation of the action leading to the water quality improvement.

C. VALUATION OF HEALTH EFFECTS

1. *Introduction*

Because most EPA policies and programs are designed primarily to protect and improve human health, it is useful to give special attention to the valuation of health effects. Any assessment of the effects on health of an action by EPA depends on a long chain of consequences: the changes

[11]If resources are diverted from one sector of the economy to another, this implies at least an incremental gain in aggregate welfare since the costs of transferring the resources must be incurred. However, it is usually difficult to measure empirically this marginal welfare gain. At the same time, if the shifted resources are more productive in their new activities, this also represents a gain in aggregate welfare. Again, in practice, it is difficult to prove such a gain in productivity has occurred.

[12]Here, it is assumed that the unemployment or resource immobility will continue for the life of the project.

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in pollution-generating activities induced by that action, the changes in polluting discharges resulting from those changes in activities, and others. Each link in this chain presents difficult scientific problems.

For example, in evaluating the health effects from air pollution abatement, assessments must rely on a determination of the relationship between improved ambient air quality and changes in the morbidity (including disability and absence from work and school) and the mortality of the exposed population.[13] The basic problem in investigating the air pollution-health relationship is isolating the effects of air pollution from the effects of numerous other factors that determine the status of human health. These include physical, socioeconomic, and personal characteristics such as age, sex, race, income, smoking habits, exercise habits, genetic history, nutritional history, and medical care, as well as other environmental factors, such as climate. Thus, the first task is to determine how air pollution levels affect morbidity and mortality rates, given all of these confounding factors. If, and when, this association can be ascertained, the policy analyst can then translate the effects into a useful measure, e.g., reduced work-days lost, reduced days of restricted activity, and so on. Finally, it may be desirable in some cases to go one step further by assigning values to such health effects.

2. *Techniques for Valuing Lives*

It is the purpose of this section to review briefly the various techniques that have been proposed for valuing life and health in monetary terms.[14] No single technique has gained wide acceptance but each has its advocates and several have, in fact, been used for the purpose of carrying out cost–benefit analysis, and arriving at decisions, on major public programs.[15]

A major difficulty in valuing lives (or health) stems from the fact that life has no market price. Under nearly all conceivable conditions, no sum of money is sufficient to compensate persons for loss of their lives; lives cannot be bartered and are obviously qualitatively different from

[13]For simplicity we are neglecting the difficult problem of determining the association between reduced air pollution emissions and their precise effects on ambient air quality.

[14]This section is taken from Raiffa, H., W. Schwartz, and M. Weinstein (1976) On Evaluating Health Effects of Societal Programs; prepared for the Committee on Environmental Decision Making.

[15]The literature that is reviewed here discusses the monetary value of a *life* and not of a *life-year*. Hence, this section will be limited to a consideration of lives rather than life-years.

commodities that society produces. In an attempt to circumvent this difficulty, two major strategies have been employed. The first employs one or another technique to determine the dollar value that should be placed on a life that is lost. For such an assessment, the most commonly used measure is so-called human capital. The second strategy is radically different in that it attempts to estimate the dollar value that should be assigned to some given statistical reduction in the probability of death or illness. It, in effect, focuses on the value of *life-saving* rather than the *value of a life*.[16] The most widely discussed method for obtaining such values depends on an assessment of the individual's willingness-to-pay for a public program involving some statistical improvement in the person's outlook for survival or health.

a. *Human Capital* Human capital is the indicator most widely used to estimate the value of life. It is calculated on the basis of projected future (present value) earnings, taking into account the age, sex, and education of the particular individual. Human capital thus measures an individual's worth in terms of what the person can produce.

Some who favor the human-capital criterion advocate the use of the net value of the earnings stream whereas others favor the use of gross value. *Net value* appraises a person in terms of the resources that the rest of society would lose if the individual were to die. This number is arrived at by subtracting the individual's anticipated (discounted) consumption from the individual's anticipated (present value) earnings. In effect, the calculation views individuals as having worth only to the extent that they contribute to the rest of society, excluding themselves. Although *net value* fairly represents direct economic losses that would be suffered by an individual's survivors, it has been severely criticized because it ignores the value of life to the individual who has died or who is a potential decedent. The net value calculation seems to say that the specific individual does not count, an attitude which ignores the fact that society exists so that people can enjoy life. Concern over this implication has led most advocates of human-capital measures to favor the use of gross rather than net values in the analysis of public programs. *Gross value*, because it includes the individual's consumption, eliminates the objection that the satisfactions which accrue to the specific person have been neglected in the accounting process.

[16]The issue of how to treat the valuation of future life-saving is treated in Section II.D.4 of this appendix.

Note, incidentally, that the classic human-capital estimate does not include any of the nonpecuniary losses that follow from an individual's death, despite the fact that such losses may loom large in terms of their social impact. The grief that is caused to a family, the loss of the individual's contribution to home duties, and the effects on the individual's friends, employer, and community are all examples of costs that may not be reflected in the human-capital measure. To provide a more comprehensive measure of the individual's contributions, it has been proposed that these factors be taken into account, with appropriate monetary values being assigned to each.

Beyond the technical criticisms of human-capital measures just discussed, there lie more basic philosophical objections to the very concept of human capital as a measure of social benefit.

One source of serious concern has been that the human-capital estimate distorts social attitudes toward human life. For example, any valuation based on earnings stream would lead to the conclusion that retired people, or those unable to work, are either of no value to society or (if net value is used as an indicator) that they represent an actual drain on the community. The logical corollary is that a public investment in saving the lives of such individuals is not justified and that in fact society would be better off if they were allowed to die. This formulation in no way conforms to society's views and is in fact repugnant as a concept. A second, and equally repugnant, conclusion, that follows inevitably from application of the human-capital measure, is that a high wage earner is worth more to society than a low wage earner. This means that in assessing the benefits of any public program in terms of earnings stream, the evaluation would consider an individual earning $30,000 to be worth as much as 3 individuals earning $10,000 each.

A most serious and fundamental criticism, however, lies in another area and can be summarized as follows: human capital does not consider the desire (demand) of the individual for survival. In other words, by using human capital as the index of benefits, society ignores the desire of individuals to improve their chances of survival.[17]

b. *Other Approaches* Several attempts have been made to obtain society's *implicit appraisal* of the value of a life through an analysis of investment in existing public programs that have an impact on survival.

[17]Despite these many objections, human-capital estimates have been used repeatedly in recent years in the analysis of a number of programs involving safety. The values that have been employed have typically been in the range of $150,000 to $250,000 per life saved.

Studies of investments in both highway safety and airline safety have indicated that there is an enormous range of investment per life saved—the implicit value of a life ranging from only a few thousand dollars to a million dollars or more.

Similar attempts have been made to obtain implicit social views through examination of jury awards for death and disability. Here again a remarkably wide range of values has been found. It appears, therefore, that implicit values obtained from either public investments in safety or from the courts cannot serve as a useful yardstick for measuring the value of a life. Furthermore, these indices are subject to the same fundamental criticism as is human capital, namely, that they assess the value of a life but do not assess the value of saving a life.

c. *Willingness-to-Pay* Over the last decade, there has been a growing interest in the concept that public programs relating to health can be evaluated by determining the willingness of an individual to pay for a particular reduction in the risk of death (or illness). When such an expression is aggregated across the population it can provide the basis for assessing the benefits of a given investment in safety. Many economists favor this approach on the grounds that persons know best their own interests and therefore that their views concerning the value of life-saving activities can provide the most reliable basis on which to make policy decisions. As a measure, willingness-to-pay has the advantage that it does not necessarily force either society or the respondent to put a value on a life.

In this section we consider briefly the two strategies that have been proposed for determining willingness-to-pay, the first based on the use of questionnaires and the second based on wage differentials in riskier-than-normal occupations.

Many investigators believe that willingness-to-pay can be elicited by means of questionnaires that ask the respondent to value a particular statistical reduction in morbidity or mortality. However, only very limited empirical data are available for analysis and criticism. For this reason, the validity of the questionnaire method remains an open issue. It does seem, however, from what little information is at hand, that willingness-to-pay increases in response to an increasing probability of death and also (as would be anticipated) in response to the promise of greater reductions in the likelihood of death or illness. These changes in willingness-to-pay are not linear, however, and for this reason one cannot extrapolate empirical findings from one range of probabilities to another.

It should also be appreciated that the individual's willingness-to-pay

can do no more than represent the lower bound of what a program is worth because it ignores all externalities; it is evident that family, friends, and others in society, in most instances, would themselves be willing to pay something in order to reduce a particular individual's risk of death or disability. Any complete measure of benefits should include these additional values.

Use of questionnaires has also been criticized on grounds relating to both equity and reliability. It is argued that this method gives undue weight to the views of the affluent; willingness-to-pay, as would be expected, increases with income and wealth with the result that the opinions of the more affluent would have more influence than those of the rest of the population.[18] There is also concern that most individuals may not be able to fully understand the problem that they are asked to consider. The reductions in the risk of death produced by most public programs are extremely small and it is not clear that individuals can comprehend very small changes in low-probability events. The questionnaire method has been further criticized on the grounds that individuals' responses may be influenced by the fact that they are not actually being asked to pay for the program. It is possible that their answers would be quite different if they knew that their taxes would be raised on the basis of their responses or that they would receive bills for the amount that they had indicated they would be willing to pay. Such issues require extensive further study before the questionnaire technique can be adequately evaluated.

Attempts have been made to estimate willingness-to-pay indirectly by looking at wage differentials in jobs that involve more than average risks (e.g., switchmen, lumberjacks, miners). Such studies have shown that for an increased risk of death of 0.001 per year, workers were on average paid an extra $200 per year (in 1954–1965 dollars). This finding indicates that each worker would presumably be willing to pay at least $200 per year (in 1976 dollars)in order to remove the 1 in 1000 extra risk of death. This value, derived as it is from the real world of the labor market, would appear on first consideration to provide an important guideline for policymakers. However, estimates of willingness-to-pay based on wage differentials have been criticized on several grounds. It has been suggested, for example, that individuals working in hazardous occupations are relatively poor and that they are therefore forced to take jobs that they otherwise would not; thus, it cannot be assumed that their

[18]In theory this income effect could be eliminated by using weighing factors that normalized the elicited values.

attitude toward risk reflects the attitude of the population in general. It has also been argued that such individuals are less likely to be well-educated and well-informed; hence, they are unlikely to be aware of the real risk to which they are exposed. For these, and a variety of other reasons discussed elsewhere, the labor market figures must be viewed with caution.

d. *Summary* From the foregoing discussion it should be clear that there is at present no single reliable and generally accepted way of placing a dollar value on the benefits that will be realized under a public program that reduces mortality or morbidity. Of all the techniques that have been proposed, willingness-to-pay seems the most promising although there are serious practical and conceptual difficulties in its application.

D. DISCOUNTING AND THE FUTURE

1. Introduction

Present benefits are usually considered more "valuable" than those same benefits in the future, and future costs are usually preferred to incurring those same costs in the present. The fundamental reason for this is that a dollar not "consumed" today can be invested in productive uses to yield more dollars tomorrow.[19] That is, both present benefits and future costs imply that resources will be available for consumption, production, or investment in the interim period. Thus, not only are the magnitudes of benefits and costs important, but also the timing of their occurrence is critical to analyses of environmental decisions. While there is little dispute over this, there has been substantial controversy over what discount factor should be used to convert future benefits and costs to present values.

