PD-AAW-251

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT DATA SHEET

1. TRANSACTION CODE: A = Add, C = Change, D = Delete — Amendment Number

DOCUMENT CODE: 3

COUNTRY/ENTITY: SUDAN

3. PROJECT NUMBER: 650-0082

4. BUREAU/OFFICE: AFRICA 06

5. PROJECT TITLE (maximum 40 characters): Sudan Reforestation and Anti-Desertification

6. PROJECT ASSISTANCE COMPLETION DATE (PACD): MM 07 DD 31 YY 93

7. ESTIMATED DATE OF OBLIGATION (Under 'B' below, enter 1, 2, 3, or 4)

A. Initial FY 87 B. Quarter 2 C. Final FY 89

8. COSTS ($000 OR EQUIVALENT $1 =)

A. FUNDING SOURCE	FIRST FY 87 B. FX	C. L/C	D. Total	LIFE OF PROJECT E. FX	F. L/C	G. Total
AID Appropriated Total	2,000		2,000	8,000		8,000
(Grant)	(2,000)	( )	(2,000)	(8,000)	( )	(8,000)
(Loan)	(-)	( )	( )	( )	( )	( )
Other U.S. 1.	-					
Other U.S. 2.	-					
Host Country	-	100	100		7,500	7,500
Other Donor(s)	-					
TOTALS	2,000	100	2,100	8,000	7,500	15,500

9. SCHEDULE OF AID FUNDING ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	2. Loan	D. OBLIGATIONS TO DATE 1. Grant	2. Loan	E. AMOUNT APPROVED THIS ACTION 1. Grant	2. Loan	F. LIFE OF PROJECT 1. Grant	2. Loan
(1) ARDN	210	067		0		8,000		8,000	
(2)									
(3)									
(4)									
TOTALS				0	0	8,000		8,000	

10. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 130 066 096

11. SECONDARY PURPOSE CODE

12. SPECIAL CONCERNS CODES (maximum 7 codes of 4 positions each)

A. Code: BS

B. Amount: 5,200

13. PROJECT PURPOSE (maximum 480 characters)

1. To develop a sound information based for planning, managing, and monitoring forest resources through vegetation, mapping and forest inventories.
2. To rehabilitate land and forest resources in five Rural Council Areas of southern Kordofan through participatory forest management agro-forestry activities

14. SCHEDULED EVALUATIONS: Interim MM 05 YY 89 MM 05 YY 90 Final MM 05 YY 93

15. SOURCE/ORIGIN OF GOODS AND SERVICES: [X] 000 [X] 941 [X] Local [ ] Other (Specify)

16. AMENDMENTS/NATURE OF CHANGE PROPOSED (This is page 1 of a ____ page PP Amendment.)

17. APPROVED BY

Signature: [signature]

Title: JOHN W. KOEHRING, DIRECTOR, USAID/Sudan

Date Signed: MM 07 DD 31 YY 87

18. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION

MM AUG DD 19 YY 1987

Rec'd 8/31/87

ACTION MEMORANDUM FOR THE DIRECTOR

FROM : William M. Jeffers, REDSO/ESA Project Officer

SUBJECT : Project Authorization -Sudan Reforestation and Anti-Desertification Project (650-0082)

I. PROBLEM

Your approval is required to authorize a six year grant to the Government of Sudan (GOS), in the amount of $8,000,000. from Section 103 of the Foreign Assistance Act (ARDN), for the Sudan Reforestation and Anti-Desertification Project. The proposed FY 1987 obligation for this project is $2,000,000.

II. DISCUSSION

A. Background

The Sudan Reforestation and Anti-Desertification (SRAAD) Project is designed to support Sudanese efforts to restore and sustain agricultural production, and to rehabilitate drought-affected areas in order to halt desertification. The Project will provide support to these efforts in two ways. First, it will assist the GOS in developing more efficient techniques for collecting and evaluating data on the tree and vegetation cover in southern Kordofan and southern Darfur, two of the areas hardest hit by the recent drought. Second, it will provide technical and financial resources to support rural institutions and communities in southern Kordofan in improving the management and conservation of their existing forest resources and in expanding the utilization of trees and shrubs in their agricultural production systems.

The SRAAD Project is consistent with USAID's overall strategy in Sudan. The maintenance of existing forest resources and the development of new ones is critical for sustaining rainfed agricultural production systems - a major objective of the Country Development Strategy Statement. The Project is also responsive to the growing Agency-wide concern for improving the management of natural resources. Furthermore, the Project is structured to incorporate the experience of previous USAID investment in the forestry sector, most notably the Eastern Forestry Project with CARE, as well as to support the numerous other USAID-financed activities in the Kordofan Region.

B. Project Description

The goal of the Project is to reverse the process of desertification and declining soil productivity which have led to a decline in the agricultural productivity and income of traditional farmers in western Sudan. The dual purposes of the Project are: 1) to develop a sound information base for planning, managing, and monitoring forest resources through vegetation mapping and forest inventories in western Sudan; and 2) to rehabilitate land and forest resources in five rural council areas of southern Kordofan through participatory forest management and agroforestry activities. The SRAAD Project is accordingly designed with two components.

The Resource Inventory Component addresses the GOS's need for more objective information on the condition of forestry resources and the extent of desertification in western Sudan. Specifically, it will support production of base maps for southern Kordofan and Darfur as well as GOS efforts to utilize satellite imagery to measure and map the extent of existing forestry resources, their rate of depletion, and their regenerative capacity in these areas. This component will also support field surveys, in those areas identified as promising by the satellite imagery, to provide basic data about marketable timber, building materials, woody biomass as a source of energy, and the current limits of the Gum Belt. Finally, the component will support the translation of the collected data into management recommendations for forestry resources in the project area.

Implementation of the Resource Inventory Component will occur in two phases. The first phase, which will be limited to an area covered by six satellite images including the administrative boundaries of five specific rural councils in southern Kordofan, will test the proposed methodology and assess the level of information which will be required to improve the management of forestry resources. This preliminary phase is expected to take from 18 to 24 months. The second phase, which will proceed on the basis of an evaluation of the previous effort, will include a significantly larger area, covering all of southern Kordofan and southern Darfur.

The Resource Rehabilitation Component, will provide direct remedies for the problems of environmental degradation and desertification. The strategy for this component is to establish and develop an extension and nursery network extending from the Regional Center in El Obeid to the village communities of the five targetted rural councils of southern Kordofan. Three types of activities will be supported by this component: the establishment of nurseries, adaptive research on agroforestry interventions, and extension programs. Five nursery/demonstration centers are planned, one in each of the targetted rural councils, to provide decentralized facilities in which to carry out each of the three types of activities. A further one hundred self-help village nurseries will be supported with technical assistance and limited supplies, as a decentralized network for providing sufficient seedlings to local farmers. Extension services aimed at introducing and sustaining increased utilization of trees in traditional agricultural systems will also be supported by this component.

At the end of the Project the following results are expected:

- A system for monitoring forest resource degradation and desertification for western Sudan will be available.

- An improved data base will be available for planning in the forest sector.

- Plans will be implemented for development, conservation, and management of forest resources based upon vegetation mapping and forest inventories in five rural councils in southern Kordofan.

- Community forests will be established and managed.

2

- Management of existing forest areas and new tree planting in the five rural councils will provide increased supplies of tree products, woodfuel, poles, and improve soil productivity and conservation.

C. Financial Summary

The following table summarizes the sources and uses of project financing.

Sources and Uses of Funds
(US Dollars)

Description	USAID Contribution	GOS* Contribution	Total Project Costs
1. Technical Assistance	$4,392,667	$962,256	$5,354,923
2. Training	$121,304	$383,945	$505,249
3. Commodities	$2,211,926	$425,830	$2,637,756
4. Construction	$0	$1,135,230	$1,135,230
5. Logistical Support	$459,993	$3,794,426	$4,254,419
6. Evaluation and Audit	$95,507	$128,144	$223,651
7. Contingency	$718,603	$670,169	$1,388,772
TOTAL PROJECT COSTS	$8,000,000	$7,500,000	$15,500,000

*Note: The foreign exchange rate used in developing this budget is $US 1 = 4.1 Sudanese pounds.

D. Project Review

The project committee met on Monday, July 13, 1987, to review the Project Paper. The following issues were discussed.

- The project committee recommended that the discussion of the SRAAD Project's relationship to the proposed World Bank Forestry Project be expanded and that AID's committment to donor coordination be strengthened.

- The status of pending forestry legislation was discussed in relation to proposed project activities. While it was agreed that the proposed Forestry Act would greatly facilitate project activities, its passage was only immediately critical to the woodland management activities. Nevertheless, it was agreed to include a covenant in the Project Grant Agreement to reinforce AID's interests in the legislation.

- The project committee endorsed the decision to include commodity procurement in the technical assistance contracts provided the contractor was capable of handling the procurement. It was noted that where special circumstances warrant, AID may be required to provide direct procurement support. It was agreed that all passenger vehicles will be covered by the Africa Bureau's blanket waiver, and that separate waivers for the motorcycles and trucks would be developed.

- In terms of the technical assistance requirements for the project, the committee agreed to solicit a non-competitive waiver to employ the Regional Center for Survey Services, Mapping and Remote Sensing (RCSSMRS) to implement the Resource Inventory Component. The technical assistance requirements of the Resource Rehabilitation Component were also discussed in detail. The committee noted the need for both the relatively high levels of technical proficiency to produce plans from the data gathered by the Resource Inventory Component and the grass roots organization to provide extension support. The committee's discussion centered around what type of organization - either a Private Voluntary Organization (PVO) or a commercial consulting firm would be most appropriate to implement the project. It was agreed to send out a Request for Expressions of Interest to both PVOs and commercial consulting firms to ascertain the market for organizations to implement the project.

- The issue of salary supplements was also discussed in light of the recent AID/W guidance provided in State 173326. Salary supplements have been included in the project in the form of project related travel and per diems, as well as housing allowances for remote project sites in El Obeid. These supplements are considered essential to attract the technical and managerial staff to work in remote project sites and undertake the types of field work which is necessary to achieve project objectives. These supplements are permitted under host country law and are reasonable in reference to the employees' base salaries.

- The project committee also suggested reducing the number of proposed covenants.

E. Legal Requirements

1. Congressional Notification

The Congress was notified that USAID intends to authorize $8 million for the SRAAD Project in a separate notification. As per State 146652, the required 15 day waiting period expired without objection from Congress.

2. Availability of Funds

AID/W informed USAID/Sudan May 14, 1987 in State 146652 that $2 million of FY 1987 ARDN is available for obligation.

3. Initial Environmental Examination

USAID/Sudan requested the clearance of GC/AF and the concurrence of the Africa Bureau Environment Officer to approve a negative determination for the Project in Nairobi 00410. The Africa Bureau Environmental Officer concurred and AFR/GC cleared for a negative determination on February 3, 1987.

4. Waivers

USAID/Sudan requested a waiver of other than full and open competition for the procurement of technical assistance services from the Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Khartoum 7209. State 243450 provided approval of the Assistant Administrator for this waiver.

USAID/Sudan will request a source origin waiver for the procurement of 30 motorcycles and 1 heavy truck at a later date. All other project vehicles will be purchased under authority of the Blanket Waiver for vehicle purchases in the Sudan.

5. Conditions Precedent and Covenants

The proposed Project Grant Agreement, attached in annex to this Action Memorandum, calls for a series of CPs and Covenants requiring the GOS to a) establish a project steering committee, b) establish separate local currency accounts, c) appoint qualified personnel, d) establish an evaluation program, e) make funds available for audits, f) monitor the environmental impact of project activities, g) make land available for nurseries, and h) meet with AID and various GOS representatives prior to the end of the project to formulate plans and secure financing for the maintenance of project services and activities.

6. Certifications

Section 611(a) - The Project Paper indicates that all the technical, engineering and forward planning required to implement the project have been done and that the cost estimates in the amendment are reasonably firm.

E. Project Implementation

1. The responsible AID officer is Marion Ford, Chief of the USAID/Sudan Agricultural Division. He will be assisted by PSC forester Tahir Qadri.

F. Authority

Under Section 4A(1) of DOA 551, you have the authority to authorize a project provided that the project:

a) Does not exceed $20 million over the approved life of project;

b) does not present significant policy issues;

c) does not require issuance of waivers that may only be approved by the Assistant Administrator for Africa or the Administrator unless such waivers are approved prior to authorization; and

d) does not have a life of project in excess of ten years.

With the approval of the Assistant Administrator to waive the competition requirements to allow non-competitive procurement with the PCSSMRS, all the conditions listed above have been satisfied. DOA 551 permits you to authorize the Reforestation and Anti-Desertification Project.

G. Recommendations

That you sign the attached Project Authorization thereby authorizing $8 million in life of project financing for the Sudan Reforestation and Anti-Desertification Project.

Attachments: A) Project Authorization
B) Project Paper

Action Memo (650-0082)

Clear: AGR:M.Ford _____ : _____
PO:E.Rauch _____ : 7/22/87
CO:J.Kryschtal _____ : _____
CONT:A.Spathopoulos _____ : 7/22/87 (substance & funds available)
CMO:M.Thompson _____ : 21 July 87
EPP:B.Jensen _____ : 7/23/87
A/DD:S.Chernenkoff _____ : _____
RLA:P.Scott DRAFT : 7/16/87

Drafter: W.Jeffers/RFDSO/ESA _____ : 7-19-87

CONT:A.Spathopoulos _____ : _____ (BROOKE)

2182G

Clear: AGR:M.Ford _____ : _____
PO:E.Rauch _____ : _____
CO:J.Kryschtal _____ : _____
CONT:A.Spathopoulos _____ : 7/22/87 (substance & funds available)
CMO:M.Thompson _____ : _____
EPP:B.Jensen _____ : _____
A/DD:S.Chernenkoff _____ : _____
RLA: P Scott _____ 7/16/87

Drafter: W.Jeffers/REDSO/ESA _____ : _____
CONT:A.Spathopoulos _____ : _____ (BROOKE)

Distribution:

2182G

AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D C 20523

ACTION MEMORANDUM FOR THE ACTING ASSISTANT ADMINISTRATOR FOR AFRICA

FROM: AFR/PD, Carol Peasley C. Peasley

SUBJECT: Justification for Other Than Full and Open Competition to Obtain Technical Services through a Contract with the Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Nairobi, Kenya for the Sudan Reforestation & Anti-Desertification Project (SRAAD) (650-0082)

Problem: Your approval is required under AIDAR 706.302-70(b)(3)(i) for a waiver of full and open competition in order to award a four-year contract to the Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) in Nairobi, Kenya for required technical services and related commodity procurement under the Sudan Reforestation & Anti-Desertification (SRAAD) Project. The Mission Director cannot exercise AFR Delegation of Authority (DOA) 551 to authorize the project until the requested waiver has been approved by the AA/AFR. A $2 million FY 1987 OYB August obligation is planned.

Background: The purpose of the Sudan Reforestation & Anti-Desertification Project is: (1) to develop a sound information base for forest resource development planning and management in Kordofan and Darfur through vegetation/physiographic mapping and a forest resource inventory; and (2) to develop and test models for appropriate land use based on available resources and needs of the local population which will result in increased and sustainable supplies of food, fuelwood, charcoal, gum arabic and other forest products. The Project Indentification Document (PID) was approved by the Sudan Mission on April 27, 1987. Anticipated life-of-project (LOP) funding is $8 million.