2. Choice of a Discount Rate

There are basically two schools of thought with regard to determining a social discount rate. The first might be called the "private opportunity rate school." This school believes that since the source of funds for public programs (e.g., environmental protection) is ultimately the private sector,

[19]Inflation is a separate issue, and one should think of all dollars as being expressed in real terms, relative to their purchasing power.

the benefits and costs of the programs should be discounted by the private opportunity rate, i.e., by the rate of return on investment in the private sector. Ideally, then, it follows that this rate of return would characterize the opportunity cost of shifting productive resources out of the private sector. In practice, however, the analyst is faced with the problem of determining the "true" opportunity rate, since rates of return vary considerably throughout the private sector due to market imperfections.

The second school advocates the "social time preference approach." This school believes that individuals in the present generation would collectively agree to provide future generations with benefits in excess of what would be reflected by investments made in the private sector.[20] If one accepts this view, some explicit (perhaps political) procedure would be needed to determine overall rates of growth, investment, and discount for society. The question then is how to make this approach operational. Conceptually, the government could, through appropriate monetary and fiscal policy, drive down the interest rates throughout the economy to correspond to some predetermined social rate. However, many believe that in practice this may not be feasible.

To some degree, the resources used for an environmental project will force the displacement of private investments. Presumably those investment opportunities would have been evaluated at a different (probably higher) rate of return than the social rate of time preference. In order to determine if the shift in productive resources is economically efficient, the same rate used to evaluate the time stream of project results must also be used to evaluate the opportunities foregone in the private sector.[21] The shift of resources is socially desirable only if the present value of project results per dollar outlay in the public sector exceeds the present value of the opportunities foregone per dollar in the private sector—both present values being computed at the social rate of discount.

In practice, then, there are two basic issues that must be resolved in order to evaluate the time stream of a public project's results. The first concerns the determination of a social discount rate (social rate of time preference). The second relates to ascertaining what opportunities would be foregone elsewhere in the economy as a result of the investment in the public sector.

[20]Technically this means that present individuals regard consumption of future generations as a "public good."

[21]The goal is to avoid the inefficiencies inherent in a two-rate system in which resources would be shifted from higher yield (private) to lower yield (public) programs.

3. *Intergenerational Transfers*

All environmental decisions are evaluated from the point of view of present consumers. In some sense, then, discounting future benefits and costs, represents discrimination against future generations. The ethical dilemma surrounding future generations arises from the fact that they are not here to "vote" on decisions that will affect their lives (and life expectancies).

At least two approaches to the problem of intergenerational equity have been forthcoming. The first advocates that, if possible, each "generation" be placed in a position to revise ongoing programs. Unfortunately, many environmental programs are not subject to simple revision from one generation to the next. The second (which is applicable to situations that are not easily revised and perhaps involve irreversible consequences)[22] recommends that intergenerational considerations be explicitly taken into account in the decision. For example, Krutilla and Fisher (1975) discuss the possibility of levying a severance tax on the extraction and consumption of exhaustible resources.

There are, to be sure, issues of intergenerational equity that no approaches can satisfy, but *interpersonal* equity questions arise in the evaluation of all public investments and are not unique to intergenerational or life-saving issues. Thus, the dilemma resembles that for all public decisions. However, as discussed in the next section, where life itself is at stake, the moral aspect becomes of prime concern.

4. *Discounting Future Lives*[23]

Before discussing the rationale for discounting future lives or life years, one must set aside the question of whether later years of life are worth more or less than early years, because it is not a present versus future issue and is best handled independently of discounting.[24] Throughout this discussion, the life measure will be age-adjusted, quality-adjusted life

[22]The reader is referred to the discussion of reversible and irreversible consequences in Section II.D.5 of this appendix.

[23]Much of this discussion is taken directly from Raiffa, H., W. Schwartz, and M. Weinstein (1976) On Evaluating Health Effects of Societal Programs; prepared for the Committee on Environmental Decision Making.

[24]Age is obviously an important factor in determining the quality of life. Holding all other health effects constant, the question is whether a 50th year of life is worth more, or less, than a 70th year. There are arguments on both sides of the issue, but the main problem is that other health effects are not constant. The average health level of a 50-year-old is higher than that of a 70-year-old. This, in principle, should be taken into account in valuing life years.

One method would be to develop a standard deflator of average health status by age, and

years. The trade-off, then, is between saving a 50-year-old this year versus a 50-year-old next year. The basic question is whether one should discount future life years relative to present (age-adjusted, quality-adjusted) life years in evaluating public investments. The answer, it shall be argued, depends on the opportunities available for investing resources for future use, and on the future opportunities that will be available for using those resources to save lives.

A simple example demonstrates why future life years ought to be discounted. Begin with the standard economic assumption that one dollar productively invested today can yield $(1+r)^t$ dollars t years from now (r is then the effective rate of interest). Suppose society can spend $10,000 now to save one life year T years from now. It can be shown that this is equivalent to spending $10,000 to save less than one life year *immediately*, i.e., it is equal to saving $(1+r)^{-T}$ life years now.

Note that spending $10,000 now for one life year in year T is equivalent to spending $\$10{,}000(1+r)^T$ in year T for one life year in year T. Furthermore, spending $\$10{,}000(1+r)^T$ in year T for one life year in year T is equivalent to spending $\$10{,}000(1+r)^T$ now for one year of life now. That is, the dollar value of a *concurrent* life year is "time invariant," i.e., it remains constant over time, or in terms of opportunity cost, the dollar cost of saving a life year at the margin remains constant over time. Finally, note that spending $\$10{,}000(1+r)^T$ now for one life year now is equivalent to spending $10,000 now for $(1+r)^{-T}$ life years now. The only assumption needed for this final step is a linear relationship between dollars and quality-adjusted life years at a given point in time.[25] No assumptions were needed as to the enhanced value of present versus future life years; on the contrary, it was assumed that life years have constant value in *current* (i.e., at the time they are spent) dollars.

The time-invariance assumption noted above has certain implications. First, the assumption actually implies not so much that future lives will be valued the same as they are now, but that investment opportunities to save lives will also be the same. This stems from the fact that the dollar value society attaches to an additional year of life would also reflect the marginal cost of saving that year if all desirable investments were being

to use this deflator to contract the scale of health status for each year of life. Thus, the health status resulting from some particular effect might be measured on a scale from 0 to 1 for a 20th year of life, but on a scale from 0 to 0.85 for a 70th year of life. This would reflect the judgment that, on average, a 70th year is of lower quality than a 20th year.

[25]Lack of linearity would alter the exchange rate, but would have no effect on the need to discount.

undertaken. If the life-saving opportunities are relatively stable, the time-invariance assumption is reasonable. If the investment under consideration, and its consequences, are small enough on a global scale so as not to affect the value of a life at the margin, then discounting is still appropriate.

If, however, the opportunities, and hence marginal costs, of saving lives are not time-invariant, we must be wary of discounting. If, *overall*, life-saving opportunities are improving, society should discount even more; if, *overall*, life-saving opportunities are diminishing, society should discount less or not at all. The irreversibility of an individual decision, unless it is so large as to affect the marginal social cost of life-saving, should *not* affect the decision to discount, any more than the secondary effect of a large economic investment on the capital market and the interest rate should affect the choice of the discount rate. Where the "secondary" effect is truly major, however (as would be the case for a cataclysmic environmental disaster), then the marginal costs of life-saving will be rising, and the appropriate discount rate may be zero, or even negative.

For example, discounted at 5 percent per year, the loss of a billion lives 500 years from now would be comparable to less than one life now. Are these really to be considered equivalent? If they are not, the reason lies in part because the opportunities will not exist to save a billion lives at reasonable cost in the future, and in part because other values come into play when one considers such a major cataclysm. To save a billion lives would, no doubt, force our descendents 500 years from now to move far out along the marginal cost curve for life-saving; the opportunity will not exist to save that many lives at the same average cost as to save, say, a thousand lives. Therefore, for the reasons given above, the effective discount rate society should use in valuing those lives should be smaller than the rate used to value smaller numbers of lives. Moreover, when perhaps 10 percent of the world's population is at risk of destruction, other values come into play: our concern for human civilization itself, apart from the individual lives involved. For both of these reasons, it is clearly inappropriate to discount cataclysmic life loss in the same manner as more moderate life loss. By the same token, arguments based on such cataclysms should not dissuade us from appropriately discounting future lives in most instances.

Discounting does not reflect lessened concern for future generations, but rather the opportunity to forego investments far in advance of the life to be saved in order to have more resources available closer to the time at which the life is actually lived. Future generations may not want us to

have squandered resources to reduce their mortality now. If they will have more efficient opportunities to save lives, then society should do them a favor by discounting them even more.

5. *Reversible and Irreversible Consequences*

Some environmental decisions have associated with them consequences that for all practical purposes can be regarded as irreversible.[25] Consider, for example, the decision to permit pollution of waterways by nondegradable contaminants such as mercury. Current scientific knowledge can do little to influence whatever effects might be associated with this form of water pollution. The analysis of environmental decisions having possibly irreversible consequences poses important theoretical and practical issues. This section discusses how these issues might be treated.

It is useful to think of irreversibility as representing a reduction in the future options available. Then, one is confronted with a clear-cut illustration of a central postulate in welfare economics—namely, that an expansion of choice represents a welfare gain; a reduction of options, a welfare loss. Clearly, the importance of irreversible consequences lies in the fact that they can lead to significant reductions in general welfare.

It has probably occurred to the reader that absolute irreversibility may represent an extreme case. In many instances, there may be some possibility of restoration, perhaps at high cost. In such cases, three important considerations should be evaluated. The first concerns the probability or likelihood of wanting to reverse the decision. The second concerns the length of time in which the "irreversible" consequences would be felt, i.e., the duration of welfare loss. The third involves the fidelity and acceptability of the restored state.

Using a simple model, Krutilla and Fisher (1975) have analyzed the development of resources found on public lands where such development has irreversible consequences. In their model, they account explicitly for the foregone benefits emanating from the preserved "state of nature." A not surprising conclusion of their analysis is that the "optimal" commitment of resources to activities that are *irreversibly* destructive of

[25]This discussion is based in large part on the work of Krutilla and Fisher (1975). It should be noted that although this research is relevant to decisions designed to *enhance* environmental quality, their primary emphasis was focused on the *preservation* of natural environments, e.g., decisions banning the extraction and consumption of exhaustible resources.

the environment is smaller than commitments to activities whose consequences are reversible—even if future demands and outcomes are known with certainty. Furthermore, this conclusion is strengthened if there is uncertainty as to either the magnitude of the consequences of their values over time. Thus, with regard to these types of environmental decisions, it may be wise to forego the programs if they have possible irreversible consequences, even if a more conventional comparison of discounted benefits and costs appears favorable.

6. *Option Value*

It has been suggested that where the demand for a publicly provided good or service is uncertain, there may be benefits to a risk-averse individual from retaining the *option* to consume, in addition to the benefits captured under the conventional willingness-to-pay doctrine.[27] The value of these additional benefits has been termed option value.

As a practical matter, the notion of option value is only important in evaluating decisions that could result in irreversible consequences. Thus, a proposed water pollution control program designed to enhance the water quality in Lake Erie might have significant "option value" attached to it. For example, it may generate outputs (such as recreation and other aesthetic uses) for which the future demand is uncertain, and the decision not to undertake the program may be, for all practical purposes, irreversible. That is, if the program is not presently initiated, it may be impossible to improve the water quality except possibly at prohibitively high cost.

Thus, when there is reason to believe that option value exists, there is an additional incentive to avoid environmental decisions having possibly irreversible consequences. That should not be interpreted as suggesting that activities involving irreversible consequences should never be undertaken. Rather, the point is that irreversibility coupled with risk aversion leads to a reduction in the present value of the activity being contemplated.

As is apparent in these discussions, it is often difficult to make quantitative normative statements with respect to carrying out analyses of this category of environmental decisions. Qualitatively, the upshot of these discussions conforms to intuition—uncertainty, irreversibility, and risk aversion all imply a conservative policy in evaluating environmental decisions.

[27]See Section II.B.2 of this appendix.

E. ALLOWANCE FOR UNCERTAINTY

1. *Introduction*

Uncertainty pervades most environmental decisions and affects analyses of such decisions in two ways: (1) the analyses rest on imperfect data and inadequate scientific understanding. For example, it may not be known precisely how a given reduction in particulate emissions will change the ambient level of suspended particulates, or how that change will affect the health of an exposed population; and (2) the consequences of the decision cannot be foretold with precision. Since every decision entails risk and since some alternatives are riskier than others, this means that it is difficult to determine how much risk is worth accepting. Although there are few generally accepted principles for handling uncertainty and risk, there are some fruitful approaches to the problem.

2. *Probabilistic Evaluation*[28]

Since in most cases some action must be taken, experts should convey to less knowledgable individuals the information they possess even though it may be imprecise. Nothing much is gained by further complicating the information-exchange process by purposely introducing vague, possibly protective language. For example, suppose scientist *A* is the world's leading expert about a given phenomenon. Scientist *A* thinks action *X*, if taken, will possibly lead to a number of deaths. If pressed, scientist *A* might think roughly that the number is somewhere about 100 but that it could possibly be between 10 and 1000. Being uncertain, the scientist might write, "I think there may be *quite a number* (or 'a substantial number' or 'not an insignificant number,' or . . .) of deaths involved." Now these so-called, semi-quantitative terms may be dysfunctionally misleading—especially if some readers, on the basis of this report, start thinking in terms of 10 or 20 deaths and others in terms of 10,000 or 15,000. It would be far better if scientist *A* said something to the effect that, "I feel uncertain, but my best guess is about 100, but I would not be surprised if the number were as low as 10 or as high as 1000." This would be an improvement, but still it also may be misleading since the reader might be confused about what is meant by "best guess" or by the expression "would not be surprised."

[28]Much of this section is taken from the paper by Raiffa, H., W. Schwartz, and M. Weinstein (1976) On Evaluating Health Effects of Societal Programs; prepared for the Committee on Environmental Decision Making.

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It is worth the effort to be precise about the state of imprecision. This can be accomplished if analysts report a few selective fractiles of their judgmental probability distributions (e.g., the 0.01 and 0.99 probability tail values, the quartiles, the median) or if they present easily understood graphical displays of the probability distributions. Equally important, ample warnings should be appended to give the audience a sense of perspective: how were these numbers chosen and how volatile are they?

There are a number of reasons why probability assessments are important:

- Probability assessments are more precise in conveying uncertain information than vague semi-quantitative terms, such as: less likely, rarely, seldom, quite a few, not so many . . . .
- Probability numbers are precise enough to be attacked by others. It is hard to start a debate over ambiguous reports that can mean different things to different people.
- If an uncertain quantity, x, can vary over a wide range and if sensitivity studies show that it really matters where x lies, then it may be important to know where the experts think x lies within that range.
- Probabilities can be combined with other probabilities to simplify and clarify a morass of numbers. If joint dependencies are critical, then the probability language is rich enough to capture these nuances.
- Probabilities can be combined with quantitative evaluations of consequences so that one can compute distributions of final payoff measures.
- It is important to think about *probability dynamics*: about the modification (and the anticipated potential modifications) of probability distributions over time. Thus, for example, if x is an uncertain quantity with a broad distribution and if payoffs are sensitive to the level of x, it is relevant to know the ways in which further research might modify the distribution of x. If the modification is anticipated to be negligible, it might be desirable to act now; if the modification could turn out to be substantial, then waiting for this information before making an irreversible decision may be a prudent course of action. A full dynamic, probabilistic analysis should systematically address such concerns.

Many of the reasons cited above extolling the virtues of probability as a language of discourse can be reversed: just because probabilities are relatively unambiguous they are administratively dangerous to use in a politically charged arena. If clarity invites criticism, is this desirable? And so on.

F. DISTRIBUTIONAL CONSIDERATIONS[29]

1. *Introduction*

As discussed in Section II, Part B of this appendix, the benefits (costs) of an action can be thought of as the increase (decrease) in some desirable component of "general welfare" that results from taking the action. Although this concept seems straightforward, in most cases a policy analyst is not dealing with "general welfare," but rather with the welfare of specific groups of individuals, industries, and so on. Furthermore, an action may cause the welfare of some groups to fall. Thus, policymakers must consider the *net* effects of their actions as well as the distribution of the effects. The practical difficulty in assessing such effects then becomes one of isolating the "net" increase or decrease in general welfare. In aiding this exercise, it is often useful to distinguish between aggregative effects and distributional effects.[30]

Aggregative effects usually refer to results of a project or action that increases directly the well-being of individuals or decreases the amount (cost) of resources required to produce goods and services. In the previously cited water quality example, all the items listed can represent aggregative results. Distributional effects, on the other hand, usually refer to changes in some people's well-being at the expense of the well-being of others. For example, suppose increased water recreation opportunities bid up the price of boat rentals and the owners of the boats experience increased profits. The increased profits would not necessarily represent aggregative benefits, since they would represent a dollar-for-dollar "loss" to the renters of the boats. The situation can be thought of as an income transfer from the boat renters to the boat owners. There is no reason to expect any net increase in the general welfare. Thus, in performing analyses of environmental decisions, care must be taken to distinguish between the aggregative effects that represent real net increases in the general well-being and strictly distributional effects that represent trade-offs between the well-being of different individuals or segments of society.

[29]Some of this discussion is based on a paper by Paul Portney (February 1976) The Distribution of Pollution Control Costs: A Literature Review and Research Agenda. Resources for the Future, unpublished.

[30]The distinction between aggregative and distributional effects is sometimes referred to as "real" versus "pecuniary" effects.

2. Distribution Across Income Groups

The most frequently discussed distributional issue probably involves the apportionment of taxes across different income groups. In characterizing this issue it is often useful to calculate taxes as percentage of household income. If one does this for various income brackets, it can be determined whether the taxes in question are distributed progressively, proportionally, or regressively. That is, one can discover whether the taxes (as a percentage of income) rise, remain constant, or fall, as income increases. An analogous situation applicable to the environmental area would be an assessment of the distributional impact of pollution control costs. For example, a policymaker might wish to determine whether control costs (as a percentage of income) rise, remain constant, or fall, as income rises. Why is such a determination of interest?

Public policies must usually be financed by some means of taxation. The policy issue becomes one of determining what desired attributes such financing should involve. For example, should a public policy be financed on the basis of the "ability to pay," or should there be a direct link between program benefits received and program costs (taxes) imposed? This issue is especially relevant in the area of environmental decision making, since many decisions in this area result in benefits spread across large segments of society. For example, control programs designed to improve ambient air quality may affect large geographical regions. Clearly, such areas are made up of households covering the spectrum of possible income profiles. Policymakers may be interested in the question of whether such programs should be financed by taxes imposed on those who benefit the most from improved air quality, or whether they should be financed out of more general tax revenues.

A related issue concerns distributional considerations across levels of government. For example, should the federal, state, or local government be responsible for bearing the costs of a particular air pollution control program? The resolution of this question is closely tied to the policymaker's objectives with regard to the program's effects on the distribution of income.[31] Unfortunately, it is often difficult to isolate these effects since different levels of government rely on different mixes of revenue-producing mechanisms, e.g., income taxes, sales taxes, property taxes, and so on. What is being stressed here, is not a normative judgment as to the methods of financing, implementation, and enforcement. Instead, what is being said is that analyses of alternative environmental programs

[31]From the policymaker's perspective, it may be more important to determine which level of government will be most efficient in implementing and enforcing the control program.

should include a display of the related distributional effects. That is, policymakers should be aware of the distributional implications of the alternative policies being decided upon.

3. Distribution Across Geographical Regions and Jurisdictions

By definition, most decisions involving the environment can be thought of as affecting a region with certain geographical boundaries. At the same time, the relative impacts of a given decision may vary to some degree within that region.[32] Thus, national policies designed to clean up air pollution related to emissions from the automobile will affect all parts of the nation to some degree, although they will have the most significant effects in areas where mobile-source air pollutants are predominant factors in determining air quality. That is, auto emission controls may dramatically improve the air quality in Los Angeles, but may have inconsequential effects on the air quality in a rural area of Wyoming.

Environmental decisions requiring auto-emission control systems are made in a political arena composed of representatives from jurisdictions that have fixed boundaries. Thus, there is a potential conflict when affected regions do not coincide with well-defined jurisdictions or when uniform national policies are adopted with differential impacts across regions or jurisdictions. Again, the policy question becomes one of how the distribution of benefits from a program should correspond to the distribution of costs imposed by that program. That is, in the example above, should the citizens of Wyoming bear the costs of cleaning up California's air? To evaluate this question, other factors must be a[illegible]. For instance, there may be significant economies of scale in p[illegible]g only one "type" of automobile for the nation,[33] and this factor may outweigh equity considerations.

Elected officials must ultimately decide on the geographical scope of an environmental policy. However, in aiding this task, the policy analyst can provide valuable information on the regional and jurisdictional impacts of the alternative policies under consideration. This is important since presumably one wants to avoid incorporating adverse effects into the decision. For example, uniform national standards may be favored over regional standards in order to reduce the likelihood that different regional standards would result in industrial relocation, plant shutdowns, and significant regional unemployment due to labor immobility.

[32]Differences in climate, terrain, and other environmental factors contribute to the differential impact of certain environmental policies within and across "regions."

[33]However, it should be noted that multi-car strategies have been proposed as one means of controlling mobile-source air pollution, (see NRC 1974).