Discussion: The SRAAD Project Paper (PP) was reviewed in USAID/Sudan and an FY 1987 authorization/obligation is anticipated. The objective of the Project is to reverse the process of desertification and declining soil productivity in Western Sudan. The resource inventory component of the project will address the Government of Sudan's (GOS) needs for reliable, quantifiable information on the condition of its forestry resources and the extent of desertification in the Kordofan and Darfur regions. During the past year, with the assistance of A.I.D. financing, the GOS was able to use remote sensing data from satellites to improve its crop yield forecasts. The introduction of this technology in Sudan has allowed Sudanese scientists and planners to reduce the gap between information acquisition, analysis and effective action.

The Sudan Mission proposes to contract with the RCSSMRS in Nairobi, Kenya as prime contractor to provide the required technical assistance for the analysis of remote sensing data and subsequent production of base maps and forest maps for the Western Sudan region. The RCSSMRS was established in 1975 under the sponsorship of the United Nations Economic Commission for Africa (ECA) to provide specialized services to the countries of Eastern and Southern Africa. The United States Government (and A.I.D. in particular) has played a major role in establishing and supporting RCSSMRS.

The Sudan Mission believes that the noncompetitive selection of the RCSSMRS to provide the technical services described above is justified on the basis that:

1. It would serve the U. S. foreign assistance objectives of strengthening regional cooperation between African countries by utilizing the services of a recognized regional African institution such as the Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS). Also, it would serve the U.S. foreign policy objective of providing support to an indigenous African institution that A.I.D. was instrumental in establishing.

2. Because of its geographic proximity to Sudan and its good institutional relationship with Sudanese organizations, the RCSSMRS would more effectively support and sustain the technical services required by the GOS both during the Sudan Reforestation & Anti-Desertification (SRAAD) Project and after its completion than other similarly qualified organizations.

3. The RCSSMRS is the only regional remote sensing facility in Eastern and Southern Africa. It is a technically sound African institution which has had extensive experience in supporting national remote sensing and mapping programs of countries in the region. In addition, it has close affiliations with several U. S. organizations involved in remote sensing and mapping, including the U. S. Geological Survey and the Environmental Resources Institute of Michigan. It is expected that both of these organizations may be included in the SRAAD Project resource inventory as subcontractors to the RCSSMRS for specific technical activities. As a member of the family of international organizations which are involved in remote sensing and mapping services, the RCSSMRS can call upon these associated organizations to assist with special technical issues, and can recruit widely for specific technical skills which may be required.

10

4. Recent RCSSMRS experience is especially relevant to the SRAAD Project. The Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS) has been intimately involved with the implementation of the A.I.D.-financed Sudan Emergency and Recovery Information and Surveillance System (SERISS) Project. Under this project, the RCSSMRS purchased the satellite imagery and constructed the sampling frames for Western Sudan which will be utilized by the SRAAD Project. The RCSSMRS was instrumental in working with the GOS in developing agricultural reports for the 1986/87 crop year and establishing a remote sensing capability within the GOS. The experience which RCSSMRS has had with the SERISS Project will permit it to move relatively quickly and effectively to implement the SRAAD Project's resource inventory activities. The RCSSMRS has established close working relationships with the Sudan Institute of Remote Sensing and the Government of Sudan (GOS) Survey Department. These existing relationships will be of considerable benefit to the SRAAD Project. With headquarters in nearby Nairobi, Kenya, RCSSMRS can provide effective project backstopping from its location.

5. There are a number of U.S. firms which have the technical capability to provide the necessary satellite data and technical interpretation services required for the SRAAD Project. However, as an African institution established to specifically serve African countries in the East Africa region, the RCSSMRS has the unique capability to gather and use data which would be difficult for U.S. firms to obtain from the GOS. Also, it would be difficult for U.S. firms to perform the required field surveys and collate and verify the satellite data. The close relationship which the RCSSMRS has maintained with the GOS has allowed it to develop ground-truthing activities under the A.I.D.-financed SERISS Project. The RCSSMRS has established relationships with a number of U.S. firms and institutions, and it is anticipated that there will be some involvement of these organizations in the SRAAD Project.

The SRAAD Project Implementation Plan requires the following inputs for the resource inventory component:

Technical Assistance	$ 850,000
Related Commodities	1,650,000
Base Maps	860,000
Aerial Photos	400,000
Additional Imagery	160,000
Office Equipment	80,000
Vehicles	150,000
Total	$2,500,000

A waiver of the requirement for full and open competition may be approved under AIDAR 706.302-70(b)(3)(i) "where compliance with full and open competition procedures would impair foreign assistance objectives, and would be inconsistent with the fulfillment of the foreign assistance program." However, AIDAR 706.302-70(c)(1) requires that "offers shall be requested from as many potential offerers as is practicable under the circumstances." Here, as demonstrated by the preceding discussion, the foreign assistance objectives of: (1) supporting a regional institution which A.I.D. has strengthened and (2) efficient implementation of the required technical assistance would be impaired by award of the technical assistance contract to other than the Regional Center for Surveying Services, Mapping and Remote Sensing (RCSSMRS) in Nairobi.

Authority: Under AIDAR 706.302-70(3)(i), the Assistant Administrator responsible for the project or program has the authority to waive the requirement for full and open competition for a single award based on this criteria without dollar limitation. There are no other grounds upon which this waiver may be justified.

Recommendation: Under the authority vested in you by AIDAR 706.302-70(3)(i), it is recommended that you determine that compliance with free and open competition procedures for the procurement of technical services and related commodities for the resource inventory component of the Sudan Reforestation & Anti-Desertification (SRAAD) Project would impair foreign assistance objectives, and that you thereby approve a waiver of the requirement for full and open competition to permit procurement from the Regional Center for Surveying, Mapping and Remote Sensing (RCSSMRS) in Nairobi.

Appoved _____

Disapproved _____

Date 8/5/87

Clearances:

DAA/AFR/ESA, LSaiers		Date	8/5/87
AFR/PD/EAP, TLofgren	(draft)	Date	08/04/87
AFR/EA, SMintz	(draft)	Date	08/04/87
GC/AFR, MAKleinjan	(draft)	Date	08/04/87
M/SER/CA, JMurphy	(draft)	Date	08/04/87

Drafter:AFR/PD/EAP, W. Darkins:06/26/87 Rev. 07/31/87
Doc#2996J

12

Project Authorization

Name of Country: Sudan

Name of Project: Sudan Reforestation and Anti-Desertification Project

Number of Project: 650-0082

1. Pursuant to Section 103 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Sudan Reforestation and Anti-Desertification Project for the Republic of Sudan involving planned obligations of not to exceed Eight Million Dollars ($8,000,000) in grant funds over a three year period from date of authorization, subject to the availability of funds in accordance with the A.I.D. OYB/allotment process, to help in financing foreign exchange and local currency costs for the project. The planned life of the project is six years from the date of initial obligation.

2. The principal purpose of the project is to support the Government of Sudan's efforts to restore and sustain agricultural production, and to rehabilitate drought-affected areas in order to halt desertification. To achieve this purpose A.I.D. will finance technical assistance, training, equipment and materials, vehicles, and other related costs. The project consists of two components:

   (a) development of an information base for planning, managing, and monitoring forest resources through vegetation mapping and forest inventories in western Sudan;

   (b) rehabilitation of land and forest resources in five rural council areas of southern Kordofan through participatory forest management and agroforestry activities.

3. The Project Agreement, which may be negotiated and executed by the officer to whom such authority is delegated in accordance with A.I.D. regulations and Delegations of Authority, shall be subject to the following essential terms and covenants and major conditions, together with such other terms and conditions as A.I.D. may deem appropriate.

   (a) Source and Origin of Commodities, Nationality of Services

   Commodities financed by A.I.D. under the project shall have their source and origin in the Cooperating Country or in countries included in A.I.D. Geographic Code 941, except as A.I.D. may otherwise agree in writing. Except for ocean shipping, the suppliers of services shall have the Cooperating Country or in countries included in A.I.D. Geographic Code 941 as their place of nationality, except as A.I.D. may otherwise agree in writing. Ocean shipping financed by A.I.D. under the project shall, except as A.I.D. may otherwise agree in writing, be financed only on flag vessels of the United States, the Cooperating Country, and other countries included in Geographic Code 941.

(b) Conditions Precedent to Disbursement

Prior to the first disbursement under the Grant, or to the issuance by A.I.D. of documentation pursuant to which disbursement will be made, the Cooperating Country will, except as the parties may otherwise agree in writing, furnish to A.I.D., in form and substance satisfactory to A.I.D.:

(1) Evidence that the Grantee has established a Project Steering Committee at the National level with appropriate representatives.

(2) Evidence that the Grantee has established a separate local currency project account for each component of the project and has deposited in each such account sufficient local currencies to meet project requirements for the first 24 months of the project.

(3) Evidence that the Grantee has transferred sufficient local currencies to a USAID Trust Fund to meet the estimated local currency costs of project technical assistance contractors for at least the first 24 months of their contracts.

(c) Covenants

The Cooperating Country will covenant in substance to :

(1) Appoint qualified personnel, on a timely basis, to all key project positions. The Cooperating Country and AID will mutually agree upon the individuals selected for these positions.

(2) Make sufficient land available for the establishment of required Nursery/Extension Centers and community forest reserves.

(3) Convene a meeting of representatives from the Regional Government, Central Forest Administration, the Ministry of Finance and Economic Planning, and A.I.D. prior to the completion of the project to formulate a definite plan and identify sources of funding for maintenance of the Project facilities and services after the end of the Project.

(4) Promptly deposit additional local currencies in the project special accounts as required throughout the project and, at the request of AID, promptly transfer such additional amounts to the AID Trust Fund as may be required during the project to meet the local currency costs of the project technical assistance contractors.

(5) The Grantee covenants to actively promote the continued development of a legal and policy environment which supports the expansion of community and private forestry.

John W. Koehring
Mission Director
USAID/Sudan

AUG - 9

Date

15

Project Authorization (650-0082)

Clear: AGR:M.Ford _____ : _____
PO:E.Rauch EHR : 7/22/87
CO:J.Kryschtal _____ : _____
CONT:A.Spathopoulos _____ : 7/21/87 (substance and funds available)
CMO:M.Thompson _____ : _____
EPP:B.Jensen _____ : 7/23/87
A/DD:S.Chernenkoff _____ : _____
RLA:P.Scott DRAFT : 7/16/87

Drafter: E.Lerner, PO

0387G

CONT:A.Spathopoulos _____ : _____ (BROOKE)

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION

PROJECT PAPER
(650-0082)

KHARTOUM
JULY 1987

17

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION
PROJECT PAPER

TABLE OF CONTENTS

Project Paper Facesheet..... i
Table of Contents..... ii
Acronyms..... iv

I. SUMMARY AND RECOMMENDATIONS..... 1

II. PROJECT RATIONALE

A. Role of the Forestry Sector in Sudan..... 4
B. USAID Interests Related to the Forestry Sector..... 6

III. PROJECT DESCRIPTION

A. Project Overview and Structure..... 10
B. Project Objectives..... 13
1. Project Goal..... 13
2. Project Purposes..... 13
3. End of Project Achievements..... 13
C. Project Components..... 14
1. Resource Inventory Component..... 14
a.Component Description..... 14
b.Component Outputs..... 17
C.Component Inputs..... 19
D.Beneficiaries..... 20
2. Resource Rehabilitation Activities Component..... 21
a.Component Description..... 21
b.Component Outputs..... 27
C.Component Inputs..... 28
D.Beneficiaries..... 30
D. Relation to Other Donors Activities..... 30

IV. COST ESTIMATES AND FINANCING PLAN

A. Project Costs..... 33
1.Overall Project Costs..... 33
2.AID Contribution..... 34
3.GOS Contribution..... 34
4.Recurrent Costs..... 35
B. Financing Plan..... 35
1.USAID Obligation Plan..... 35
2.Methods of Financing..... 35

18

V. PROJECT IMPLEMENTATION

A. Project Management Structure..... 38
B. Contracting Mechanisms..... 40
C. Commodity Procurement..... 41
D. Construction..... 42
E. Disbursement of Financing..... 42
F. Logistic Support..... 43

VI. SUMMARIES OF ANALYSES

A. Summary of Institutional Analysis..... 43
B. Summary of Technical Analyses..... 45
C. Summary of Social Soundness Analysis..... 47
D. Summary of Economic and Financial Analysis..... 49

VII. EVALUATION AND MONITORING ARRANGEMENTS..... 50

VIII. NEGOTIATING STATUS..... 52

ANNEXES

A. Logical Framework
B. GOS Request for Assistance
C. Statutory Checklist
D. Project Analyses
  1. Institutional Analysis
  2. Technical Analyses
  3. Social Soundness Analysis
  4. Economic and Financial Analysis
E. Implementation Schedule
F. Detailed Cost Estimates
G. Scopes of Work

TABLES, CHARTS AND FIGURES

Table 1 Summary Project Costs
Table 2 Sources and Uses of Funds
Table 3 Summary USAID Contributions
Table 4. USAID Contributions to Resource Inventory
Table 5. USAID Contributions to Resource Rehabilitation
Table 6 Summary GOS Contributions
Table 7 GOS Contributions to Resource Inventory
Table 8 GOS Contributions to Resource Rehabilitation
Table 9 Technical Assistance Plan
Table 10 Training Plan
Table 11 Vehicle Procurement Plan
Table 12 Construction Plan
Table 13 Procurement List
Chart 1 USAID Methods of Implementation and Financing
Chart 2 Implementation Schedule
Map 1 Sudan - Project Area
Map 2 Sudan - Thematic Mapper Coverage
Map 3 Sudan - SRAAD Project Area (Kordofan)
Map 4 Kordofan - Project sites (Rural Councils)

ACRONYMS

ACF	Area Coordinator
AF	Agroforestry
AID	Agency for International Development
CARE	Cooperative for American Relief Everywhere
CBD	Commerce Business Daily
CDSS	Country Development Strategy Statement
CFA	Central Forestry Administration
CIDA	Canadian International Development Agency
EEC	European Economic Community
ERIM	Environmental Research Institute, Michigan
E/TS	Extension/Training Specialist
FEO	Forestry Extension Officer
FPO	Field Project Officer
FRC	Forest Rehabilitation Coordinator
FS	Field Supervisor
GIS	Geographic Information System
GOS	Government of Sudan
IES	Institute of Environmental Studies
IRM	Inventory Reservation and Management
IT	Inventory Team
LS	Sudanese Pounds
MFC	Mechanized Farming Corporation
MOA	Ministry of Agriculture
MOADS	Ministry of Agriculture, Division of Statistics
NRSC	National Remote Sensing Center
OPG	Operational Program Grant
PACD	Project Assistance Completion Date
PEC	Project Extension Coordinator
PIO/T	Project Implementation Order/Technical Services
PP	Project Paper
PSU	Primary Sampling Units
PVO	Private Voluntary Organization
USAID	United States Agency for International Development
RC	Rural Council
RCPO	Rural Council Project Officer
RCSSMRS	Regional Center for Services in Surveying Mapping and Remote Sensing
RIG	Regional Inspector General
SERISS	Sudan Emergency and Recovery Information and Surveillance System
SF	Saudia Fund
SRAAD	Sudan Reforestation and Anti Desertification
SREP	Sudan Renewable Energy Project
SSA	Soil Survey Administration
SSD	Sudan Survey Department
TM	Thematic Mapping
USGS	United States Geological Service
VCE	Village Council Extensionist
VCP	Village Contact Person
WSARP	Western Sudan Agricultural Research Project

20

I. SUMMARY AND RECOMMENDATIONS

A. Responsibilities

The Grantee for the Sudan Reforestation and Anti-Desertification (SRAAD) Project will be the Government of Sudan. The GOS Central Forestry Administration will be the primary implementing agency.