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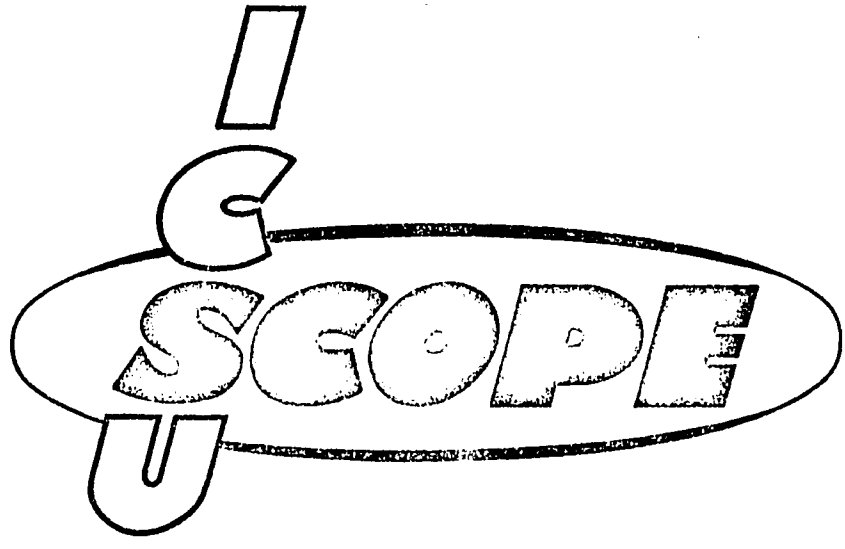

SCOPE SECRETARIAT 51, boulevard de Montmorency 75016 Paris, France

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1. INTRODUCTION

The Scientific Committee on Problems of the Environment (SCOPE) is an international non-governmental organization established in 1969. The objectives of SCOPE are :

- *To advance knowledge of the influence of man on his environment, as well as the effects of these environmental changes upon man, his health and his welfare - with particular attention to those influences and effects which are either global or shared by several nations.*
- *To serve as a non-governmental, interdisciplinary and international council of scientists and as a source of advice for the benefit of governments and inter-governmental and non-governmental bodies with respect to environmental problems.*

The membership of SCOPE includes at present 33 National Members and 15 adhering International Scientific Unions and Committees. A General Assembly is held every three years. The SCOPE Constitution, given at the end of this brochure, shows its structure and functioning.

SCOPE is a component of ICSU, which is an international non-governmental scientific organization. The membership of ICSU includes representatives from 66 National Academies of Science, 18 International Unions and 12 other bodies (called Scientific Associates). Where there is a need for continuing collaboration amongst several Unions, ICSU establishes Scientific Committees. At present, there are 10 such Committees, including SCOPE, COSPAR (the Committee on Space Research), COSTED (the Committee on Science and Technology in Developing Countries), SCOR (the Scientific Committee on Oceanic Research), SCAR (the Scientific Committee on Antarctic Research), COWAR (the Scientific Committee on Water Research), CODATA (the Committee on Data for Science and Technology), the Committee on the Teaching of Science, the Special Committee on Solar Terrestrial Physics, COGENE (the Committee on Genetic Experimentation).

2. THE SCOPE PROGRAM

SCOPE seeks to help scientists synthesize environmental information from diverse fields, identifying knowledge gaps and disseminating the results. During the last two years, the main emphasis has been on the following seven projects :

1. *Biogeochemical cycles ;*
2. *Dynamic changes and evolution of ecosystems;*
3. *Environmental aspects of human settlements ;*
4. *Ecotoxicology ;*
5. *Methods of simulation modeling of environmental systems ;*
6. *Methods of environmental monitoring ;*
7. *Methods of communication of environmental information ; and societal assessment and response.*

Project 1. BIOGEOCHEMICAL CYCLES

The biogeochemical cycling of both natural and man-produced substances is the dynamic framework upon which life exists. Among the biogeochemical cycles, those of carbon, oxygen, nitrogen, phosphorus, sulphur and calcium are the most important for an understanding of the biosphere as a whole. Other substances that should be studied include toxic elements such as lead, mercury, cadmium and plutonium as well as compounds produced exclusively by man such as DDT and PCB which have considerable effect upon living systems.

Although some of the mechanisms for biogeochemical cycling are known, there are still some serious knowledge gaps. For example, the information necessary for formulating steady-state and transient models of biogeochemical cycles must be improved if sound judgments are to be made on questions relating to the effects of such activities as fossil fuel combustion or fertilizer application upon global stocks of carbon and

nitrogen. This includes knowledge such as the size of environmental reservoirs, the forms of compounds, the residence times of materials within these reservoirs, and the rates of transfer of materials between reservoirs. It is important also to emphasize that some interface interactions are microbially-mediated. The object of these evaluations is to develop a capability to construct biogeochemical models on global, regional, and local scales.

The subject is inter-disciplinary, and collaborating scientists sometimes have difficulty in communicating with each other because of the depth of their specialization. The Swedish National Committee for SCOPE took the leadership in organizing a Workshop and in associated studies which led to the publication of a monograph on the global cycles of nitrogen, phosphorus and sulphur (SCOPE Report No. 7, Ecol. Bull. 22. Stockholm, Swedish Natural Sciences Research Council, 1976).

These studies are being extended to include the establishment of SCOPE Centres for nitrogen in Sweden, for carbon in the FRG, and for sulphur in the USSR. In addition, consideration is being given to organizing a SCOPE focal point for biogeochemical cartography in Belgium.

The Project Chairman is :

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Project 2. DYNAMIC CHANGES AND EVOLUTION OF ECOSYSTEMS

Man is continually modifying his environment in an attempt to produce more food, fibre, goods and services. This often produces severe stress on ecosystems causing instability and loss of productivity. The results are evident in those areas where renewable natural resources have deteriorated, including desertification of arid and semi-arid areas, salinization and waterlogging of irrigated soils, and destruction of tropical forests.

Project 2 focuses on :

— identifying those processes which lead to resource deterioration:
— identifying gaps in present knowledge, discrepancies between knowledge and application, and socio-economic constraints which limit the optimum management of resource use.

One of the key requirements for understanding human impact on renewable natural resources is the ability to assess dynamic changes in the population structure of key component species in ecosystems, both in natural and man-modified situations, since these changes reflect the impact

of natural and human events and permit an assessment of the relative stability of various ecosystems and their tolerance to different types of perturbations. These changes are commonly referred to under the general topic of ecological succession. Rapid theoretical and experimental progress has been made in the field in recent years, particularly in terms of the degree to which future changes in ecosystem structure can be predicted from the pattern of previous changes under given management regimes. Furthermore, it now seems likely that a better understanding of dynamic successional processes may play a key role in clarifying some of the present controversy in ecology as to inter-relationships between such characteristics as dominance and diversity on the one hand and stability and resilience of ecosystems on the other.

In collaboration with UNESCO and within the framework of SCOPE Project 2, a joint workshop was organized in Santa Barbara, California, in 1976, on the topic of ecological succession. The findings have been published by UNESCO in their Man and Biosphere (MAB) series (Dynamic changes in terrestrial ecosystems : patterns of change, techniques for study and applications to management - MAB Technical Note 4). A handbook on method for use in developing countries is in preparation.

SCOPE joined with MAB and COWAR in sponsoring the preparation of a review of the experience with irrigation in developing countries (Arid Lands Irrigation in Developing Countries : Environmental Effects).

Project 2 is now beginning a detailed analysis of the ecological effects of fire. A preparatory meeting, held in England in January 1977, decided that the program should have two main objectives :

- *To improve the scientific understanding of the manner in which fire interacts with biota;*
- *To improve the manner in which fire can be used as a tool in ecosystem management.*

The chairman of this Fire Project is :

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Project 3. ENVIRONMENTAL ASPECTS OF HUMAN SETTLEMENTS

The environmental problems that arise from rapid population growth and major redistribution of population are world-wide but affect the less developed areas of the world to a particularly acute degree. These problems include overcrowding, poor housing, poor sanitation, deficient services

and a degradation of the natural landscape. The scale at which these problems are felt varies between countries, but it is not unusual to find all of the symptoms in the same city. Concomitant with these largely urban environmental problems are those resulting from rural depopulation and inadequate rural housing and services.

Although various agencies study these problems, the work has tended to be widely diffused and to lack the orientation needed for effective action. Part of the reason for this is that different perspectives are obtained from such varied disciplines as architecture, the social, bio-medical and natural sciences, engineering, and urban and regional planning. Especially in the developing countries, these differing perspectives have been further coloured by usages and standards derived not infrequently from previous colonial relations with countries in other continents.

There is a major need for inter-disciplinary appraisals of existing states of knowledge of the environmental aspects of human settlement. One topic regarded as of the highest priority is the evaluation of the scientific rationale, and the range of application appropriate for standards relating to construction methods and density of building (with special emphasis on the use of renewable and non-renewable resources, climate, cultural values, building and administration costs), water supply, air quality, occupational noise levels, geophysical hazards, sanitary and educational services.

A SCOPE contract with UNEP on this topic was signed in January 1975. Through regional collaborating institutes in Nigeria, India and Argentina, building standards and criteria were obtained from many countries in Africa, Asia and South America. The information was evaluated in each institute, followed by an international synthesis (Paris workshop in early 1977). The final report is now in press.

The Project Chairman has been :

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Project 4. ENVIRONMENTAL TOXICOLOGY

One of the main components of the UNEP programme labelled "Earthwatch" concerns the effects of pollutants on man and the biosphere. Although WHO has given leadership to the assessment of human health consequences, at present there is no unified conceptual treatment of the scientific basis for assessing the full range of environmental effects. The objective of project 4 has been to fill this gap, by preparing a monograph on the principles for the assessment of the effects of noxious agents in the environment, as a contribution to a scientific system for :

1. Developing criteria
2. Setting standards
3. Designing monitoring programs
4. Determining research priorities.

The resulting monograph is in press.

The Project Chairman is :

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Ottawa, Ontario,
Canada

Project 5. SIMULATION MODELING

Simulation models are used in almost every branch of the physical, biological, sociological and economic sciences. They are particularly useful in representing complex systems containing many components, elements and processes.

Simulation modeling of complex ecosystems requires interdisciplinary understanding and cooperation; unfortunately, scientists engaged in such studies are working in groups that have little contact with one another. The objective of Project 5 has therefore been to promote dialogue amongst the builders and users of models on the methods of constructing and using models of environmental systems. A reasonable degree of success has been achieved and three monographs have been published.

(1) SCOPE 5 : Environmental Impact Assessment. SCOPE 5 was drafted at a workshop held in 1974, supported by SCOPE, UNEP, UNESCO and Environment Canada. This monograph has been widely referenced, and has been translated into French and Japanese.

(2) Environmental Modeling and Decision Making, the United States Experience. This book was prepared under the auspices of the US National Committee for SCOPE, with financial support from the Holcomb Research Institute, Indianapolis.

(3) Simulation Modeling of Environmental Problems (in press) prepared by an international working group with support from the Holcomb Research Institute, Indianapolis.

Project 6. ENVIRONMENTAL MONITORING

It is self-evident that any environment program (e.g. for human health, resource use, agriculture, forestry, weather forecasting) needs the monitoring process to (a) sample the current state, (b) detect likely changes, and (c) check on the efficacy of any control actions.

Monitoring is the process of observing in a space-time series designed to give representative samples of the environment (global, regional, national or local) so that the necessary data become available for predicting future trends in an environment which may be important to man, directly or indirectly. These environmental pictures may be built up from measuring five different types of parameters :

(a) levels of important chemicals in air, water, soil, biota (including man and his food);

(b) physical attribues of the above media (e.g. solar radiation, soil texture);

(c) frequency and severity of effects on living things and inanimate objects caused by (a) or (b) above (e.g. disease, productivity, mortality, corrosion, depreciation of property values);

(d) inventories reflecting (i) climate change (e.g. area of ice-caps) or (ii) human impact (e.g. deforestation, desertification, resource use);

(e) source strengths of trace substances (e.g. from volcanoes, sewage, etc.)

The first undertaking of SCOPE was the preparation of a monograph on environmental monitoring (SCOPE 2, 1971), commissioned by the United Nations for the 1971 Stockholm Conference on the Human Environment. This was followed by a second monograph (SCOPE 3, 1973) on the same subject. In 1975, a Monitoring and Assessment Research Centre (MARC) was established by SCOPE at Chelsea College, London, England, sponsored by the UK National Committee for SCOPE, UNEP, the Rockefeller Foundation and the UK Department of the Environment.

MARC has become an active research institution, and has attracted scientists from all parts of the world for periods of from one to twelve months. The publication titles provide an indication of the breadth of the program.

The Project Co-Chairmen are :

Dr. R.R. MUNN,
Institute for Environmental Studies,
University of Toronto,
Toronto, Ontario,
Canada

Dr. R. W. J. KEAY,
The Royal Society,
6 Carlton House Terrace,
London, England

Additional information on Marc can be obtained by writing to :

Dr. A. SORS,
MARC,
The Octagon Building,
459A Fulham Road,
London, England

MARC PUBLICATIONS

Published

MARC Report N° 1 :
The ozone depletion problem (An example of harm commitment)

MARC Report N° 2 :
Vanadium in the environment

MARC Report N° 3 :
Suggestions for the development of a hazard evaluation procedure for potentially toxic chemicals

MARC Report N° 4 :
The relevance and utility of the peasant farmer's knowledge in the management and monitoring of agricultural resources - a Nigerian case study

MARC Report N° 5 :
Monitoring tropical forests : a review with special reference to Africa

In Preparation

Air quality

Atmospheric halocarbon concentrations from denitrification processes on land surfaces

Satellite remote sensing for environmental monitoring programs

Species transported by man - a different kind of pollution

The role of environmental monitoring in the ecological management of wildlife conservation areas

Regional monitoring needs : Spain

Regional monitoring needs : Nigeria

Environmental monitoring and assessment : the institutional structures in some West African countries

The dose commitment concept in relation to the environmental control of stable compounds

Assessment of dose commitments from an atmospheric point source

Air concentration and deposition rate from uniform area sources

The dose commitment concept applied to environmental monitoring and assessment

Cadmium and zinc : a study of their transport and relationship in the environment

Heterogeneity with special reference to lead in relation to the dose commitment concept

Suggestions for the global monitoring of heavy metals in the freshwater environment

Regional application of the dose commitment concept - suggestions for management of mercury in a river system

Historical monitoring for heavy metals in biological material

Restrospective trend analysis of the content of U.K. air particulate material; 1957 - 1974.

These MARC Publications are available from :

The Monitoring and Assessment Research Centre (MARC)
Chelsea College
The Octagon Building
459 A Fulham Road
LONDON SW 10 OQX
U.K.

Project 7. COMMUNICATION OF ENVIRONMENTAL INFORMATION AND SOCIETAL ASSESSMENT AND RESPONSE

Scientific information, which ultimately finds its way into the domain of public awareness and action, often arrives there in an irregular fashion with unpredictable consequences. Threats to human health and well-being as reported by scientists can sometimes lead to reactions bordering on panic for reasons which are inadequately understood. There is clearly a need for investigation of the communication and use of scientific information on environmental risks, the nature of individual and societal responses, and of the factors that may affect both. The key policy issues which arise may also be analysed in terms of the consequences of particular choices of action.

The objective of Project 7 is :

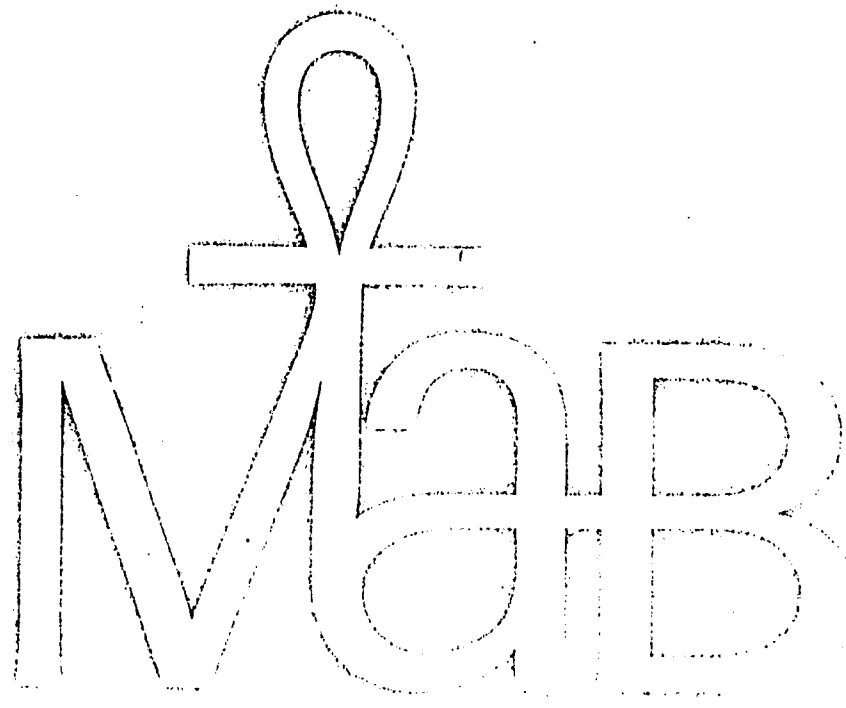
1. to prepare reviews identifying the current knowledge of the communication of environmental information and the assessment and response of society as a guide to scientists and decision-makers on the use of information;
2. to analyse the related policy and legal issues to provide a basis for the formulation of recommendations to national governments, international agencies and non-governmental organizations.

A first review, "Risk Assessment of Environmental Hazard", is in press as SCOPE 8 (1977). This report provided a basis for a major "international working seminar on environmental risk assessment in an international context", held in Hungary in June 1977. The proceedings are to be published.

The Project Chairman is :

Professor Ian BURTON,
Institute for Environmental Studies,
University of Toronto,
Toronto, Ontario,
Canada

Unesco



Programme on Man and the Biosphere (MAB)

Expert consultations on Project 10: Effects on man and his environment of major engineering works

Final Report

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S Y N O P S I S

In recent decades, the rate of construction of large engineering works - as well as the scale of their impact - has accelerated markedly. Major engineering works - such as river basin projects and new communication routes - are favoured instruments of development, and can result in considerable economic and social benefit to the peoples of the countries concerned. However, the anticipated levels of benefits of particular engineering schemes have sometimes proven illusory, in part because the environmental and social costs attendant with any such scheme were either ignored or not anticipated.

Substantial efforts have in consequence been directed in recent years to recording the side-effects of particular engineering schemes. The perspectives that are generally brought to bear in management evaluations have also been broadened, and some quite sophisticated techniques of evaluation have been developed. There has been more general appreciation of the complexity of the conflicts which are implicit in most development actions which affect the quality of the environment and the use of natural resources. The importance of different time frames of concern and reference has become widely acknowledged.

In spite of the progress made in these fields, there remain severe weaknesses in present techniques for assessment and prediction of the effects of engineering works. While the primary effects of an engineering scheme can usually be predicted with an acceptable degree of probability, the secondary and tertiary effects remain obscure and subtle. These effects may, however, affect society more profoundly than the primary effects. A major need therefore is to improve current methods of evaluation, so that the planning process may become more sensitive to social and environmental issues and more responsive to community concerns than is possible with conventional cost-benefit analyses. In particular, evaluation of the likely consequences of a given scheme should deal not only with costs and benefits that can be quantified precisely in monetary terms, but with a full range of other impacts, such as health, amenity and safety from hazards.

Improvement of decision-making on the construction and design of large engineering works calls for better understanding of the decision-making process itself, and of the various interest groups involved in this process. In addition, there is need to develop and apply improved operational procedures of impact assessment. The quality and quantity of available ecological data should also be increased, and better use made of these data. It is here that the MAB Programme has a role to play and a function to fulfil.

One of the fourteen international themes of the Programme - MAB Project 10 - is specifically addressed to study of the effects on man and his environment of major engineering schemes. MAB Project 10 is an "integrative" project which is concerned with an impact of major importance in many parts of the world, an impact which has major repercussions on both the natural environment and human populations over very extensive areas. It provides a focal point within the Programme for discussion on the types of assessment and prediction approaches that can be applied to study of the social and environmental effects of major land development schemes. Project 10 is not concerned with operational procedures and administrative frameworks for environmental impact assessment. It does, however, provide a focus for viewing relevant MAB research on changing man-environment relations within the broader context of formalised assessment procedures and of the increasing use of environmental impact statements as an integral part of the evaluation of proposed development projects.

The main objective of MAB Project 10 is to contribute to the body of methods, criteria and knowledge that is currently demanded by many development agencies in

the field of pre- and post-construction evaluation of engineering works, and other related land developments. The actual implementation of MAB research on the environmental effects of engineering works should, however, be centred on the various geographic projects of MAB. Within these projects analysis should be made of the effects of engineering works and other types of human activity on the environment and on man, considered as an adaptive and biological entity as well as an economic, social and cultural being.

There is, in brief, a need to launch integrated, co-operative studies which have economic, social, cultural, biological and physical dimensions. Two particular approaches are recommended. Firstly, MAB National Committees might usefully explore the possibilities of undertaking post-audit assessment - or hindsight evaluation - of one or more major engineering works, the construction of which was completed some years ago. Secondly, efforts should be made to promote in-depth monitoring and assessment of the effects on the natural environment and on human populations of particular engineering works. This might usefully be approached through concentrating a long-term integrated research effort on a discrete development land unit in which a major engineering scheme is envisaged.

At the same time as new research is undertaken for improving current evaluative techniques, better use should be made of existing information. Case studies should be documented on a regional basis, and guidance material on environmental impact assessment should be prepared for use by planners and resource managers.

Statement of

Richard A. Carpenter
Executive Director
Commission on Natural Resources
National Research Council

before the public hearings of the

Council on Environmental Quality

June 8, 1977

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Dr. Gilbert F. White, Chairman of the Environmental Studies Board of the Commission on Natural Resources within the National Research Council has asked me to represent the Board in these hearings. The ESB is concerned with the foundations upon which assertions can or cannot be made as to prospective changes in natural systems as a result of human perturbations. The Environmental Impact Statement mandated by NEPA has generated a requirement for exhaustive information about the structure and functions of ecosystems. In my view, the EIS has been a procedural success, but a substantive failure.

The success is characterized by the opening up of the decision-making process, the provision of information to all participants and affected parties, and the insistence on a consideration of diverse impacts and reasonable alternatives. The EIS has drastically changed the ways of bureaucracy for the better. This is true despite some misuse of the law to delay decisions and the sheer volume of some EISs that is an impediment to their usefulness.

The failure is characterized by the lack of content. I have identified ten specific problems with EISs today; there are undoubtedly more.

1) There is little baseline information. We have no "national ecological survey" analagous to the geological survey or soils survey.

2) Organisms are counted and species are discussed but rarely are habitats or ecosystems described.

3) A predictive capability is lacking in ecology so that the consequences to the environment from alternative actions cannot be forecast.

4) Models are inadequate for long time spans or for large areas.

5) Monitoring information lacks continuity and certainty. Good statistical design is not practiced.