B. Recommended Sources and Uses of Funds

Authorization of a grant in the amount of $8,000,000 over a six year period commencing July 31, 1987 to the Government of Sudan for the Sudan Reforestation and Anti-Desertification Project. Total Project costs are estimated to be the equivalent of US $ 15,500,000. A.I.D. financing provides for fifty-two percent of total project costs and all of the foreign exchange costs of the Project. The GOS contribution is LS 30,224,600 representing forty eight percent of total Project costs. The distribution of financing between different categories of expenditure and over the life-of-project is provided in Section IV of this Project Paper.

C. Objectives of the Project

The goal of the Project is to reverse the process of desertification and declining soil productivity which have led to a reduction in agricultural production and income of traditional farmers in Western Sudan.

The purposes of the Project are: 1) to develop a sound information base for planning, managing, and monitoring forest resources through vegetation mapping and forest inventories in Western Sudan; and, 2)to rehabilitate land and forest resources in five rural council areas of southern Kordofan through participatory forestry including natural woodland management and agroforestry activities.

D. Background to the Project

The Sudan Reforestation and Anti-Desertification Project is part of a larger comprehensive effort by the GOS to restore agricultural production and rehabilitate drought-affected areas in order to halt desertification. The Project aims to assist in this effort in two ways. First, it will develop more efficient techniques for collecting and evaluating information on the tree and vegetation cover in the southern areas of Kordofan and Darfur; some of the areas hardest hit by the recent drought. Second, it will provide technical and financial resources to mobilize rural institutions and communities to improve the management and conservation of existing forest resources and to expand the utilization of trees and shrubs in their agricultural production systems.

The SRAAD Project is supportive of USAID's overall strategy in Sudan. The maintenance of existing forest resources and the development of new ones is critical for sustaining rain-fed agricultural production systems- a major objective of the Country Development Strategy Statement. The Project also reflects the growing Agency-wide concern for improving the management of natural resources. The Project is also structured to incorporate the

experience of previous USAID investment in the forestry sector, most notably the Eastern Refugee Reforestation Project with CARE, as well as to support other USAID-financed activities in the Kordofan Region.

E. Description of the Project

The SRAAD Project is designed with two components. The Resource Inventory Component addresses the GOS's need for more objective information on the condition of the forestry resources and the extent of desertification in Western Sudan. Specifically, it will support the production of base maps for the southern Kordofan and southern Darfur and the GOS efforts to utilize satellite imagery to measure and map the extent of existing forestry resources, their rate of depletion, and regenerative capacity. This component will also support field surveys, in those areas identified as promising by the satellite imagery, to provide basic data about marketable timber, building materials, woody biomass as a source of energy, and the current limits of the Gum Belt. Finally, the component will support the translation of the collected data into management recommendations for forestry resources in the project area. The implementation of the Resource Inventory Component is divided into two phases. The first phase, which will include the area covered by six satellite images including the administrative boundaries of five Rural Councils in southern Kordofan, will test the proposed methodology and assess the level of information which will be required to improve the management of forestry resources. The first phase is expected to take 18 - 24 months. The second phase, which will proceed on the basis of an evaluation of the previous effort, will include a significantly larger area, covering rest of southern Kordofan and all southern Darfur.

The Resource Rehabilitation Component provides direct remedies for the problems of environmental degradation and desertification. The strategy for this component is to establish and develop an extension and nursery network extending from the Regional Center in El Obeid into the village communities of the five targetted Rural Councils of southern Kordofan. Two types of activities are supported by this component: the participatory forestry through natural woodland management and agroforestry including establishment of nurseries, adaptive research and demonstrations and extension programs. Five Nursery/Demonstration Centers are planned, one in each of the Councils, which will support all types of activities as stated. These will include development and implementation of forest management plans for an area of 50,000 feddan, providing a nursery for seedlings, adaptive research demonstration plots, and facilities for extension/training programs. One hundred self-help village nurseries will be supported with technical assistance and limited supplies, as a decentralized network for providing sufficient seedlings to local farmers. An extension system will also be supported by this component which aims at introducing and sustaining increased utilization of trees in traditional agricultural systems.

At the end of the Project the following results are expected:

- A system for monitoring forest resource degradation and desertification for Western Sudan will be available

- An improved data base will be available for planning in the forest sector

- Plans will be implemented for development, conservation, and management of forest resources based upon vegetation mapping and forest inventories in Southern Kordofan and Southern Darfur

- Community forests will be established and managed by rural people

- Management of existing forest areas and new tree planting in the five Rural Councils will provide increased supplies of tree products, woodfuel, poles, and improve soil productivity and conservation

- Agroforestry over an area of 50,000 feddans.

F. Summary Findings

The Design Team has examined each of the Project activities with respect to their institutional, technical, social, and economic implications. All activities have been judged to be technically viable and administratively practical.

The Institutional Analysis has pointed out the existing structure for supporting forestry and agroforestry activities is limited in terms of personnel and budget. There are however, encouraging legislative and structural changes as well as a major World Bank Project, which will expand the capability of national institutions and facilitate the implementation of Project activities.

The Technical Analyses have described the serious problems of environmental degradation and desertification caused by the depletion of the forest resource base. There are interventions which are technically viable which can be introduced within the existing systems and are acceptable to farmers. These interventions include: enhancement of the gum garden system, to increase on-farm trees, introduction of fruit trees, to bring more productive land under agricultural use with tree crops, and to introduce woodlots and shelterbelts.

The Social Analysis indicates that there is broad support for increased forestry activities. In the southern Kordofan area, where the Resource Rehabilitation Component will be implemented, the analysis highlighted the role of women, and the importance of land and grazing rights in relation to the Project's proposed activities. The social analysis has influenced the strong emphasis on monitoring and evaluation as a major and on-going part of Project implementation.

The Economic Analysis shows that the project is economically sound.

G. Consideration of Small, Disadvantaged, and Women Owned Firms

The Design Team considered whether it would be feasible to set aside any of the project activities for firms or institutions which qualify for special

consideration under the Gray Amendment. The Inventory Component of the project requires highly specialized technical skills and faculties which, as far as the Mission is aware, is not available from any small, minority business. It is also considered essential that such services be provided by an organization with considerable experience in Africa and Sudan and has established working relationships with the specialized agencies in Sudan concerned with satellite imagery. Gray Amendment organizations may be able to carry out some of the activities proposed under the Resource Rehabilitation Component. The technical service requirements for this component will be widely advertised and solicitations will include provisions specifically encouraging small businesses to participate in the procurement, either as the prime or subcontractors. The Request for Expression of Interest and RFTP will be sent to the AID small business office with a request that the contract requirements be brought to the attention of small businesses with experience and expertise in the required areas. USAID proposes to utilize the RCSSMRS for the Inventory Component based upon the U.S. foreign policy interest.

H. Waivers and Approvals

The following waivers and approvals are required.

1. A Non-Competitive procurement waiver to procure technical services from the Regional Center for Services in Surveying, Mapping and Remote Sensing. This waiver will be obtained prior to project authorization.

2. Source/Origin Procurement Waivers for 30 motorcycles and 2 trucks. Waivers will be sought as required during project implementation.

II. PROJECT RATIONALE

A. Role of the Forestry Sector in Sudan

Sudan's forestry resources consist of an estimated 58.5 million hectares of woodlands and forests, which is 23% of the country's total land area. These resources are vital to the Sudanese economy. First, they provide an estimated 90% of the nation's energy consumption in the form of fuelwood and charcoal. Second, they provide polewood and timber for building. Third, they earn valuable foreign exchange from gum arabic. Fourth, they contribute to a greater resilience in traditional smallholder agricultural systems through improved soil and water conservation and increased income from the sale of forest products. Finally, they provide one of Sudan's most effective means for preventing desertification.

The future of Sudan's forests and woodlands is in jeopardy. The accelerating rate of degradation in forested areas caused by population pressure, changing economic livelihoods (e.g. the introduction of mechanized farming), and drought has pushed Sudan's forestry problem past its critical threshold. Over the last twenty years, Sudan's forestry area has been reduced by an estimated twenty percent. Furthermore, a recent report has estimated that under present conditions and without improvement in resource management strategies, the 10 million hectares of natural savannah woodland within a radius of 500-600 kilometers of Khartoum will disappear by the turn of the century. To date,

public management of the forestry subsector has been ineffective in reversing this trend, which is depleting the nation's forest capital stock and a major contributory cause of accelerated desertification. Inadequate personnel and material resources of the Forest Department have limited Sudan's forestry management to administration and protection of forest reserve areas which make up just over one percent of the total forest area.

The Government of Sudan recognized the need to address this deteriorating situation in 1982 when it requested the World Bank to undertake an overall assessment of Sudan's forestry sector. The Sudan Forestry Sector Review was undertaken by a multi-donor team led by the World Bank (and including USAID representation) in 1984, and its final report was published in April 1986. The Review provided recommendations for addressing Sudan's forest policy issues, highlighted the costs and benefits of an accelerated investment in the forestry sector, and recommended a prioritized five year development plan to implement a forestry investment program. The priorities in this Plan included:

> The first priority is to conserve existing wood supplies through a combination of continued efforts to improve the efficiency of charcoal production throughout the country and to improve recovery of waste wood from land cleared for agriculture.
>
> The second priority is to bring the existing forestry resources under more effective protection and management and to increase the level of stumpage tax collection on fuelwood and timber harvesting operations both outside and inside government owned forest reserves.
>
> The third priority is to establish new fuelwood resources with special emphasis on low cost technologies such as direct reseeding of abandoned mechanized farming or degraded forest lands and on involvement of farmers in cash crop tree farming. Because it will take time to raise fuelwood prices to the level needed to trigger large scale spontaneous investment by farmers in fuelwood crops, strong emphasis is given to planting multi-purpose trees from which the financial rates of return would be much higher than for fuelwood alone, and which are more likely to be in line with farmers currently perceived needs.
>
> The fourth priority is agroforestry: planting trees as an integral part of the farming system not only to protect crops and soils and to provide essential needs like fruit, fodder, fuelwood and poles, but also in appropriate situations, to provide additional sources of farm income, e.g. from gum arabic. This includes investment in accelerated shelterbelt planting, particularly along canal banks and around mechanized farming schemes as well as pilot scale reforestation works in upland watershed catchments, and sand dune fixation works aimed at protecting high value infrastructure investment or fertile agricultural lands that are threatened by dune encroachment.

> The fifth priority is industrial forest management and the establishment and protection of new plantations, purchase of spare parts for existing sawmills and logging operations, expansion of new sawmilling capacity and improved transport access into forest areas.

The Sector Review proposed a three part investment strategy for implementing the above development program. First, the re-creation of a strong Central Forestry Administration (CFA) with the capacity to plan, monitor, and provide effective extension support to the many agencies and farmers that will be involved in implementation of the forestry program. Second, the strengthening of forestry research, education, and training which are currently under Agricultural Research Corporation (ARC) and the Ministry of Education. Third, the provision of a series of intensive planning and economic studies including, in particular, forest and biomass inventories that can provide detailed information on the resource base and improve the effectiveness of future investment strategy.

B. USAID Interests Related to the Forestry Sector

1. USAID CDSS Commitment to Rain-fed Agriculture

USAID/Sudan's Country Development Strategy Statement(CDSS) for FY 1986 outlines a strategy which directed US assistance efforts toward policy reform, support for the private sector, decentralization of government control, rain-fed agriculture, and the development of southern Sudan. Over the past two years a civil war has prevented effective assistance for southern Sudan, and two changes of government have stymied policy reform efforts. As a result, the USAID strategy has increasingly come to focus on the development of the private rain-fed agricultural sector.
Among the objectives of the rain-fed agricultural strategy enunciated in the CDSS are to:

> "Increase yields through improved seeds, access to other complementary inputs such as seed dressing and selective mechanization, and application of research findings in order to improve planting techniques and introduce farming practices that will sustain soil fertility and increase soil moisture" and to "increase foreign exchange earnings through export of cash crops having minimal imported input requirements, particularly sesame, livestock, groundnuts and gum arabic." (underlining added)

These objectives were to be achieved in part by identifying and introducing sound, cost effective means for controlling desertification and protecting the environment, by encouraging the GOS to increase producer prices for gum arabic, and by working directly with area councils in order to bring planning and implementation of development activities as close to the intended beneficiaries as possible.

USAID projects currently supporting rainfed agriculture include: Kordofan Rainfed Agriculture Development, the Western Agricultural Marketing Road, the

Regional Finance and Planning Project, the Western Sudan Agricultural Research Project, and the Agricultural Planning and Statistics Project.

2. USAID Experience with the Forestry Sector

USAID-financed forestry activities have been successfully implemented by PVOs in Sudan. The Eastern Refugee Reforestation Project (650-0064) is an over $5.0 million effort which has been operating since April 1983. This Project is being implemented through an OPG with CARE-Sudan. It's activities include: block forest plantations, forestry extension for promotion of tree planting, agroforestry, shelterbelts, dissemination of stoves, nurseries, seedling distribution, and training to support the GOS Forest Department. This project is considered one of USAID's most successful projects, and CARE is currently making plans for extending its efforts for an additional three years to concentrate primarily upon forestry extension, seedling production/distribution, and technical assistance.
The CARE Water Rehabilitation Project, located in the Kordofan Region, includes forestry activities. It has introduced a very successful village tree nursery program based using waste water. These nurseries utilize self help village labor for nursery planting, maintenance and sale of seedlings.

Save the Children U.S. has an Emergency Water Supply Project in the Um Ruwaba district of Kordofan Region which has been operating since 1986. It includes a tree nursery component which is based upon the model described above. Save the Children plans to expand their activities to several villages in the district.

The Sudan Renewable Energy Project also has a grants program which has supported community forestry and agroforestry efforts in several parts of the country, including the Kordofan Region. The agroforestry activities have demonstrated a very high economic rate of return for plantings of Eucalyptus trees and Karkadeh on marginal irrigable land.

3. USAID Interests in Natural Resources Management

The United States Agency for International Development (AID) has recently launched a "Plan for Supporting Natural Resource Management in Sub-Saharan Africa". This plan has been developed in recognition of Africa's unique environmental problems and with the hope of tapping the potential of its vast natural resources. The Plan reflects AID's long-term committment to natural resource management in Africa and provides a mechanisms for better articulating and coordinating AID's approach to Sub-Saharan Africa's environmental problems-- including, inter alia, desertification, deforestation, soil degradation, the loss of agricultural productivity and biological diversity.

The implementation of AID's Plan will support specific natural resources management opportunities and needs. In relation to Sudan's position in the Arid/Semi-Arid Zone of Sub-Saharan Africa, the plan calls for continued strong support to tree planting, agroforestry, soil and water conservation and water resources management to counter the impacts of desertification and stabilize environmental conditions for sustainable productive agriculture and livestock

husbandry. USAID Missions have been requested to utilize a variety of program elements to address country specific natural resource issues. Those most relevant to Sudan include:

-Policy dialogue to build national awareness and commitment and the development of appropriate policies and programs which recognize the importance of natural resources, particularly soils, vegetation, and water for sustainable agricultural and livestock productivity and development, as well as the importance of conservation and maintenance of biological diversity.