6) There is no retrospective evaluation of projects and their ecological consequences in order to check the validity of whatever predictions are attempted.

7) EISs constitute a "grey literature" of unreviewed and unvalidated science that may be erroneous and incomplete (Schindler, Science, 7 May 1976) and is given unwarranted credibility.

8) The statements are often inconsistent with one another and are noncomparable as to format.

9) They are often prepared by second-rate scientists who are attracted into the field by funds available for EIS preparation but who would not be competitive for research grants or contracts.

10) There is little permanent scientific gain in the preparation of these statements and large sums are diverted from research.

These deficiencies diminish the credibility of decisions that are supposed to be based on the EISs and lead to continued controversy about the environmental values that are at stake.

What should and can we do to increase the scientific basis of environmental management? First and simply, we have to get on with long-range research on ecosystems, biogeochemical cycles (such as carbon, nitrogen, sulfur, phosphorous), and the work that is needed to establish principles of ecology; we have to have a commitment by government. Should that be through a special legislative mandate of some sort to the Environmental Protection Agency?

EPA has quite properly used the research support that it has had for regulatory decision making; that is its business. It does not have the responsibility for pushing back the frontiers of knowledge in environmental science. The reorganization plan that created EPA transferred a mandate (of NEPA) for ecological research from CEQ into the new agency. CEQ was not an operating agency and it was thought that that function would better be discharged by EPA. EPA has not been able to secure funding and has not sought to implement that specific activity, which was at least one place in law where the Congress clearly said, "We want to do more ecological research."

This research should be separated from the necessary scientific activity that supports regulation. In part, this is so because of the "fire fighting" that goes on constantly in these mission-oriented activities. Researchers complain about fire fighting, but in my mind, they really love it. Fire fighting increases the apparent importance of their jobs. "I was called off to work on Kepone; I was called off to help with the such and such bill." And, it is a handy excuse for not accomplishing the research that they were assigned in the first place.

My final suggestion comes from the recognition that, in a peculiar way, the academic and other non-government scientists have not been adequately involved in this governmental, regulatory mission that requires new ecological information. There have been tight time tables, a confusion of agencies, an absence of focus and coordination in the federal government. It is difficult to find out where to send unsolicited research proposals. Funding has been closely attached to missions rather than to this kind of research. We have had little environmental science leadership in government to look to. So, in a sense, there has been a detachment and disinterest in the academic community; there were other things to do and there were other attractive colors to paint proposals than the green of EPA.

I think that we have to work hard on both sides to build close contacts between the scientific community and the CEQ and the EPA. They

are relatively new on the scene, and do not have the history of close association that the defense department or NIH has had with the science and engineering community. We need to look at the good things that happened to build up that useful closeness; e.g., research and training linked together in grants, block grants to support centers of excellence, more involvement of the scientific community in agency planning, and peer review. These are self-serving statements for science but we just have to keep making the case for more ecological research dollars as forthrightly and as clearly as we possibly can. Better management of the environment and natural resources depends on greater understanding of ecosystems and that can come only through competent scientists adequately supported in fundamental research.

Objective and Subjective Judgements in Environmental Impact Analysis

by

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The present paper is based on the premise that the analysis of environmental impacts requires both objective and subjective judgements at almost every stage, and that if these two types of judgements are confused in the mind of the analyst, or in his final product, then the effectiveness—and even the credibility—of his work will be seriously compromised. In order to aid the analyst in these distinctions, the present paper will discuss the types of objective and subjective judgements that must be made at each of the steps taken in arriving at the final analysis.

For the purposes of this paper, *objective judgements* are those which involve or use facts that are observable or verifiable—especially by scientific methods—and which do not depend on personal reflections, feelings, or prejudices. This does not suggest that knowledgeable persons will always make the same objective judgements. There is much disagreement among scientists and other scholars on important points of theory and interpretation of verifiable data. Thus objective judgements may indeed be different and still be objective. In these cases, however, there is a danger of subjective considerations slipping in as will be discussed later.

On the other hand, *subjective judgements* are those which are made on the basis of values, feelings, and beliefs. They generally vary widely from person to person, group to group, institution to institution, and society to society. Subjective judgements can be changed, but this requires a change in the underlying values of the party that is making the judgement; objective judgements, conversely, can be changed by the simple introduction of new objective data or acceptable interpretations. With respect to environmental impacts, the objective judgement describes the impact (for example, the number of fish that would be killed under certain circumstances) whereas subjective judgements are made with respect to how people feel about that 'fact' (for example, one citizen may not care at all while another, who enjoys fishing, may be extremely upset).

In an effort to help scientists and analysts to avoid this outcome, this paper will discuss some of the objective and subjective judgements that must be made in the following major steps of predicting, analyzing, and judging, environmental impacts:

- Identifying Major Activities
- Selecting Environmental Components
- Selecting Types of Impacts
- Assessing the Possibilities and/or Probabilities of Occurrences
- Determining the Degree of the Impacts
- Determining the Time-frame of Impacts
- Designating Impacts as Positive, Neutral, or Negative
- Determining Trade-offs among Activities and Impacts.

Selecting Environmental Components

The selection of those components of the environment that will be considered in the impact analysis is critical. These choices will determine the boundaries of concern about an activity and thus to a large degree determine the very nature of the problems and any potential solutions. There is essentially an infinite list of objectively determinable environmental components and ways of defining relationships among them. Once again, the thoroughly objective analyst will have a never-ending task of listing the components that could be considered in the analysis. Subjective judgements must be introduced in such a manner that

only 'important' components and relationships are singled out for detailed analysis. The decision must also be made on how 'environment' is to be defined: for example, whether it will include social as well as natural components and relationships.

The concept of 'importance' implies a set of value-judgements that must be made relative to something, and that are made by a person or group holding those values. Whose values are to be used in setting these criteria for selection—the local conservation group, the multinational corporation, the tourist industry, the government, or some other interested or disinterested parties? The list of 'important' components will vary from group to group, and the reasons for listing the same components may also vary (thus a species of fish may be listed by commercial fishermen and by conservationists for widely opposing reasons).

The analyst must somehow decide whose values he will accept for purposes of deciding which environmental components to consider, and whose he will reject. He should explicitly specify whatever criteria he chooses in making these critical choices—whether they are based on social, political, or ecological, grounds or on his own personal or institutional biases. When once this has been done, his analysis is no longer an 'objective analysis' but an analysis in which objective determinations are made within the context of subjectively-chosen parameters. Thus even one of the most 'scientific' of all the steps—selecting environmental components—is ultimately based more on values than on science, if one is to have a manageable list for analysis. When once these selections have been made, the earlier relationship becomes the following: Σ (Activities)$_i$ + $\sum_n$ (By-products)$_j$ $\rightarrow$ Impacts on $\sum_p$ (Environmental Components)$_k$.

Selecting Types of Impacts

For any given component of the environment that is affected by some activity or by-product, there are a wide variety of types of impacts that could be considered. For example, if a certain species of plant or animal is affected, then is the impact listed only if the species is eradicated, or if its numbers are reduced below a certain level (what level?), or if its general health or well-being is affected (how much?), or if the impact on the species creates another set of impacts on other species or on biological, geological, chemical, or social, processes—and so on?

The identification of the types of impacts—such as extinction, mortality, morbidity, and instability—for any component, is an objective process. But here again the analyst is overwhelmed with the theoretical length of such a list, as was the case in the previous steps. In addition there is a new and profound difficulty—the state of scientific understanding is very poor with respect to the types of impacts that are possible, and to their ramifications on related parts of the environment. This situation has not improved at all markedly since a group of prestigious scientists on the National Science Board (1971) reported the following to the President of the United States as their 'principal conclusion':

> 'Environmental science, today, is unable to match the needs of society for definitive information, predictive capability, and the analysis of environmental systems as systems. Because existing data and current theoretical models are inadequate, environmental science remains unable in virtually all areas of application to offer more than qualitative interpretations or suggestions of environmental change that may occur in response to specific actions.'

The necessity of reducing the list of impacts to those of 'importance', coupled with the limitations of the scientific community to provide guidance on the implications of many impacts, forces the analyst to make innumerable subjective judgements. When objective facts are lacking, he must rely on the only things available—values, feelings, beliefs, and prejudices. It is useless to debate whether he should do this, for he has no choice if he is to proceed with what information he does have and make decisions on how to allocate resources to supplement his information in carefully selected areas. There is, however, an important question of whose values and biases he adopts for purposes of this selection process, and how explicit he is about these choices in his report. The issue is not whether he makes subjective judgements but the degree to which he recognizes *when* he is doing it, his basis for doing it, and his responsibility to make these explicit in his analysis.

The principal subjective judgements that must be made are with respect to the following: What types of damage or enhancement of *each specific* environmental component will be noted (for example, the spectrum from extinction to inconvenience, or from irreversible process to self-correcting perturbation); how much damage or enhancement to *each specific* component will be considered 'important' enough to require a full analysis (for example, the extinction of tunas *versus* Peregrine Falcons, or the general reduction in health of a city *versus* that of a seal colony, or a few per cent yearly change in local precipitation *versus* a few degrees steady-state change in global temperature); and finally, and very profoundly, what types of second-, third-, and fourth-order effects of the primary impact will be considered and how much creative energy will be devoted to identifying these. The following example illustrates this last point: one activity of a new plant in a community might be to create new jobs which could have a 'primary' impact of changing the material standard of living in the community; this might then result in a change in the dominant life-styles, which in

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turn could result in an influx of different types of people, thus creating changes in ethnic and religious groupings which could then begin changes in the cultural fabric of the community—and so on.

The compilation and analysis of the objective data that exist on impacts, and the application of the types of subjective judgements discussed above, combine with the previous steps to produce the following relationship:

$$\sum_{n} (\text{Activities})_i + \sum_{m} (\text{By-products})_j \rightarrow \sum_{o} (\text{Impacts})_k$$
$$\sum_{p} (\text{Environmental Components})_l$$

This relationship is useful in illustrating how complex the analysis is, especially if the summation totals—n, m, o, and p—are very large. The only way that they can be kept small is by making numerous subjective judgements, using such criteria as 'major' or 'important'. If an analysis that is not absolutely comprehensive in its coverage of a complex environmental 'problem' claims to be objective, then it is probably either being misrepresented wilfully or unknowingly or else the analyst is so in tune with the values, mores, and preferences, of the recipients of the analysis, that both writer and reader share and accept the same implicit subjective constraints on what is to be analyzed objectively. Such a state of harmony is rare among concerned parties who scrutinize analyses of most environmental issues.

SUMMARY

Analyses of environmental impacts, and descriptions of methodologies for conducting them, have not always been explicitly cognizant of the subjective value-judgements that must be made in the process of collecting, refining, assessing, and presenting, objective scientific information. This paper has outlined the types of objective and subjective judgements that are made in each of the following major steps of the analysis: identifying major activities; selecting environmental components; selecting types of impacts; assessing the possibilities and/or probabilities of occurrences; determining the degree of the impacts; determining the time-frame of impacts; designating impacts as positive, neutral, or negative; and determining trade-offs among activities and impacts.

The subjective judgements that must be made are based on values, feelings, beliefs, and prejudices, and are functions of the personal, institutional, professional, and societal, contexts of the analyst. If great care is not taken in making these judgements, and in making very explicit the value-framework used, the effectiveness and credibility of the analyst may be sharply reduced. There is also the danger that society and its decision-makers will be presented with an analysis having so many built-in biases that the legitimate role of the decision-makers in assessing the analysis and then making important value trade-offs is seriously compromised. This paper has attempted to make the nature of the process of analysis explicit with respect to the introduction and treatment of values, so that these problems can be understood and, it is hoped, properly managed by both scientists and decision-makers.

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TWO ROLES OF ECOLOGISTS IN DEFINING AND DETERMINING THE ACCEPTABILITY OF ENVIRONMENTAL IMPACTS†

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A framework is presented for defining the environmental impact of a project on an ecosystem. An 8-step decision tree is introduced which leads to operational definitions of unacceptable and acceptable impacts. Within this framework, two roles ecologists play in the field of environmental impact assessment are considered: (1) To supply scientifically sound and objective predictions of the potential impact of a project on an ecosystem, and (2) to reach conclusions, based on his own value system, concerning the acceptability of the predicted impact.

I. INTRODUCTION

In the wake of public awareness and concern about "ecology" during the late 1960's, a number of laws, such as the National Environmental Policy Act[1] of 1969 (NEPA), were enacted. While the effects of such laws involve scientists and laymen from a variety of professions, certain specific consequences are of particular interest to professional ecologists as individuals and to the ecological profession as a whole. In particular, a demand has been created for a substantial number of ecologists to collect and analyze data, to write Environmental Reports and Environmental Impact Statements, and to participate in adjudicatory proceedings as "expert witnesses."[2,3] Such ecologists cannot help but become acutely aware of the limitations in the "state of the art" of impact assessment and of the role of value judgments when they are asked to play substantive roles in a decision-making process which stands at the controversial interface between industrial or economic progress and environmental protection. The validity of the "environmental predicament" delineated by Bella *et al.*[4] is reinforced with each new impact assessment:

> Man's ability to modify the environment will increase faster than his ability to foresee the effects of his activities . . . (or) to anticipate his changing environmental needs.

As a framework for discussing some problems faced by an ecologist in the field of environmental impact assessment, we will consider the following four topics: (1) conceptual criteria for defining environmental impact; (2) gradients associated with assessing environmental impacts; (3) derivation of a scalar index summarizing the total environmental loss or gain associated with a project; and (4) a decision tree leading to operational definitions of unacceptable and acceptable impacts on an ecosystem. Within this framework, which we feel reflects the way the present environmental impact assessment system operates, two roles that ecologists play are discussed.

To some extent, the concepts presented are the result of the authors' involvement with the process of impact assessment. Our perspective is based largely on assessments, carried out for the Nuclear Regulatory Commission as required by NEPA, of the environmental impact of nuclear power plants. Three caveats are in order. First, the impact assessment process differs somewhat for other regulatory agencies, such as the U.S. Environmental Protection Agency, where there is a greater relative reliance on regulatory criteria than on benefit-cost or benefit-risk analyses. Second, the mathematical formalism developed in this paper is intended to facilitate communication of our ideas more concisely and precisely than is possible with prose alone; it is not intended to be of practical value in obtaining numerical answers. Third, numerical limits for environmental impacts based

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on, for example, number of fish killed, percentage reduction in a fish population, or decrease in species diversity indices, are neither proffered nor discussed.

The ideas developed in this paper are based on the conceptual framework originally presented in Christensen *et al.*[5] Since that paper our thinking has been stimulated and has evolved in response to discussions with colleagues and to other papers presented at the Workshop on the Biological Significance of Environmental Impacts held at Ann Arbor, Michigan, June 4–6, 1975.

II. CRITERIA FOR DEFINING ENVIRONMENTAL IMPACT

A clear understanding of what is meant by the term "impact" is fundamental to the assessment of a project. Ideally, both the definition and the assessment of impact should be at the ecosystem level, and they should involve all of the structural and functional parameters important in characterizing the ecosystem. The impracticability of this approach can be ignored to an extent in conceptually defining impact.

An ecosystem can be represented as an N-dimensional space in terms of N state variables which define the state of the ecosystem potentially affected by the proposed project. These variables would represent structural or functional biological parameters (e.g., numbers of individuals of each of many species, or biomass of each trophic level), and physical and chemical parameters (e.g., hydrogen sulfide concentration). The N state variables without the project, each a function of time (t), can be denoted as $x_1(t), x_2(t), \ldots, x_N(t)$. $\mathbf{x}(t)$ then can be defined as the vector denoting the state of the ecosystem at a fixed point in time without the project. We can also define a similar vector to represent the state of the ecosystem, but this time with the project. The state variables in this case now can be denoted $y_1(t), y_2(t), \ldots, y_N(t)$, and they define a vector $\mathbf{y}(t)$ at any fixed point in time.

It is now possible to provide definitions for no impact, for a reversible impact, and for an irreversible impact using the above characterization of an ecosystem as a point in an N-dimensional space.

a. No Impact

$$\mathbf{y}(t) - \mathbf{x}(t) = \mathbf{0}(t) \pm \delta(t), t > C \qquad (1a)$$

where C is the starting time of construction of the project and δ is a vector of deviations from zero to be discussed later. Alternatively,

$$\lim_{T\to\infty} \int_C^T [\mathbf{y}(t) - \mathbf{x}(t)]dt = \mathbf{0} \pm \delta \qquad (1b)$$

In words, the project is forecasted to have no impact on the ecosystem if, at all times after start of construction, the difference between the predicted state of the ecosystem with and without the project is close to zero.

b. Reversible Impact

$$\mathbf{y}(t) - \mathbf{x}(t) = \mathbf{0}(t) \pm \delta(t), t \geq D + \tau \qquad (2a)$$

where $D + \tau$ specifies a time interval (τ) after the project is decommissioned at time D. Alternatively,

$$\lim_{T\to\infty} \int_{D+\tau}^T [\mathbf{y}(t) - \mathbf{x}(t)]dt = \mathbf{0} \pm \delta \qquad (2b)$$

In words, the project is forecasted to have a reversible impact on the ecosystem if, at all times starting from some fixed time after the project is decommissioned, the difference between the predicted state of the ecosystem with and without the project is close to zero.

c. Irreversible Impact

Failure to satisfy Eq. (2a) or (2b). In words, the project is forecasted to have an irreversible impact on the ecosystem if, at all times starting from some fixed time after the project is decommissioned, the difference between the predicted state of the ecosystem with and without the project is not close to zero.

III. GRADIENTS ASSOCIATED WITH ASSESSING ENVIRONMENTAL IMPACTS

The above definitions have been couched in terms of the total ecosystem, although it is doubtful if an analysis of this type could be made on an ecosystem larger than that of Teal,[6] who studied a spring approximately $3m^2$ in surface area. Since impacted or potentially impacted ecosystems are generally very much larger than Teal's, some compromise must be made.

In determining what compromises are needed, it

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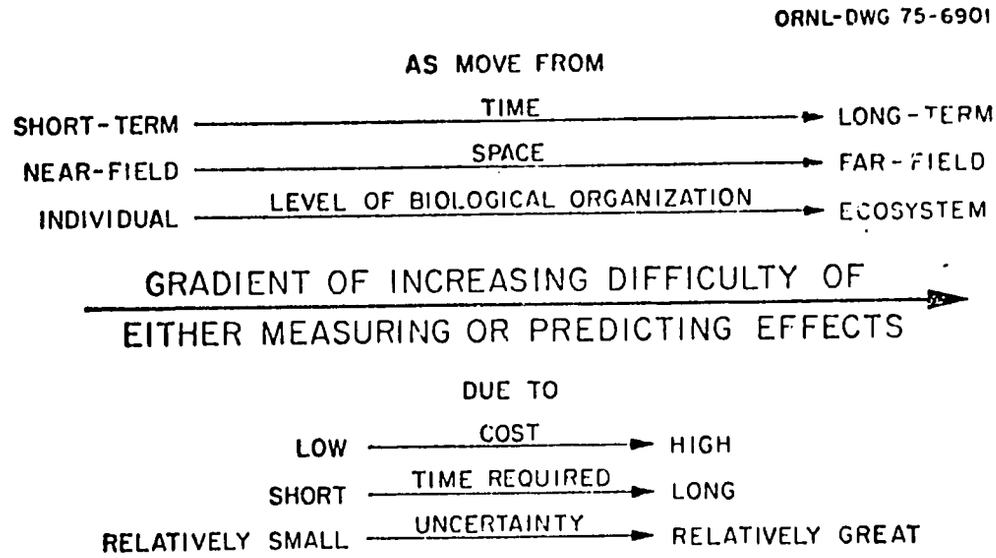

FIGURE 1 Gradients associated with analyzing impacts.[5]

is helpful to recognize certain gradients of difficulty in the process of assessing impacts, as illustrated in Figure 1 and discussed by Christensen *et al.*[5] Although the direct impact of a power plant on an ecosystem will be manifested as short-term, near-field effects on individuals of many species, impact assessment at the individual level alone is not adequate. Even estimates of annual percentage mortality suffered by a population would be of limited value (except at the extremes), unless these estimates were related to the potential, longer-term impact on the population. A logical way to analyze an impact, then, is to begin at the left-hand side of the gradients for time, space, and level of biological organization (Figure 1), where the impact will be most amenable to prediction via the quantitative application of laboratory and field studies, and to proceed as far to the right as data, time and money will allow. However, because only limited information is available concerning community and ecosystem effects in field situations, the population level will commonly be the focus of an assessment. The winter flounder population in the vicinity of Millstone Point, Connecticut[7] and the striped bass populations which spawn in the Chesapeake and Delaware Canal[8-10] and in the Hudson River[11-16] are examples of populations which have been the subject of impact assessments at the population level.

IV. DERIVATION OF A SCALAR INDEX SUMMARIZING THE TOTAL LOSS OR GAIN IN VALUE OF THE ECOSYSTEM

The term "significance" is frequently used in impact assessment. However, as discussed in a previous paper[5] the term is commonly used without clear definition. One common tendency is to conclude that an impact is acceptable because it will not have a "significant" adverse impact, while in fact the conclusion is unconsciously predicated on the benefits of the project. In reality, society may judge that a project is acceptable in spite of its having an impact that many people would consider "significant." We feel that for clarifying the process of impact assessment and the roles of ecologists, an operational definition of the terms "acceptable" and "unacceptable" (see below), divorced from a consideration of "significance", is most useful. In our opinion, to claim an impact is acceptable or unacceptable requires a value judgment. An ecosystem cannot make value judgments and cannot tell us when an unacceptable impact has taken place. Thus, a value judgment must be made about what constitutes an unacceptable impact and what to do about it.

To clarify this problem, we propose a vector of weighting functions, w. Each element of the vector, w_j, converts predicted changes in ecosystem sta

variable "j", $\left(\text{i.e., } \lim_{T\to\infty} \int_C^T [y_j(t) - x_j(t)]dt \right)$ to common units of value (e.g., energy[17] or dollars) lost or gained. Thus, the total predicted change in the value of the ecosystem (V) may be calculated by summing the products of the predicted change in ecosystem state variable "j" times its corresponding weighting function over all "j's", i.e.,

$$V = \mathbf{w}^{Tr} \lim_{T\to\infty} \int_C^T [\mathbf{y}(t) - \mathbf{x}(t)]dt \qquad (3)$$

where

$\mathbf{w}^{Tr}$ = transpose of the vector of weighting functions.