-Increased attention to compiling socio-economic and qualitative information on natural resources as part of enhancing the national capability for agricultural and natural resource planning.

-More attention to gathering and analyzing baseline data on soils, water, and biomass resource use, including support for monitoring and analysis programs, ground surveys and census work, low level aerial surveys and remote sensing.

-Continued support to Private Voluntary Organizations (PVOs) and National Non-Governmental Organizations (NGOs) utilizing both development assistance funding and PL 480 resources, for an accelerated program of pilot demonstration efforts in tree planting, agroforestry, soil and water conservation and maintenance of biological diversity.

4. USAID Interests in Responding to GOS Requirements

The recent drought, the worst in living memory, has exacerbated Sudan's natural resource problems, including those directly related to the forestry sector Since the drought ended in 1984, among the highest priorities of the Government of Sudan have been to restore agricultural production and to rehabilitate drought-affected areas in order to halt desertification. The emphasis on agricultural production has led the Government of Sudan to concentrate scarce resources on the provision of agricultural inputs and maintenance of support prices for basic food commodities. This approach, combined with favorable rains, has resulted in record grain harvests in both 1985 and 1986. These record harvests have provided impetus to the mechanized farming sector of eastern, western, and central Sudan. The recovery of Sudan's traditional farm sector has not been as rapid due to the substantial migration during the drought years and environmental degradation in the rain-fed areas where Sudan's subsistence farmers are concentrated.

The GOS has developed resource rehabilitation plans to assist the rural population of western and northeastern Sudan to recover from the drought, but these plans have not been implemented. Understandably, the GOS would prefer to assist farmers to remain where they now live by increasing the number of water supplies and introducing techniques such as water harvesting near seasonal streams to increase water availability for agriculture. However, this will not be a viable strategy for all the drought-affected areas. Therefore, there are plans to move farmers from areas which can no longer sustain agriculture to areas of higher rainfall further south.

Government is considering using the southern parts of the Kordofan and Darfur regions for these displaced farmers, but this area is already under severe pressure. As a consequence of the continuing drought between 1982 and 1984, this area suffered both as a result of not being able to grow any food crops and also from the consequences of mass migration into the area by both of nomadic and sedentary populations and their animals, resulting in increased pressure on the already fragile resource base. In order to meet needs of fuelwood, charcoal and fodder, many green trees were felled, for use as well as for sale. The cutting of green trees was further encouraged by the fact that the farmer could earn more by cutting even gum arabic trees and converting them into charcoal than by collecting gum in view of very low producer prices then offered for gum arabic. The results are obvious. An entire area which boasted being one of the largest producers of gum arabic in the world, where the farmers had arrived at a balance with nature by incorporating gum arabic as a part of the fallow cycle, and where a subsistence farmer was able to produce enough for his family and earn some extra income through collection of gum, fell apart. The process of desertification that had set in prior to drought as a consequence of heavy population pressure on natural resources not only became quite noticeable but started spreading across the terrain, encompassing more and more land, leading to further decline in agricultural production and shortage of fuelwood, fodder and charcoal, and a net reduction in the production of gum arabic.

The problem was further accentuated by inroads made by mechanized farmers, most of whom are outsiders (mainly merchants), into the forest areas, grazing areas, as well as some fallow lands. The expansion of mechanized farming, both regulated and unregulated, without any regard to appropriate farming practices, such as retention of vegetated tree strips at regular intervals over 10% of the allocated area as required by contract for regulated mechanized farming, has resulted in land mining and rapid declines in land productivity. This has led in turn to further expansion of mechanized farm areas. The net result has been the onset of the process of desertification, increasing the vulnerability of the local population to the changes of nature in the form of strong winds, rainfall distribution erratic both in intensity and magnitude, and resultant soil loss and reduced land productivity.

The population of this area is currently experiencing acute shortages of food, fodder, charcoal and other agricultural commodities. Although the population pressure has led to a breakdown of the traditional farming system, there is still hope for reversing the process of environmental degradation -- if appropriate farming practices that include some form of agroforestry are followed, including shelterbelts on traditional and mechanized farms; if the gum gardens are rehabilitated through seeding or planting; if conservation is practiced in the use of fuelwood and charcoal; and if the remaining woodland is protected and managed under a sustainable system. With concerted effort and total participation of the local population, the area can once again have a sustainable balance between the demands of the people for use of the land for agriculture, forestry and animal husbandry and the supply of resources.

One positive aspect of the area's recent misfortune is that the consequences of drought and desertification have had a significant impact on peoples' attitudes. Both the GOS authorities and the local people have started to give

serious thought to their land-use practices. Concern has repeatedly been voiced by civil servants and politicians that plans should be made now to manage the new influx in a way that minimizes the stress on the natural resource base of the area. The newly appointed Governor of Kordofan has discussed with USAID his desire to obtain support for his efforts to scientifically assess the area's natural resource potential in order to prepare effective development plans.There is also a growing awareness about the significance of trees in the farming systems, protection of woodlands, conservation of woodfuel, and, last but not least, about drought and desertification. A recent increase in the producer price of gum arabic has created a tremendous interest among traditional farmers of the area for the planting and protection of gum arabic trees.

With regard to the detrimental effects of current mechanized farming practices, the authorities seem quite serious about implementing regulations enforcing appropriate farming practices. These include establishment of shelterbelts, crop and land rotations, and retention of wooded strips at regular intervals over 10% of the allocated area. The Governor of Kordofan Region has also expressed to USAID his interest in enforcing these regulations.

III. PROJECT DESCRIPTION

A. Project Overview and Structure

Based upon the importance of the forestry sector to Sudan's economy, its important linkages to USAID interests in rain-fed agricultural systems and natural resource management, and the GOS requirements for rehabilitating its agricultural and forestry resources after the recent drought, USAID/Sudan is initiating assistance to the forestry sector through the Sudan Reforestation and Anti-Desertification (SRAAD) Project. This Project is intended to accomplish two things. First it will introduce and adopt innovative approaches for assessing the significant problems of desertification and declining agricultural productivity over a large part of western Sudan. Second, it will promote reforestation and resource conservation using well-known and widely accepted technical practices at the farm level in a smaller part of this area.

1. Project Setting

An area based project mode, located in southern Kordofan and southern Darfur, has been selected as the most appropriate form of project assistance. This decision is based upon two factors. First, this area is characterized by overstressed resources in the north and more balanced resource distribution and use in the south. This means that there is a need for rehabilitation as well as conservation and management of existing resources. Second, this area represents the greatest concentration of USAID/Sudan's investment. USAID projects currently operating within this area include: Kordofan Rain-fed Agriculture Development Project, the Western Agricultural Marketing Road Project, the Regional Finance and Planning Project, the Western Sudan Agricultural Research Project, the Agricultural Planning and Statistics Project, and the various projects which include forestry components.

2. Project Structure

The SRAAD Project is structured into two distinct yet interrelated components: the Resource Inventory Component and the Resource Rehabilitation Component. The Resource Inventory Component will employ innovative geographic and cartographic techniques, based on satellite imagery, to inventory the forest resources of a large part southern Darfur and southern Kordofan. This effort will generate base maps for the area which can be used to organize and assess information on natural resources as well as a data base to devise forestry development strategies in these areas. The Resource Rehabilitation Component of the SRAAD Project will operate in a smaller area corresponding to the administrative region of five Rural Councils in southern Kordofan. This second component is based upon utilizing specific information generated by the Resource Inventory Component, combined with the results of a household survey conducted in the five Rural Council areas, to design forest management and development plans and to introduce resource rehabilitation activities. The rehabilitation activities will utilize appropriate reforestation and agroforestry techniques. Additional linkages between the two components are highlighted in the component descriptions.

Budgetary allocations for the Project should be viewed as fundable for accomplishing the objectives of the Project. The total budget level for the Project is well established, but the exact requirements for either of the two components may vary over the life of the Project.

3. Donor Coordination with the SRAAD Project

The SRAAD Project design addresses donor coordination- an important concern of the Africa Bureau. Other international donors, including the World Bank, the EEC, the Dutch, the Germans, and Finnida, were consulted as part of the design activity. What emerged is a clear interest by all parties in continued coordination of efforts in the forestry sector, although a number of parties prefer to retain the individual identity of their programs. There was general agreement that the SRAAD Project will lay the groundwork for future donor efforts by improving the information base through the maps and statistics that result from the forest inventory and the development of interventions that utilize this information.

By far the largest intervention in the sector is the forestry project presently being organized under the leadership of the World Bank and UNDP: as a five year multi-donor activity with financing expected from the World Bank and Scandanavia. The Project is based on the recommendations and plans outlined in the Forestry Sector Review which was prepared by the GOS, World Bank, and other donors, including USAID. Components of this project include institutional strengthening of the Central Forest Administration and the National Energy Administration, forest management, education and research, energy, plantations, forest inventories, and social forestry. From USAID discussions with the Bank it was clear that the SRAAD Project would assist the proposed Bank project by providing additional baseline data for their project which is not due to start for another eighteen months.

The EEC and the Germans have completed their future plans for forestry activities in the Sudan. EEC will expand the forestry activities in their Nuba Mountain and Jebel Marra Rural Development Projects and will resume forestry activities in southern Sudan when the security situation permits. The EEC also intends to provide local currency funding to NGO's for forestry activities under the umbrella of the Lome Program. The Germans plan to finance a major forestry project in the Jebel Marra area of south Darfur Province and will reactivate their assistance to several timber/sawmill projects in southern Sudan when the security situation permits.

The Dutch and the Finnish count forestry as one of their highest priority areas for the Sudan. Both intend to continue their substantial assistance to the sector, although the exact form of that assistance is unclear at this time.

4. Policy Environment for the SRAAD Project

Many donor organizations and Sudanese professionals have pointed to the need for policy changes and reforms to promote better land and tree use practices and to strengthen the institutional framework for forestry and agroforestry programs. Three policy issues bear heavily on the implementation of this Project. These include: a) the current practices of existing mechanized farmers and extent to which this type of farming is expanded; b) the producer and export prices of gum arabic; and c) the administrative structure of the Central Forest Administration.

Regulations exist, but are not enforced, governing the establishment of shelterbelts on mechanized farms. The response of the mechanized farmer is to disregard the regulations, since they are able to move to another area and clear it of forest when the soil productivity of the existing land declines. During recent years these practices have denuned large areas of Sudan's forests. Most of the forest is converted illegally without leases or following CFA regulations. This situation has the effect of subsidizing the charcoal prices. In turn, this reduces charcoal makers and end user interest in efficient conversion and conservation technologies, and eliminates the opportunity for reducing wood fuel consumption. Consequently, these activities lead to increase pressure on already fragile land base resulting in desertification and environmental degradation. Until very recently gum arabic prices to producers represented less than 15 percent of the FOB value. To encourage gum arabic production producer prices were increased recently. While this is extremely important in terms of supporting gum producers and for encouraging the establishment of new gum gardens, it has been financed by large increases in the international prices. As a result the international markets may erode and the demand for gum arabic is likely to be moderated in response to higher prices. In order to sustain favorable producer prices the GOS needs to reevaluate the structure of the domestic prices and the role of the Gum Arabic Corporation as an income generating public monopoly.

Another major policy issue, related to the design and implementation of the SRAAD Project, is the GOS proposal to create an autonomous Forestry Commission. Currently, drafts of revised Forest Policy and Forest Ordinances are pending approval by the Minister of Agriculture and endorsement by the Constituent Assembly. Beyond the institutional and budgetary implications

this legislation poses, it would also : 1)enhance the management and enforcement and facilitate through new regulations private ownership of trees to people who plant them; and, 2) strengthen the enforcement of existing forest ordinances about conversion of wood to charcoal. Overall, the legislation would be an important step forward for Sudan's forestry sector.

B. Project Objectives

1. Project Goal

The goal of the Sudan Reforestation and Anti-Desertification Project is to reverse the process of desertification and declining soil productivity which have led to a reduction in the agricultural production and income of traditional farmers in Western Sudan.

2. Project Purposes

The SRAAD Project has dual purposes. These are:

-To develop a sound information base for planning, managing, and monitoring forest resources through vegetation mapping and forest inventories in Western Sudan.

-To begin rehabilitating land and forest in five rural council areas of southern Kordofan through participatory forestry management and agroforestry activities.

3. Expected Achievements and Accomplishments

Through Project activities which provide reliable forest resource information and seek solutions to declining land productivity, shortages of fuel wood and charcoal, and other factors which contribute to desertification, the Project is expected to achieve the following results.

-System available for monitoring forest resource degradation and desertification.

-Improved data base for planning and management in the forestry sector.

-Plans being implemented for development, conservation and management of forest resources based on vegetation mapping and forest inventories, in 5 Southern Kordofan Rural Councils.

-Establishment and management of community forests.

-Increased supplies of tree products, woodfuel, poles, and improved soil conservation and productivity as a result of increased tree planting and improved forest management.

C. Project Components

1. Resource Inventory Component

a. Component Description - Resource Inventory

The Resource Inventory Component of the SRAAD Project addresses the need of the Government of Sudan for more extensive and reliable information on desertification and declining soil productivity and for more efficient and cost effective techniques for evaluating and updating such information. Sudan's natural resource problems are legion. The first step, in approaching these problems is to accurately assess their extent and scope. Currently, there are few up to date base maps on which to plot Sudan's natural resources, and none for the western regions of Darfur and Kordofan. The recent drought has been particularly severe in these two regions, destroying much of the scrub bush in their northern parts. The resulting migration of people and animals from the north to the south has put increased pressure on the natural resources. To obtain an objective impact of the drought in these regions, the development of base maps is a prerequisite to other assessment activities and subsequent action plans.

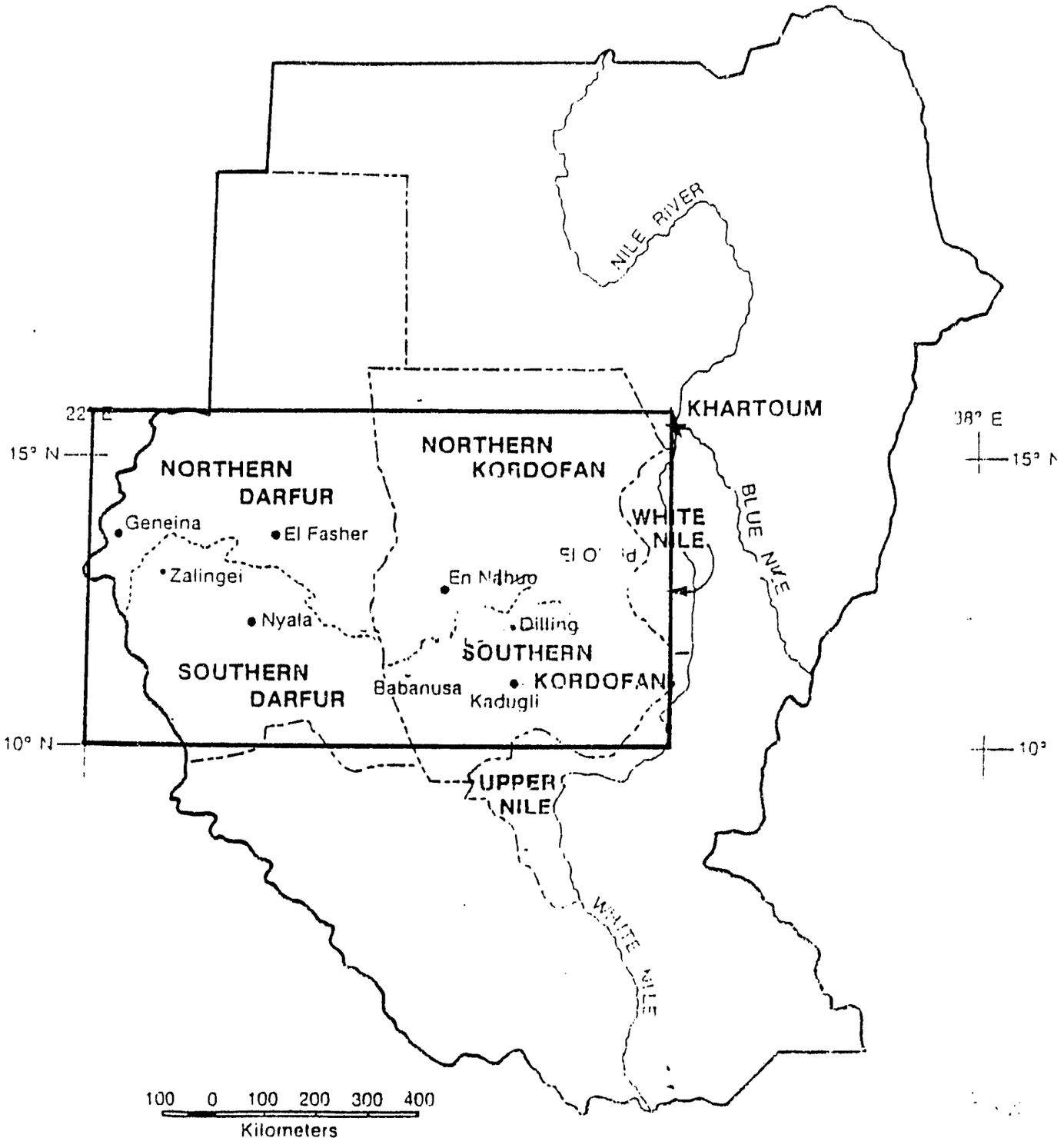
Another problem the GOS faces in assessing it's natural resource problems is that, until recently, Sudan has not had a comprehensive framework for measuring and evaluating its natural resource base. Previous assessment techniques have included area-specific studies, resource specific inventories, and mapping exercises which have not been well coordinated. Much of the information developed with these techniques was based upon forestry information from the 1930's. While many of these techniques could be employed for assessing Sudan's current natural resource problems, their cost, both in terms of personnel and financing, would be prohibitively expensive for the GOS. Moreover, these approaches are also time and labor intensive.

Recently, interpretation of remotely sensed data collected from satellites has been introduced in Sudan. The Sudan Emergency and Recovery Information and Surveillance System (SERISS), funded by USAID and implemented through the Ministry of Agriculture and Regional Center for Services in Surveying Mapping and Remote Sensing (RCSSMRS), was established in 1985 to enhance the GOS's ability to forecast crop yields. This method, based on information made available through satellite imagery, allows government scientists and planners to compress the lag between information acquisition, analysis and effective action. Utilizing the available remotely sensed data and sampling frame developed by the SERISS Project, the Resource Inventory Component of the SRAAD Project is designed to identify and assess the forestry resources in the Kordofan and Darfur regions and to provide data which can be used to develop forest management plans in these areas. This effort is significant in two respects. First, it will develop up to date base maps for southern parts of the Darfur and Kordofan regions which can be used to more accurately locate other natural resource information identified under SERISS. Second, by adding information about another important agricultural resource - forests the overall framework supported by SERISS and SRAAD offers greater utility as an agricultural planning tool.

PROJECT AREA-RESOURCE INVENTORY AND MAPPING-KORDOFAN AND DARFUR

SUDAN

MAP 1



The specific objectives of the Resource Inventory Component are to:

-develop a method for monitoring forest resource degradation, destruction, and the attendant process of desertification

-develop an improved data base for monitoring, planning, and managing the forests of southern Kordofan and southern Darfur.

-implement plans for development, conservation and management of forest resources based upon information collected during the inventory.

These two objectives, described in more detail below, correspond to a continuum of action beginning with the collection of data and ending with the application of that data for improving forest management.

The implementation of the Resource Inventory Component is divided into two phases. The first phase will consist of the preparation of base maps for the entire project area and forest inventory activities within an area covered by six complete satellite images which largely correspond to the boundaries of the five target Rural Councils. The second phase will support the extension of the forest inventory activities in the remaining areas of southern Kordofan and southern Darfur. In between the first and second phases an evaluation of the the forest inventory activities will be undertaken to assess its progress.

(i) Reconnaissance Survey

The Resource Inventory Component will begin with a Reconnaissance Survey which will provide preliminary information on the extent of forest resources in the areas of southern Darfur and southern Kordofan. The Reconnaissance Survey will use 1:250,000 imagery from Land Sat E' Thematic Mapping (TM) device already procured under the SERISS project. This imagery was taken in overflights during fall 1985 and fall 1986. Several additional LandSat scenes may be required where coverage was incomplete or quality obviates the use of existing stock.

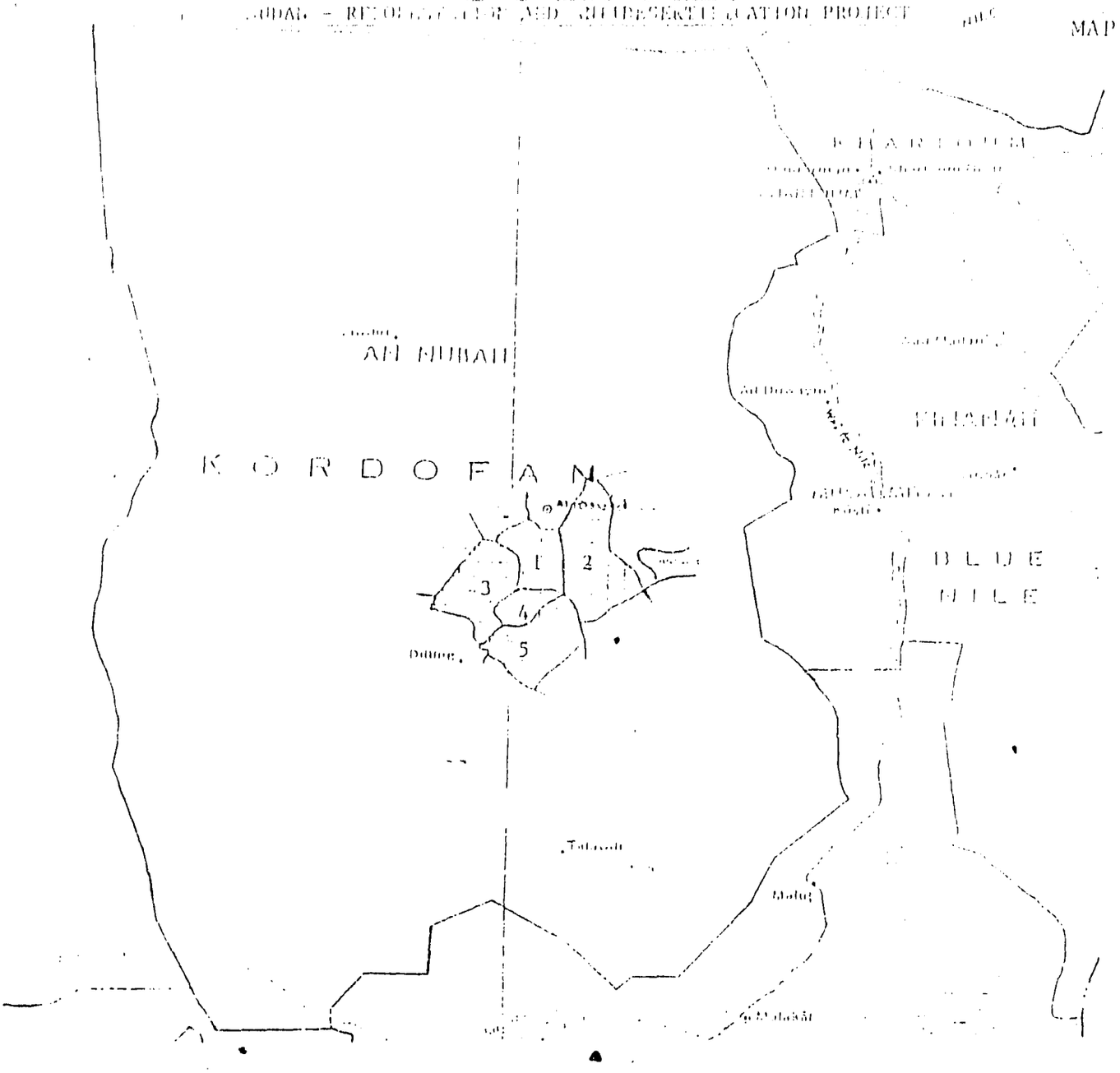
The first task of the Reconnaissance Survey is to develop up to date base maps for the area bordered by latitudes 10°N & 16°N and longitudes 22°E and 33° E. Thirty-six true color image maps are planned at a scale of 1:250,000. This task will involve mostly desk work with some field truthing, and can be implemented independently of the other tasks of the Reconnaissance Survey. These maps will provide a framework for organizing the information developed during the forestry inventory. They will also provide national and local authorities with the ability to implement resource planning and allocation decisions based upon up to date information on physical and administrative infrastructure.

Utilizing the same satellite imagery and the cartographic framework provided by the base maps, the second task of the Reconnaissance Survey is to map the forestry resources of the southern areas of the Darfur and Kordofan regions. This forest mapping exercise has two purposes. First, for those areas where significant forest resources exist, further investigations will be undertaken to determine their extent, and present

PROPOSED PROJECT SITES

SUDAN - RESOURCE AND REHABILITATION PROJECT

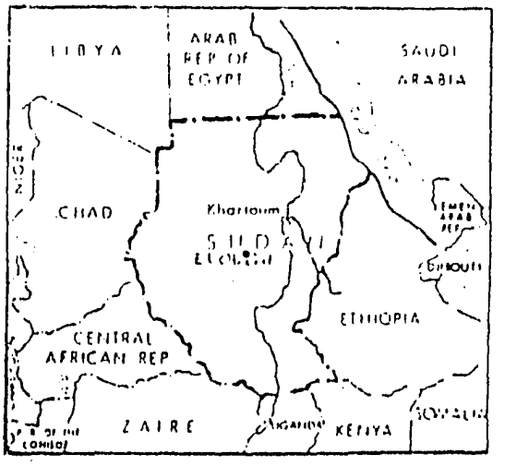
MAP 3



Rural Councils in the Project:

1. KAZGEIL
2. ER RAHAD
3. ED DUBEIBAT
4. HAMADI
5. HABILA

100 KMS



and potential productivity under improved management. Equally important, for those areas clearly deficient in forest resources, the mapping exercise will lead to further investigations on the viability of re-establishing tree cover through plantations, agroforestry interventions or community forests.

Aerial photo interpreters will analyze the images (1:250,000) to visually stratify forest cover into broad classes for eventual verification and refinement. The stratification, based on the SERISS experience suggested for the classes, of forest crown cover is: 1)Category A - 10% to 25%; 2)Category B - from 25% to 75%; and Category C from 50-75% and Category D - greater than 75%. In view of high variability in woodland density, ranging from very sparse woody vegetation (open woodland) to very dense (closed forests), it is essential to get a clear idea about the magnitude of this variation. While the CFA has few trained remote sensing specialists, past experience indicates that qualified individuals can be seconded from the National Remote Sensing Center, Department of Survey, the Range and Pasture Administration and the Soil Survey Administration (Wad Medani). Some third-country training and Khartoum-based workshops intend to address practical training needs. The proposed contract with RCSSMRS in Nairobi will provide access to required specialists presently unavailable in Sudan.

Using foresters familiar with the areas under study and limited ground truthing, an initial interpretation and classification of broad species categories will be attempted. Later large scale aerial photography will be employed to verify and modify this stratification. It is suggested the minimum resolution during stratification be limited to 100 ha. areas. This will undoubtably change in high production areas and in forests proximate to populated areas. Classes for useful stratification will necessarily evolve during the inventory process. These vegetation and physical details on the 1:250,000 scale maps will later be transferred to 1:1,000,000 general forest maps for national planning use.

Sample surveys will be conducted on a provincial basis which seek to identify the quality and quantity of forest resources within 20 percent at a 95 percent probability level. Biomass and volumetric estimates will be determined by non-destructive sampling techniques to provide this data. These will be wide estimates showing the approximate quantities of standing forest stock, which will be most useful as tools to guide national policy and monitor the increase or decrease of forest cover.

(ii) Operational Survey

The second activity of the Resource Inventory Component is an Operational Survey. This activity corresponds to in the-field work to ground truth information developed during the Reconnaissance Survey and to provide additional details which would be required either to develop forest management or re-establishment plans. This activity follows the two-phased schedule for the Resource Inventory Component. The Operational Survey begins with the identification and prioritization of areas which should be considered in more detail. Priorities will be based upon several factors including: the level of degradation or environmental pressure and the availability of high standing

SUDAN—THEMATIC MAPPER COVERAGE

MAP 2

forest volume with good growth potential and need for immediate management plans. The end result of this exercise is a series of Primary Sampling Units (PSU's) which represent specific locations in the Project area.

Descriptions of the areas to receive more intensive work during this activity will be obtained from the 1:250,000 satellite imagery and enlargements. Additional large scale aerial photography will be required as the sampling frame resolution becomes more precise. Area-based sampling techniques and supporting remote sensing tools will be dependent on the size of the area, biomass density or marketable timber, accessibility and management priorities/capabilities. As the inventory moves toward the ground, considerable area to area variation can be expected.

Data required during the implementation of the operational inventory includes:

- Geographic extent of forest areas
- Spatial distribution, by species composition, of forested land
- Biomass and volume of useable/marketable forest
- Estimates of the forest growth and regenerative capacity
- Land-use capability - present versus potential use
- Legal status, ownership patterns

The Operational Survey will be implemented in the selected PSU's by the Forest Inventory, Reservation and Management Section (IRM) field teams, guided by the Inventory Team Leader. Assisted by large scale photographs, the team will locate the sites and begin the ground-based inventory necessary to validate sub-Provincial and Provincial-estimates as well as the real growth rates around which management plans will be eventually developed. The field team results will be reported back to the IRM Headquarters in Khartoum, which will subsequently forward tabular results to the Central (CFA) Directorate.

b. Component Outputs - Resource Inventory

The outputs of the Resource Inventory Component will be a set of cartographic and statistical products for southern Kordofan and southern Darfur designed to enhance Sudan's capability for resource planning and management. Given that this Component utilizes a wide set of somewhat sophisticated tools and techniques, some deviation in the proposed inventory methodology can be expected. For example, the numbers and scales of maps are likely to undergo revision. By necessity, sampling frames and techniques will also change as teams begin ground-level inventories and encounter problems and ways of taking better advantage of the tools at their disposition. Certain deviations from the list of physical outputs (listed below) are therefore to be expected.

(i) Two thousand multi-thematic base maps (1,250,000) of southern Kordofan and southern Darfur:

- UTM coordinates, latitude and longitude grid lines, titles and other annotations.