A negative value of V indicates an overall loss in value of the ecosystem, while a positive value of V indicates an overall gain in value of the ecosystem. Shugart[18] discusses similar "suitability" indices for the ecological evaluation of alternative implementations of a project.

The above formulation does not take into consideration the fact that environmental impact assessments commonly involve more than two parties (e.g., applicant, regulatory agency, and intervenors). The very presence of intervenors on environmental issues indicates that the parties are not in agreement on the predictions of changes that may occur in the ecosystem, on the values to be assigned to the predicted changes in the ecosystem, on the benefits of the project, or all three. However, Eq. (3) is easily modified to reflect that both the vector of predicted changes in the ecosystem state variables and the vector of weighting functions may differ among the parties by letting the subscript "i" denote party "i". Then, Eq. (3) may be rewritten as:

$$V_i = \mathbf{w}_i^{Tr} \lim_{T\to\infty} \int_C^T [\mathbf{y}_i(t) - \mathbf{x}_i(t)]dt \qquad (4)$$

Three points merit discussion. First, all the weighting functions are assumed to be scalar-valued with a common range, e.g., energy[17] or dollars. Thus, V_i is a scalar which summarizes in a single number the total loss or gain in the energy or dollar value of the ecosystem due to the environmental impact of the project from the viewpoint of party "i". This procedure does not permit straightforward treatment of considerations that are difficult to assign a strict energy or monetary value, such as aesthetics and a belief in the value of preserving and conserving the natural environment. Second, the value of each of the V_i's from Eq. (4) would be that estimated at a particular time, namely, the time of the public forum or adversary licensing hearing for the project in question. At a later time it is not unreasonable to expect that the predicted impacts and/or the weighting functions for one or more of the parties may change.[19–21] However, in terms of hearings and the decision-making process, what is relevant is the current position of each party. Third, as indicated by the formulation of Eqs. (1) to (4), it is the deviation between the state of the ecosystem with and without the project which is of primary concern in assessing the environmental impact. This approach necessitates establishment of a reference point without the project for comparison at each time (t) following initiation of the impact. The problem involved with this procedure and the subsequent ramifications for impact analysis are considered in detail by Christensen *et al.*[5]

V. A DECISION TREE PROVIDING OPERATIONAL DEFINITIONS OF ACCEPTABLE AND UNACCEPTABLE IMPACTS ON AN ECOSYSTEM

Operational definitions of acceptable and unacceptable with regard to a given environmental impact can be given by means of a decision tree (Figure 2). In this decision tree answers to questions lead one dichotomously through a series of decisions, ultimately leading to acceptance or rejection of the project. A project which is rejected, or one which is not accepted without an alternative design or mode of operation, can be said to have an unacceptable impact on the environment.

A brief discussion of each of the decision points will lead to a clarification of the range of issues involved in attempting to determine the acceptability of an impact. The ordering of the decision points in Figure 2 may not correspond to the order in which they are considered in any given assessment. In particular, Decision Point 4 (dealing with environmental legal standards and regulatory criteria) might be considered first. A similar, although less specific, decision framework has been proposed by Gros *et al.*[22] involving a systems analysis approach to nuclear facility siting. Our decision tree reflects our perception of the methodology of environmental impact assessment, i.e., the way the system appears to operate.

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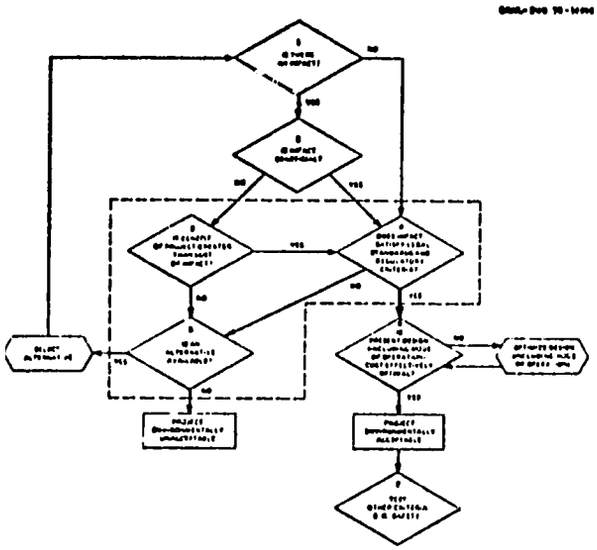

FIGURE 2 Decision-tree for determining the acceptability of a project with respect to its impact on an ecosystem. The dashed box indicates the region where the project may be rejected for lack of a suitable alternative. The heavy arrow leaving the dashed box shows the point at which the project is assured of eventual environmental acceptability (although further changes may still be needed) (modified from Ref. 5).

1) Is there an impact? This is defined by Eq. (1). Value judgments are involved, since a decision is required as to the magnitude of the deviation (δ) which would still be considered to satisfy the equation.

2) Is the impact of the project on the ecosystem beneficial? This decision point reflects that the decision process differs for beneficial as opposed to adverse impacts. A predicted beneficial impact would be indicated by a positive number for V_i in Eq. (4) for all or most of the parties.

3) Is the benefit of the total project greater than the cost of the impact on the ecosystem? This comparison involves both quantitative (e.g., energy and dollars) and qualitative (e.g., preservation and conservation ethnic) considerations.

4) Does the project satisfy environmental legal standards and regulatory criteria? Relevant laws, such as NEPA[1] and the Federal Water Pollution Control Act Amendments of 1972,[2,3] contain qualitative or quantitative goals relating to maintaining or enhancing environmental quality, consistent with other national priorities. Decision Point 4 recognizes these standards and criteria and must at least be considered even if it is judged that there is no impact (Decision Point 1) or that the impact is beneficial (Decision Point 2). As our knowledge of the effects of impacts on an ecosystem improves, we can expect to see this increased knowledge reflected (albeit with an unfortunate lag-time) in more realistic environmental legal standards and regulatory criteria.

5) Is an alternative to the project available? At this decision point, if reached, lack of alternatives results in project rejection. Selection of alternatives recycles project consideration through the decision tree starting with Decision Point 1.

6) Is the present design (including mode of operation) cost-effectively optimal with respect to minimizing the damage to or enhancing the value of the ecosystem? This decision point reflects the fact that there is a potential value (measured in energy, dollars, or qualitatively) in minimizing adverse effects or enhancing the environment even though an impact may be acceptable otherwise. Most adjudicatory proceedings appear to focus on this decision point. In the case of projects which have already been constructed but which have not yet received all the necessary licenses and permits,[14] the decision-making process will commonly focus on Decision Point 6.

7) Decision Point 7 is included to clarify that only the impacts of the project on the ecosystem have been considered up to this point. Other impacts (e.g., socioeconomic impacts or costs and safety) need to be considered, and a final benefit-cost comparison (including the costs of these other impacts) needs to be made.

The above decision tree suggests criteria to apply in assessing environmental impacts and in making management decisions. However, we do not mean to imply that these criteria can be formally invoked in the decision-making process. It is essential to note that value judgments [e.g., the vector of deviations (δ) in Eqs. (1) and (2) and the vector of weighting functions (w) in Eqs. (3) and (4)] are involved in a number of the steps of the decision making process (Figure 2). Such value judgments on the part of professionals in various disciplines will always be a necessity in the field of impact assessment, regardless of advances in the "state of the art" of ecosystem analysis.

In particular, value judgments are involved at Decision Points 3 and 6. It is at these decision points that the following matters are generally considered: (a) reversible [see Eq. (2)] versus irreversible adverse impacts;[5] (b) regional versus project-by-project impact assessment;[5] (c) main-

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tenance of environmental diversity and future options;[4,5] and (d) decision making in the face of uncertainty and a shifting time-perspective of values.[19,20,24,25]

VI. TWO ROLES FOR ECOLOGISTS

The ideas developed in the preceding sections provide a framework within which to discuss two roles ecologists (and scientists in general) play in the field of environmental impact assessment. Auerbach[26] implied similar dual roles for ecologists, while Hollander[27] discussed similar roles (researcher and citizen-professional) for scientists in general.

First, ecologists have a responsibility to supply scientifically sound and objective predictions of the potential impact of a project on an ecosystem, i.e., a vector of predicted changes in the ecosystem state variables for Eq. (4). Better fulfilling this role requires both basic and applied research directed at better understanding and forecasting the dynamics of entire ecosystems and the important components of ecosystems.

Since it is not practical to make predictions of the impact for each ecosystem state variable, the professional ecologist, given constraints of cost, time and uncertainty, bears a responsibility in selecting the temporal scale, the spatial-scale, and the level of biological organization (see Figure 1) to be used in assessing the environmental impact of the project.[24,28] For example, the ecologist may proceed by carrying out a detailed assessment of the potential impact for several representative and important species (RIS)[29] or for groupings of species that are important in the functioning of the ecosystem.[30,31] Since the assessment of environmental impact involves forecasting effects, the ecologist has an obligation to predict effects quantitatively (at least with respect to direction and order of magnitude) by means of past experience, simulation models, and or his intuition and judgment as a professional ecologist. As Shugart[18] pointed out, a valuable side-effect of variable quantification is that controversies tend to become less emotional.

In this first role, the ecologist must be wary that regulatory bodies do not transform ecological concepts and methods into rigid procedures.[2] The establishment of standard procedures and requirements is to be expected in the name of efficiency, uniformity, and ease of regulation. However, since there are unique features to each project and each site, such standardization may hinder the making of responsible decisions based on scientifically sound and objective predictions of the potential environmental impact. In this role the ecologist must also be wary of special interest groups focusing to too great an extent on a restricted set of ecosystem state variables.

Second, ecologists have a responsibility, in collaboration with professionals from other fields where appropriate, to recommend as to the acceptability of the predicted impact. These recommendations may appear in the form of a vector of "acceptable" deviations between the state of the ecosystem with and without the project [δ, see Eqs. (1) and (2)], in terms of a vector of weighting functions for converting predicted changes in the ecosystem state variables to predicted changes in the value of the ecosystem [w, see Eqs. (3) and (4)], and in terms of answers to the decision-point questions in Figure 2.

It is difficult to participate effectively in public forums or in adversary licensing hearings without playing this second role to some extent. And as Platt[32] commented:

> The less we ecologists can speak for ecology in an articulate and meaningful way, the more others will speak for us. . . .

The ecologist is commonly pressured to judge for nonecologists, such as members of a hearing board, the meaning, seriousness and acceptability of predicted environmental impacts. Not infrequently, the recommendations of an ecologist provide a major part of the basis for a decision on environmental issues.[14,33] However, in playing this second role, an ecologist must be aware, and has an obligation to make others aware, that he is offering his opinion as a citizen-professional. His recommendations are based, in part, on his own values and biases, including those of his professional discipline[24] and those of the party which he represents in the impact assessment procedure.

In summary, value judgments are inevitably involved at several points in determining the acceptability of environmental impacts. In the role of supplying predictions of the potential impact of a project on an ecosystem, an ecologist must be as scientifically sound and objective as possible. In the role of recommending as to the acceptability of the predicted impact, an ecologist should recognize that he is speaking as a citizen-professional and that his recommendations inevitably reflect his own value system.

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