- Cultural features (transportation networks, infrastructures).

- Administrative features (boundaries for Regions, District and Rural Councils, and neighboring countries).

- Legal boundaries (national parks, forest reserves, irrigation zones etc.)

- Physical features (elevation of specific locations, water courses, geologic formations).

- Existing land-use (farming, forests, rangeland, desert, swamps, communications links, etc.)

- Population and settlement distribution.

(ii) Five hundred forest maps of southern Kordofan and southern Darfur including:

- General Forest Maps at 1:1,000,000 scale identifying the overall forest resources and physical infrastructures of the Project area.

- 1:250,000 scale maps of Southern Kordofan and Southern Darfur Provinces illustrating the extent of forest resources and other major land uses such as agriculture, range and pasture, surface water, and communication links larger than 100 ha. in size.

- Individual maps at larger scales will be produced of specific Forest Reserves and plantations illustrating forest distribution by area, species, age, density class and their physical relationship to transportation networks, markets and demographic patterns.

- Analogue representations of digitized forest maps on 1:50,000 scale. These will form the basis for the interactive Geographic Information System (GIS) to be used to monitor changes in the forest resource. These GIS "maps" will be developed from the data collected below.

(iii) Statistical tables and tabular results will include:

- Area of forest and non-forest area by crown cover classes and forest types;
- Break-down of legal status of forest resources;
- Age class and composition distribution;
- Standing volume and biomass estimations, including brush;
- Estimations on rates of harvest, planting and depletion;

41

- General soil taxonomies located in the area;
- Expected (under given management) regenerative capacity;
- Area under gum arabic fallow/production and rehabilitation.

Reserve-specific details for gazetted (community and privately owned/operated) forest land will include all the above baseline statistics (at the + 20% @ 95% probability level) plus:

- Demographic patterns encompassing the forest;
- Estimated existing and hypothetical animal carrying capacity;
- Annual growth rates of forest type and age class;

(iv) Improved institutional capacity to acquire, analyze and manipulate data in the support of sustained yield forest management will be demonstrated by:

- Four technician-level and two M.Sc-level foresters will receive short-term, third country and on-the-ground training in remote sensing and forest inventory techniques.

- Development of a functional Forest Inventory and Planning Unit at the National level.

c. Component Inputs

The following is a summary of USAID and GOS contributions to the Inventory Component:

(i) AID Contribution (Total): $ 2,626,871

(a) **Technical Assistance** ($ 837,480): 3 person-years of long-term technical assistance and 10 person-months of short-term TA is provided for as follows:

POSITION	PERSON YEARS	PERSON MONTHS	DUTY LOCATION
Chief Technical Advisor	3	0	Khartoum/Kordofan/Darfur
Imagery Enhancement Expert	0	2	" " "
Forest Mensuration Expert	0	2	" " "
GIS Specialist	0	2	Khartoum
Workshop Facilitator	0	4	Khartoum

(b) **Training Inputs** ($36,354) within inventory activities include third country training at RCSSMRS and a series of short in-country workshops as follows:

Training Exercise	Person-Months
In-service training at RCSSMRS	8
Training workshops (Sudan)	40

The U.S.contribution to these training exercises will include the foreign exchange costs of transportation, lodging, and tuition for external training. For the in-country workshops limited foreign exchange support will be required for instructors and training materials.

(c) **Commodities** ($ 1,418,536) for this component's implementation the following commodities will be financed. Production of base maps, imagery acquisition, aerial photos, lab equipment, photo/satellite interpretation, field equipment, office equipment, vehicles, and computers. A complete list of the commodities to be financed is included in Table 13 in Annex F.

(d) **Logistical Support** ($95,682) is provided to use foreign exchange to purchase spare parts for vehicles and in emergency instances fuel and lubricants.

(e) **Contingency** ($238,819)

(ii) Host Country Contribution (LS 4,466,684 = $1,089,434) to the Inventory Component will include the field costs of the Sudanese staff, housing and office rental, in-country travel, vehicle operations, aircraft charter, ground truthing, office supplies, and utilities. These resources are presented in Table 7 of Annex F.

d. Beneficiaries

The users of the Resource Inventory Component will be various central and regional government organizations, which will obtain access to reliable information regarding extent, distribution, typology, species associations and growth characteristics of woody vegetation. The Central Forest Administration, as the principal beneficiary of the Project, will utilize the base maps and specific forestry information to develop management plans, and rehabilitation plans, draw up and implement forest reservation plans at a much faster rate than at present, and improve the monitoring of its wood and timber resources.

The Ministry of Agriculture and Natural Resources (MOANR) has access to additional information on forests which are important agricultural resources. Futhermore, the MOANR will be able to use the forest information to complement the data generated through SERISS and other crop estimation projects. Base maps and the Resource Inventory data will be of direct benefit to the Relief and Rehabilitation Commission (RRC) in facilitating their efforts to identify and rehabilitate desertified areas.Resource information, communication links and identification of areas of greater stress are particularly important to the RRC in their Famine Early Warning System (FEWS) program.

These maps will assist the entire GOS in its overall development planning exercises in sectors such as health, communications (roads, bridges, telephones, etc.), water resources, agriculture, animal husbandry, and wildlife management.

The Rural Council, District and Provincial levels, the regional governments will also have access to improved information on their natural resources. This information can very effectively be used in regional development planning to facilitate more rational distribution of resources and also facilitate closer monitoring of various development initiatives.

Institutions of higher education, including the four national universities will utilize information generated from the Resource Inventory for teaching and research purposes.

To the extent that Project -generated information is used by the above organizations it should also benefit rural farmers.

2. Resource Rehabilitation Component

a. Component Description - Resource Rehabilitation through Participatory Forestry

The Resource Rehabilitation Component addresses the problem of resource degradation in southern Kordofan and focuses on an area covered by five Rural Councils. These councils include: Kazgail, Hamadi, Ed Dubeibat, Habiela and Er Rahad. The causes of resource degradation have been discussed in an earlier section. This Component supports two categories of rehabilitation activities: participatory forestry including natural forest management and agroforestry.

This Component is structured to involve rural people in the management of natural resources. Specifically it attempts to: 1) address the problems of degradation and desertification of natural woodlands through involvement of local people in forest management and protection; 2) reverse the decline of gum gardens through on farm reforestation program for farmers; and 3) stem the decline in depletion of soils through various forms of agroforestry. This approach requires a efficient extension network, with strong ties at the farm level. Recognizing the present institutional structure and capacity to implement such activities is limited the project will support extension activity to assume such responsibilities and functions.

An extension training program will therefore be developed and implemented for officers and staff working on the project. The program will consist of a series of in-service courses for each job category taking into account job responsibilities and functions and previous training and experience. The courses will cover technical topics, such as communication techniques, and relevant management skills. Attention will be given to methods for facilitating participation of men and women in project activities. Data collected by the Monitoring and Evaluation

Section will be incorporated into the courses and will help determine the course content. Various teaching techniques will be used that are appropriate for adult learners. Field trips will be conducted to other village based forestry and agroforestry project areas in the Sudan for a limited number of staff.

In addition, local leaders, village nursery supervisors and village extension workers will be trained. Training will be based on appropriate methods of adult education and incorporate "hands-on" experience. A series of courses will be given for the nursery supervisors and extension workers incorporating feedback from supervisors and the Monitoring and Evaluation Section. These courses will include: extension methodology, nursery management and seedling production, and tree planting. Field trips inside and outside the project area will be made by members of this cadre. To promote the involvement of women, visits will be made to sites of related projects which focus on women's participation.

(i) Natural Woodland Management

The maps and statistical data provided by the resource inventory component will provide information for devising plans for the development, protection and management of the forest resources in the five council areas. The plans will identify and prioritize actions that will guide the participatory forest management activity. While these plans are being developed during the initial months of the Project, actions will be based on available information on existing forests and critical denuded areas that need reforestation.

One of the first tasks of this activity is the identification, demarcation and reservation of forests/woodlands and critical denuded areas within each of the five Rural Councils into the following categories:

a. Community forests/woodlands
b. Private forests/woodlands
c. Institutional forests/woodlands
d. Regional forest reserves
e. National forest reserves

Based on information obtained through the resource inventory and estimates based on the results of project household surveys, and other relevant sources a determination will be made by project staff on whether sufficient community forests/woodlands are available for meeting the domestic fuel and wood products requirements of the local population. If not, areas of existing regional and national forest reserves will be set aside to assist in meeting the domestic needs of the local population and those areas will be designated as community forests.

Management plans will be developed for various categories of forests/woodlands based upon the individual category and objectives. Management plans for community forests/woodlands will be based on the

results of surveys in the respective communities which identify preferred end-uses and species and take into consideration the unmet needs. Implementation of the management plans will rest with the related entity: community, individuals, institutions, regional administration and national forest department. To demonstrate appropriate forest management, the Project will also implement management plans in regional or national forest reserves. In order to perform a demonstration function, these reserves will be evenly distributed in the five Rural Councils and be managed for varying objectives such as fuelwood production, charcoal production, timber, poles, protection of reservoirs or a combination thereof.

Depending on the condition of the forest area, the management prescription may include promoting natural regeneration, artificial regeneration (through seeding or planting), and/or establishment of firelines and nomadic corridors. The success of the management prescriptions depends on the interests of the neighboring inhabitants and migratory population. As for community woodlands/forests, the benefits will need to be equitably distributed so that all members have a stake in maintaining this resource. A formal, written agreement will be drawn up for community woodlands/forests that delineates the responsibilities, rights and obligations of the community and the forestry department.

Because a significant number of woodland/forest management prescriptions will call for planting or seeding, quality seeds must be available. Also, the agroforestry activity will need seeds. It is expected the predominant species for such interventions will be Acacia senegal. Therefore, the project will strengthen the seed quality improvement program of the Gum Arabic Research Station in El Obeid to ensure an adequate supply of improved seeds. Technical assistance and funds for the establishment of seed stands for high gum yielding strains will be provided by the project. A total area of 200 feddans will be reserved and managed for this purpose.

(ii) Agroforestry/Extension

The Project's agroforestry activities propose direct remedies to the desertification problems of the communities included in the five Rural Councils of southern Kordofan. The strategy for the Component is to establish an extension and nursery network, which will allow the Project to respond to local needs and provide rural communities with technical advice and basic planting materials. The initial set of agroforestry interventions have been identified through the technical analysis and socioeconomic survey conducted during the project design phase. These include: 1) increasing the area and per unit production of gum arabic-bush fallow system; 2) increasing the area under intercropping schemes with particular emphasis on reintroduction of Acacia albida; 3) improving and extending areas under alley cropping and hedgerow farming, 4) creating windbreaks and shelterbelts; and 5) improving and expanding horticultural production. Thus, the training of staff and the nurseries established will initially concentrate on the associated technologies.

The availability of tree seedlings for farmers in the Project area is critical to achieve the aims of the Project. Initially, the best method of providing the maximum supply of seedlings to meet the farmers demand is to establish nurseries. The Project will support a network of five central nurseries, and 100 self help nurseries.

The Nursery/Demonstration Centers will be sited on an area of approximately 25 feddans provided by each of the Rural Councils. Twenty feddans will be set aside and utilized to serve as a demonstration area for various agroforestry models and as the site for Extension/Training classroom, office, and store. A portion of this area will also be reserved for production of such seeds as are difficult to obtain, such as Acacia albida, Tamarindus indica, and xemenia africana. In addition, a 5 feddan Central Nursery will be established adjacent to the demonstration center, with a production capacity of 500,000 seedlings. These Central nurseries will also process and store seeds of various species for distribution. The seedlings and seeds at the Central Nurseries will be sold and the money will be deposited in a revolving fund to finance the recurrent costs of these nurseries by the end of project. The Regional Forestry Department will manage these Nursery/Extension Centers. Since this system involves the securing of appropriate staff and their training, Project implementation will begin in one Rural Council and coverage of the other four will be phased over the first three years of the project.

Nurseries will be established in 100 villages, with capacities ranging from 5,000 to 10,000 seedlings. These will be established adjacent to the water yards where possible. Where such water yards do not exist, hand dug wells will be constructed. The labor for both the nurseries and hand dug wells will be provided by the villages. The project will provide materials and technical advice. The operation and management of these nurseries and wells will be the responsibility of the village. Water and seedlings will be sold to pay for maintenance costs of both the wells and nurseries. A survey will be conducted in each participating village to determine the predominant species for that village nursery.

Through demonstrations at the Nursery/Demonstration Center and on farmer plots and fields the Project will attempt to influence the traditional management practices. Farmers will be encouraged and assisted to adopt optimum temporal and spatial combinations of tree-based agricultural systems. The agricultural research station at El Obeid, the center of the USAID-financed Western Sudan Agriculture Research Project, will play the lead role in the adaptive research effort. Adaptive research and demonstration plots will be established at the Nursery/Demonstration Centers for verification and refinement of promulgated technologies over a wide range of soil types. The research staff will help to assure that methodologies for measuring crop yields under various systems are accurately designed.

A functioning extension and training system is the basis for identifying local production problems and introducing technology to improve

traditional agricultural systems by incorporating multi-purpose tree species. Currently, there is no agricultural extension service operating at the village level in the Project area. The Project will support the creation and development of an extension system to support agroforestry activities. This system is designed in a tiered structure.

The Village Council Extensionist (VCE) is at the base of the Project's extension system. He/she will be based in one of the 200 target villages and provide extension services to two to three villages. In the participating villages, the VCE will help establish village nurseries, promote agroforestry practices, and provide technical advice. Due to the large proportion of full time farmers who are women in the Project area, preference will be given to hiring women as VCE's. The female extensionists may assist with extension activities on woodfuel conservation, e.g. improved stoves or improved cooking methods, that are under other projects. They will also participate in some data collection efforts.

The Village Council Extensionists will be supported by Area Coordinators who are experienced technicians, e.g. foresters and agriculturalists. Each Coordinator will be responsible for the supervision of approximately 4 VCE's. Coordinators will be expected to spend most of their time visiting village nurseries and on-farm demonstrations. The Coordinators will also report on technical and management problems to Rural Council Project Officer(RCPO).

Five RCPO's will be recruited-from the ranks of Assistant Conservator of Forest cadre, of the CFA, and will be responsible for all Project activities within each of the respective Rural Councils. At the technical level, the RCPO will provide support to the Area Coordinators, establish and manage Nursery/Demonstration Centers, and prepare project performance reports. Administratively, the RCPO will represent the Project at the Rural Council. The RCPO will be supported by a staff of four extension officers and two Nursery/Demonstration Center supervisors. The extension officers include: a Forest Ranger for forest management and rehabilitation, a Forest Extension Officer for nursery support and technical advice on tree planting , an Agricultural Extension Officer for providing technical advice on agroforestry and other on-farm agricultural activities, and an Extension Training Officer for farmer and staff training.

The RCPO reports to the Project Manager in El Obeid. The Project Manager who constitutes Project's long-term technical assistance shall have a specialization in agroforestry. The Project Manager will have a counterpart Co-Project Manager of the rank of Conservator of Forests. The technical support team in El Obeid will consist of: an Extension Training Specialist (Project Funded) with a GOS counterpart; a Forest Rehabilitation Coordinator of the rank of ACF, and a Monitoring and Evaluation Expert (Project Funded).

48

(iii) Monitoring and Evaluation

Monitoring and evaluation efforts is an integral part of both the management of natural woodlands and agroforestry activities. A full time Monitoring and Evaluation Section is financed under the project to undertake the following tasks:

a) develop questionnaires and monitoring forms in collaboration with the technical officers and the testing and revision of these;

b) train individuals responsible for collecting the data and make arrangements to ensure adequate supervision;

c) process data and analyse project surveys and other sources for the forestry management activity;

d) publish and distribute reports;

e) serve as a repository of project data and related information; and,

f)in collaboration with the training section, devising a method for assessing the training activities and their effect.

Funds will be available to the Monitoring and Evaluation Section for contracting services to carry out special topic studies, especially those not based on survey methods. --

To assist in the final selection of villages that will actively participate in the participatory forestry activities, an initial reconnaissance will be carried out on those initially slated for involvement. The reconnaissance will concentrate on a) the pattern of land distribution, tenure and rights, b) evidence of the strength of local organizations and leadership in implementing self-help activities, and c) willingness to participate and undertake measures both to ensure maintenance of land and tree rights and to sustain nursery and extension efforts in the village. After the final selection a survey will be conducted to address a) the needs of households with respect to food, fodder, fuelwood, charcoal and other forest products, b) priority end-uses and species preferred for each, c) attitudes, knowledge and practices associated with different participatory forestry configurations and the preferred configurations. It will also address land and tree tenure and rights, with special attention on women and recent settlers and grazing rights. Data analysis will be based the sender of the respondent.

To guide in the planning and implementation of forest/woodland management plans, surveys will be undertaken to supplement data from other sources on: a) the unmet needs of the population with respect to food, fodder, fuelwood, charcoal, poles and other forest products, b) priority unmet end-uses and preferred species for each end-use, and c) ethnobotanical knowledge. In those areas slated for community forests or woodlots,

information will be gathered to assist in organizing and managing local participation in the management, and possibly planting, of forest resources. Data analysis will be disaggregated by the sender of the respondent.

Monitoring will center on nursery records and an annual follow-up of participating farmers to provide feedback to project management and extension training officers about problems of management and survival of seedlings, evolving species preference, changing attitudes toward alternative configurations, and effectiveness of extension services and demonstrations.

Monitoring section will also include liaison with Agricultural Research Corporation (ARC) El Obeid Center and Faculty of Agriculture, University of Khartoum. Services of scientists at ARC will be utilized for conduct of various adaptive research projects in the project area on subjects like soils, agroforestry, and gum arabic.

Fellowships for graduate students (M.Sc. & Ph.D levels) have been provided under the project (3 in Forestry and 1 in Agriculture each year for 5 years). The Monitoring Section will liase with the Faculty of Agriculture in Khartoum and assist in the development of research projects for graduate level dissertation by the students. The students will conduct research in the project area, on subjects, as mutually agreed upon by the Project Management and Faculty of Agriculture. The subject should include soils, soil-plant relationships, tree-crops inter face, other aspects of agroforestry, forestry extension reforestation and woodland management.

The Section will be headed by a long-term technical assistance position who will provide on the job training to a Sudanese counterpart hired as the associate. The latter is expected to take full responsibility during the final years of the Project. In addition a computer data entry person, secretary and other support staff will be hired with local currency funds.

b. Component Outputs - Resource Rehabilitation

The following outputs will be achieved by the end of the project. The indicators of achievement of these are specified below.

i. A system of participatory forestry will be operational.

- 50,000 Feddans of woodlands under management including 25,000 feddans of community forests.

- Forest management models are developed that are socially, economically and technically sound and sustainable.

ii. Increased production on a sustainable basis results from agroforestry interventions.

- 60% of the households in participating villages increase their production of food, fodder, woodfuel or gum arabic.
- 50% of the participating farmers are women
- 25,000 feddans of degraded gum gardens rehabilitated.
- 11,000,000 seedlings and 6,000 kilograms of seed are produced and distributed.
- 5, 25 feddan nursery/demonstration centers established.
- 50 kms of windbreaks and shelterbelts have been installed.
- 200 feddans of sed stands of Acacia senegal established.

iii. The GOS institutional capacity for resource rehabilitation programs is enhanced.

- A network of Forestry Extension in place.
- 100 village self-help nurseries, and 5 central nurseries producing an adequate number of tree seedlings and mix of species to meet local demand.
- 20 officers who received short term, out of country training are working on the project.
- 25 area coordinators, 100 Village Extension staff, and 100 male and 100 female village contact persons, and 15 forestry extension officers trained and performing their assigned functions.
- 20 fellowships awarded to Faculty of Agriculture for gradutate students would have added to the available knowledge on forestry and related problems in semi-arid regions.
- A monitoring and evaluation system is available for participatory forestry activities.

c. Component Inputs

The following is a summary of USAID and GOS contributions to the Resource Rehabilitation Component:

(i) AID Contribution (Total): $ 5,277,622

(a) Technical Assistance ($ 3,555,187): 13 person-years of long-term technical assistance and 19 person-months of short-term TA is provided for as follows:

POSITION	PERSON YEARS	PERSON MONTHS	DUTY LOCATION
Project Manager(Agroforester)	5	0	El Obeid, Kordofan
Extension/Training Specialist	4	0	" " "
Monitoring/Evaluation Expert	4	0	" " "
Soil Agronomist	0	2	" " "
Agroforestry Research Expert	0	2	" " "
Rural Sociologist	0	3	" " "
Seed/Tree Improvement Expert	0	3	" " "
Tropical Forest Mgmt Expert	0	6	" " "
Extension Specialist	0	3	" " "

(b) Training Inputs ($ 84,950_) within rehabilitation activities include third country training and a series of short in-country workshops as follows:

Training Exercise	Person-Months
In-service Technical Training	10
Training workshops (Sudan)	125
Study Tours	18

The U.S.contribution to these training exercises will include the foreign exchange costs of transportation, lodging, and tuition for external training. For the in-country workshops limited foreign exchange support will be required for instructors and training materials:

(c)Commodities ($ 793,390) for this component's implementation the following commodities will be financed: Nursery tools and implements, extension equipment, seed and soil testing kits, seeds, office supplies, field Equipment, office equipment, vehicles, and a computer. A complete list of the financed commodities is included in Table 13 in Annex F.

(d)Logistical Support ($364,311) is provided foreign exchange for spare parts and in emergency situation, financing for fuel and lubricants.

(e)Contingency ($479,784)

(ii) Host Country Contribution (LS 25,757,925 = $6,282,421) to the Resource Rehabilitation Component will include the costs of the Sudanese support staff, housing and office rental, in-country travel, vehicle operations, aircraft charter, office supply/utility, seedling production, establishment of village nurseries, and Rural Council Nursery Demonstration centers, hand dug wells, research projects, fellowships and local consultancies.

52

d. Component Beneficiaries - Resource Rehabilitation

The main target population are traditional farmers in the five rural councils. They will benefit from: 1) increased productivity on their land by adopting agroforestry practices which conserve the soil and add organic matter and nitrogen; 2) an increased supply of forest products such as fodder and fuelwood; 3) higher cash incomes from the production of gum arabic and horticultural products; and 4) increased supply of food, such as fruits and vegetables for domestic consumption. Two hundred villages are expected to be actively involved in the project, that is those in which a Village Council Extensionist is based and at least one other village per extension coordinator. In these villages approximately 60 percent of the households are expected to adopt improved agroforestry practices. It is anticipated that at least 50% of the farmers utilizing improved practices and directly benefiting from these will be women.

In addition, all villages in the five rural councils will indirectly benefit from the forestry plans which include the gazetting and reservation of community forests. Under the project approximately 30 communities are expected to be assisted to develop community forests through technical advice and access to seeds or seedlings. The management plan for each of these community forests will be based on the objectives as stated by the community.

D. Relationship to Other Donor and Relevant USAID Projects

There are a number of important relationships between the Resource Inventory and Resource Rehabilitation Components of the Project and other development activities in the Kordofan and Darfur regions. These include projects in the USAID portfolio and those of other donors.

(i) Other Donors

Other major donors who support forestry development activities include the Dutch, the Finns, the Germans, the British, UNDP and FAO. The World Bank has led the multi-donor forestry sector review and is preparing a five-year forestry development program for the Sudan. A number of forestry related rural development activities are supported by EEC, CIDA, SF, Kuwait, Oxfam, DANIDA, SIDA, and others. PVO's who have forestry programs in their portfolio include CARE, Save the Children (US), SOS Sahel, Green Deserts, CONCERN, and Inter Aid.

The activities planned in the SRAAD project are expected to generally benefit the activities of other donors, not only those that support forestry but also those that support rural and community development. This Project will specifically support the activities of other donors in the field of natural resource management. These activities include:

- The Nuba Mountains Rural Development Project in South Kordofan, financed by the EEC, started in 1980. The objective of this Project is integrated rural development through extension services, the introduction of improved varieties of seeds, animal traction, provision of credit for improved tools and implements, animal husbandry and community forestry activities.

- The UNDP/UNSO Gumbelt Restocking Project, started in 1981, aims at restocking of the gumbelt with trees of Acacia senegal through production and distribution of tree seedlings and extension services, in Um Ruwaba (northern part), Bara and El Obeid districts of Kordofan.

- The OXFAM/EEC projects in Kordofan and Darfur, aim at agricultural extension and community forestry through peoples participation, providing extension services and establishing village level nurseries for forestry and fruit tree seedling.

- Finnish aided reforestation project in Tendelti in White Nile Province aims at reforestation through planting of Acacia senegal and Prosopis species by establishing central production nurseries (over 500,000 capacity) and extension services for planting, maintenance and tapping of gum arabic (Acacia senegal).

- The EEC funded Jebel Marra Rural Development Project in Darfur addresses agricultural development through an intensive extension program involving distribution of improved seeds, animal traction, improved tools and implements and encouragement of women's participation in agricultural development.

- The German funded Jebel Marra Development Project in Darfur addresses industrial forest development through softwood plantation programs on the western slopes of Jebel Marra; creation of man made forests through afforestation; and development and implementation of management systems for existing woodland resources in the Jebel Marra area for industrial use.

- The Western Savannah Development project, funded by the World Bank, IFAD, ODA and SF, in Darfur started in 1981, is based in Nyala and aims at rehabilitation of wateryards, improvements of roads, development of appropriate range and pasture management systems, and animal husbandry. A strong extension component of the project provides services to small farmers and pastoralists for agricultural development, animal husbandry and pasture management. The project has also established seed production areas for reseeding pastures.

- The World Bank in its Forestry Sector Review of 1986, which included significant participation by AID has clearly pointed out the necessity and importance of resource inventories as a tool for planning and management of forest resources. Availability of information on forest resources and resource rehabilitation will greatly facilitate the development and implementation of their five year forestry development plan in which various donors such as the Dutch, Finns, Germans, FAO and UNDP are expected to participate.

- A number of PVO's active in various rural development efforts through waterward rehabilitation, agricultural development, agroforestry and community forestry, with varying degrees of success include CARE, Save the Children (US), OXFAM (UK), German Agro-Action, Euro Action Accord, SOS Sahel, Green Deserts, CONCERN, and Inter Aid.

(ii) USAID Projects

The USAID projects that will complement, or be complemented by, the SRAAD Project include the following:

- As mentioned above, the SRAAD Project complements the efforts of the SERISS (650-0076) Project. SRAAD will utilize the materials, personnel, and information gathered through the SERISS project and develop base maps, forest maps, and inventory data which will complement and enhance the earlier SERISS information. This will result in a more comprehensive picture of natural resources in Kordofan and Darfur regions.

- The Western Sudan Agricultural Research Project (WSARP) 650-0020 was initiated in 1978 with the purpose of increasing the capability of the Agricultural Research Corporation (ARC) to develop and test improved production systems that conserve and rehabilitate natural resources and improve the standard of living of subsistence farmers and pastoralists of Western Sudan. The SRAAD project will generate information about the Western Sudan's distribution of natural resources which will be utilized by the WSARP Project in conceptualizing and developing research programs for the conservation and rehabilitation of natural resources. In turn the SRAAD Project depends upon the WSARP Project to provide applied research for various tree crops, particularly gum arabic and various agroforestry systems.

- The Kordofan Rain-fed Agriculture Development Project (KORAG - 650-0054), started in 1986, aims at the development of feeder roads, grain storage facilities and agriculture credit for small farmers in Kordofan. The KORAG Project will benefit from the base maps for Western Sudan provided by SRAAD.

- The Western Agricultural Marketing Roads Project (650-0069), aimed at complementing the KORAG project in Kordofan, links the main markets of Kordofan with those of the central region and Khartoum. This project will also utilize the base maps developed under the SRAAD Project for monitoring the environmental effects and impact of the project. Both these projects (KORAG and WSAMR) will facilitate communication links in the project area that will be of immense value in project implementation.

- The Sudan Renewable Energy Project (650-0041), which began in 1981, aims at increasing the utilization of charcoal by 50% and to increase fuelwood on mechanized farms. The SRAAD Project through its reforestation activities will directly complement the SREP Project.

IV. COST ESTIMATES AND FINANCIAL PLAN

A. Project Costs

1. Overall Project Costs

The Project cost is $15,500,000 over the five-year project period.

TABLE 1
SUMMARY OF PROJECT COSTS
(US Dollars)

Description	USAID Contribution	GOS* Contribution	Total Project Costs
1. Resource Inventory Component	$2,626,871	$1,089,435	$3,716,306
2. Resource Rehabilitation Component	$5,277,622	$6,282,421	$11,560,043
3. Other Project Support	$95,507	$128,144	$223,651
Total Project Costs	$8,000,000	$7,500,000	$15,500,000

This sum reflects the following contributions: AID - $8,000,000 and the GOS - $7,500,000. Total Project costs by funding categories are found in Table 2.

TABLE 2
SOURCES AND USES OF AID FINANCING

Funding Categories	USAID	GOS
Technical Assistance	$ 4,392,667	962,256
Training	121,304	383,945
Commodities	2,211,926	425,830
Construction	0	1,135,230
Logistical Support	459,993	3,794,426
Evaluation/Audit	86,825	128,144
Contingencies	727,285	670,169
TOTAL	$ 8,000,000	$ 7,500,000

* Note: The foreign exchange rate used in developing this budget is $US 1 = 4.1 Sudanese pounds.

2. AID Contributions

The AID grant contribution to the Project will provide $8,000,000 or 52% of the total costs. Budget Table 1 contains a summary of AID's contribution as follows: Resource Inventory $2,626,871; Resource Rehabilitation $5,277,622; and other Project Support $95,507.

Details for each component are contained in Tables 4 - 5 in Annex D. A summary of AID financing is found in Table 3 in the same Annex.

3. GOS Contribution

The Government of Sudan contribution to the Project is the equivalent of $7,500,000 which represents 48% of total costs. A summary of the GOS contribution is contained in Table 6. The GOS contribution to the two components (in dollar equivalents) are: Resource Inventory, $1,089,435; Resource Rehabilitation, $6,282,421 and other project support $128,144. Budget details of the GOS contribution for each component are contained in Budget Tables 6 - 8 in Annex D.

Local Currency costs are supported both by the Project Trust Fund Account and the Special Local Currency Accounts established by the Project. The Trust Fund will provide funding for the direct support costs of the contractor personnel. Such costs will include, but not be limited to, the costs for housing, utilities, local transportation, and assorted moving costs. Two Local Currency Special Accounts will be established, one for each of the major project components, to cover the local currency financing for other project procurement denominated in Sudanese Pounds.

4. Recurrent Costs

New GOS recurrent costs have been minimized in the design of the SRAAD Project by utilizing, to the extent possible, existing GOS resources to support Project activities. For the Resource Inventory Component, most project costs are either capital items or one-off services which will not have recurrent liabilities on the GOS. The maintenance and upkeep of the various maps and data generated by the project will be borne by the existing CFA staff of the Inventory Unit, thus no additional recurrent funds are needed.

For the activities included in the Resource Rehabilitation Component additional recurrent costs are expected. For the management of national woodlands and agro-forestry activities the recurrent costs will be borne by farmers. The additional costs, can be financed by the higher returns which farmers earn from these practices as described in Annex D.4. For the nursery activities, the project intends to make them self sufficient from the start through various cost recovery mechanisms described in the Project Paper. GOS extension services will require additional recurrent budget support. Various alternatives for financing these extension costs will be developed during the life of project.

B. Financing Plan

1. Obligation Schedule

The proposed schedule of obligations for this Project is as follows:

Table 2a: AID Obligation Schedule
(U.S. $ Thousands)

	FY 1987	FY 1988	FY 1989	FY 1990	FY 1991	FY 1992	FY 1993	Total
Tech Asst	800	1,200	2,400	-0-	-0-	-0-	-0-	4,400
Training	10	50	60	-0-	-0-	-0-	-0-	120
Commodities	1,000	500	700	-0-	-0-	-0-	-0-	2,700
Construction	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Logistical Support	10	70	380	-0-	-0-	-0-	-0-	460
Evaluation and Audit	-0-	20	70	0-	-0-	-0-	-0-	90
Contingencies	180	160	390	-0-	-0-	-0-	-0-	.730
TOTAL	2,000	2,000	4,000	-0-	-0-	-0-	-0-	8,000

2. Methods of Implementation and Financing

A review of alternative methods of implementation and financing from the standpoint of funds accountability and project needs has been conducted during the course of the PP design. Host country contracting was considered by the design team; however, it was determined to be inappropriate for this project based upon the administrative limits of the host country institutions. The preferred methods of implementation are: (1) Direct AID contracting, using direct pay or direct reimbursement procedures for foreign exchange costs; and, for logistical support and construction services; (2) Host country arrangements for those procurement financed from the GOS Special Local Currency Account. These two methods of implementation conform to USAID/Sudan's current policies on program financing and implementation.

Table 3 outlines the preferred methods of implementation and financing for Project activities. These are discussed in the next section.

TABLE 3: METHODS OF IMPLEMENTATION AND DISBURSEMENT

CATEGORY	METHOD OF IMPLEMENTATION	METHOD OF DISBURSEMENT	AMOUNT (US$)	AMOUNT (LS)
a. Resource Inventory Component				
(i) Technical Assistance	Direct AID Contract	Direct Payment		
-(Foreign Exchange)	Contractor	Reimbursment	837,480	
-(Local Costs-Trust Fund)	USAID	Direct Payment		414,000
-(Local Costs)	Host Country	Cost Reimbursement (GOS Special Acct)		518,906
(ii) Short Term Training	AID/GOS Contractors	Direct Payment		
-(Foreign Exchange)	Contractor	Reimbursement	36,354	
-(Local Costs-Trust Fund)	USAID	Direct Payment		96,000
-(Local Costs)	Host Country	Cost Reimbursement		180,000
(iii) Commodities	AID/GOS Contractors	Direct Payment		
-(Foreign Exchange)	Contractor	Reimbursement	1,418,536	
-(Local Costs)	GOS Contractor/ Supplier	Direct HC Payment		40,000
(iv) Logistical Support				
-(Foreign Exchange)	AID Contractor	Direct Payment	95,682	
-(Local Costs)	GOS-HC Arrangement	Direct HC Payment		2,811,716
b. Resource Rehabilitation Component				
(i) Technical Assistance	AID Contractor	Direct Payment		
-(Foreign Exchange)	Contractor	Reimbursement	3,555,187	
-(Local Cost - Trust Fund)	USAID	Direct		1,422,000
-(Local Costs)	Host Country	Cost Reimbursement (GOS Special Acct)		1,590,341

(ii) Short Term Training	AID Contractor	Direct Payment		
-(Foreign Exchange)	Contractor	Reimbursement	84,050	
-(Local Costs-Trust Fund)	USAID	Direct		216,000
-(Local Costs)	Host Country	Cost Reimbursment (GOS Special Acct)		1,082,176
(iii) Commodities	AID/GOS Contractors	Direct Payment	793,390	
-(Foreign Exchange)	Contractor	Reimbursement	793,790	
-(Local Costs)	GOS Contract	Direct Payment		1,705,904
(iv)-Construction Host -(Local Costs)	Direct Country	Payment		4,654,443
(v) -Logistical Support				
-(Foreign Exchange)	AID Contractor	Direct Payment	364,311	
-(Local Costs)	GOS Contract	Direct HC Payment		12,745,432
c. Other Project Support				
-Evaluation/Audits				
-(Foreign Exchange)	AID Contractor	Direct Payment	95,507	
-(Local Costs-Trust Fund)	AID	Direct Payment		525,391

With AA/Africa approval of a non-competitive procurement waiver to contract with RCSSMRS, USAID//Sudan will initiate a financial review of the centers' accounting and contracting capability, through AID's Regional Inspector General (RIG/A/N) Office in Nairobi. Periodically during the Project life, the USAID/Sudan will arrange for RIG/A/N to issue work orders to a certified public accounting (CPA) firm (to be selected through indefinite quantity contract (IOC) to carry out a non-federal audit of the dollar and local currency accounts under the Project for all contracts and/or cooperative agreements and the implementation agencies. The scope of work and work order for the accounting firm is limited to financial and compliance matters and will be prepared by RIG/A/N with guidance provided by the USAID/Sudan Controller. The audit findings, work papers and report will be reviewed by the same office which ultimately will issue an opinion. The Inspector General's office will also ensure that the audit firm's qualifications and performance standards for non-federal auditors are met.

The Contractor will audit for compliance with Project criteria and requirements and the performance of project entities viz-a-viz these criteria and requirements. The terms of reference will include semi-annual auditing of

activities with resulting reports submitted through RIG to USAID's Project Manager. Solicitation and award of the work order is expected to be handled by the RIG/A/N, with the assistance of USAID/Sudan Controller and USAID/Sudan or REDSO/ESA Contracting Office.

Tables 1 and 2 on the preceding pages are the summaries, respectively, of the total USAID and GOS contributions to SRAAD. Full details of Project financing by source and component are described in Budget Tables 1 - 8 in Annex D.

V. PROJECT IMPLEMENTATION

A. Project Management Structure

The Sudan Reforestation and Anti-Desertification Project will be implemented and coordinated on behalf of the GOS by the Central Forestry Administration, headed by the Director, CFA. USAID management responsibilities for the Project will be provided by the USAID/Sudan Agricultural Development Officer or his designate.

The Project's management structure has been designed with several factors in mind. The first is to coordinate the numerous organizations and institutions who are involved both in mapping, natural resource planning, and rural development projects in the Kordofan region. This concern is based upon the fact that the SRAAD Project generates significant amounts of data and detailed information on natural resources which must be productively applied by others. The second factor which has influenced the SRAAD Project management structure is the need to obtain the participation and support of the institutions and individuals who will be required to continue supporting this long term effort after the completion of the Project. Third, there is a clear need for maintaining a strong bridge between the information gathering activities of the project and the utilization of this information for improving Sudan's development programs.

A SRAAD Project Steering Committee, supported by two sub-committees which correspond to the two Project components, will be employed as the principal mechanisms for coordinating project activities. It is also hoped that eventually this committee will be utilized by the GOS to coordinate the activities in the forestry sector. The Steering Committee will meet every six months. It will be responsible for review and approval of annual work plans and oversight of project implementation within the members' respective organizations and through the review of project implementation reports. Furthermore, the Central Steering Committee will be expected to identify points where collaboration and cooperation between agencies and donor financed projects can be mutually beneficial. The Project Steering Committee will include the following representatives:

- Undersecretary, Ministry of Agriculture and Natural Resources - Chairman
- Director, Central Forestry Administration - Secretary
- Director, USAID/Sudan or his Representative
- Chief Technical Advisor(Inventory)
- Co-Project Manager (Inventory)

-Project Leader (Resource Rehabilitation)
-Co-Project Manager (Resource Rehabilitation)
-Representative, Ministry of Finance and Planning
-Representative, Division of Statistics, MOANR
-Representative, Agricultural Research Corporation
-Governor, Kordofan
-Director, National Remote Sensing Center

The functions of this Steering Committee will be to:

-review, discuss, and make recommendations concerning any policy level issues or concerns which substantially impact on the Project

-monitor the Project with respect to the targets established in the Project Paper and recommend management actions to ensure those targets are met, or where necessary propose to USAID modification of those targets

-review and recommend approval of major implementation processes and procedures, and thereafter monitor performance.

-monitor and ensure coordination of Project components and activities.

Two subcommittees will be established by the Project Steering Committee: a Resource Inventory Sub-committee and a Resource Rehabilitation Sub-Committee. The Resource Inventory Component will be coordinated by a sub-committee of the Project Steering Committee. The Sub-Committee will meet monthly and be responsible for ensuring the delivery of the required inputs in a timely and coordinated manner. Moreover, it will be charged with the development of annual work plans and monitoring of project activities. It will also be expected to review and approve quarterly implementation plans. This structure has already been successfully used during the implementation of the SERISS Project. The sub-committee, based in Khartoum, will consist of the following members:

-Director, Central Forestry Administration- Chairman
-Co-Project Manager, (Inventory)- Secretary
-Chief Technical Advisor (Inventory)
-Director, National Remote Sensing Center
-Representative, Sudan Survey Department
-Representative, Soil Survey Administration
-Representative, Division of Statistics, Ministry of Agriculture
-Representative, Ministry of Finance and Planning
-Representative, USAID/Sudan
-Field Project Officers, (Inventory)(2)

The sub-committee for the Resource Rehabilitation Component will be responsible for the review and initial approval of the annual work plans and general oversight of Project activities in the five Rural Councils in southern Kordofan. It will be expected to meet bi-annually, at which time Project progress reports will be discussed with the view of improvement of Project performance. The membership of this Sub-committee is as follows.

-Governor of Kordofan, or his Representative - Chairman
-Co-Project Manager- Secretary
-Project Leader
-Regional Director, Agriculture
-Regional Director, Forestry
-Regional Director, Horticulture
-Regional Planning Representative
-Gum Producers Association Representative
-Representative (WSARP), El Obeid Station
-USAID/Sudan Representative

B. Contracting Mechanisms

Several factors have been taken into consideration in determining the manner in which goods and services should be provided for the SRAAD Project. First is the natural break in the Project structure between the Resource Inventory and Resource Rehabilitation Components. Second, USAID is interested in utilizing local institutions and resources to implement Project activities wherever possible. Third, there is a need to minimize the administrative requirements for both the GOS and USAID/Sudan. These factors are reflected in the two contracting packages listed below.

1. Resource Inventory Component

The mapping and forest inventory activities in the Resource Inventory Component are technically complex and will require the participation of various organizations. Chief-among these organizations is the Regional Center for Services in Surveying Mapping and Remote Sensing. The RCSSMRS has institutional affiliations with Sudan's Remote Sensing Center and has worked with several GOS institutions, including the Ministry of Agriculture on last year's SERISS Project, and trained a number of Sudanese who will be working on the SRAAD Project. At the same time it also has institutional experience in Sudan with the U.S. organizations capable of preparing base maps (United States Geological Services (USGS))and interpreting imagery for the forest inventory (Environmental Resources Institute of Michigan (ERIM)). Based upon RCSSMRS's past performance and AID's long-standing financial committment to developing it into a regional institution it is proposed to request the AA/AFR to approve a waiver of competition so that USAID/Sudan can contract with the Center to be the prime contractor for all activities planned under the Resource Inventory Component. Subcontractors will include both USGS and ERIM and several local organizations, including the National Remote Sensing Center and the University of Khartoum. In keeping with the need to minimize AID and GOS administrative responsibilities, this contract would also include all of the training, commodity procurement, and the logistical support planned for the Inventory Component.

Based upon the RCSSMRS's initial project proposal and the activities contained within this Project Paper, USAID/Sudan will prepare an Action Memorandum to the Assistant Administrator, Africa Bureau requesting that he waive the competition requirements for AID contract and permit procurement from a single source, the RCSSMRS located in Nairobi. With the AA approval to undertake sole source procurement, the Project Manager will prepare a PIO/T requesting the USAID/Sudan Contracting Officer to negotiate and execute a final contract.

2. Resource Rehabilitation Component

A competitively selected contract awarded either to a U.S. Private Voluntary Organization (PVO) or a U.S. firm is the preferred procurement method for providing good and services to implement the Resource Rehabilitation Component. This decision is based upon the A.I.D.'s requirement to implement its detailed plans contained in this project paper which are both technically complex and require substantial amounts of field work. The selected contractor will be responsible for procurring all goods and services included in the Resource Rehabilitation Component.

In order to assess the market for PVOs and commercial firms wishing to participate in the project, a Request for Expressions of Interest (REI) will be advertised in the U.S. by the USAID/Sudan Contracting Officer. This REI is not intended to prequalify potential contractors for the project and will in no way limit further competition at a later stage. Rather, it is to test the availability and interest of organizations to implement this relatively unique activity.

Based upon the response to the REI the Project Manager will prepare a PIO/T which requests the USAID/Sudan Contracting Officer to prepare a Request for Technical Proposals (RFTP). This PIO/T will include a concise scope of work for the contractor and for the individual TA positions. It will also include draft evaluation criteria against which the various proposals will be judged. The RFTP will be announced in the CBD and copies will be sent to those organizations/firms which have provided expressions of interest to USAID/Sudan.

USAID/Sudan will form an Evaluation Committee which will consist of two or more direct hire USAID employees and two or more GOS representatives. The USAID/Sudan Forestry and Natural Resources Advisor will serve as a technical resource person to the Committee. The USAID Chief of Project's Division will serve as the chairman of the Committee and will be responsible for the preparation of a selection memorandum to the Contracting Officer. The USAID/Sudan Contracting Officer will serve as an advisor to the Committee and will prepare and sign the final contracting document.

3. Other Project Contracting

USAID Sudan will use direct contracting methods to provide technical assistance which is required for: 1)the Project prior to the negotiation of the contract and/or grant described above; and, 2) Project evaluations and special studies.

C. Commodity Procurement

A list of commodities which will be purchased by Project financing is contained in Table 13 in Annex F.

For the Resource Inventory Component the contractor's scope of work will include both the development of technical specifications of the commodities required for preparing the base maps and undertaking the forestry inventory.

These services will be included as part of their fee for implementing the contract. Procurement fees will be negotiated separately with the contractor in conjunction with all other services cited in the PIO/T. Sufficient funding to cover the total value of all commodities to be purchased and all commodity related services will be made a part of the contract. Reimbursement to the contractor for commodity purchases and related services will be made at actual cost to the contractor against standard payment documentation as required by AID.

The procurement of commodities for the Resource Rehabilitation Component will be included as part of the contract with the selected implementing organization. The costs associated with this service will be examined as part of the evaluation of the contract cost proposal.

D. Construction

Limited construction activities are planned within the Resource Rehabilitation Component of the SRAAD Project. These include: staff houses, offices, other housing, nursery extension facilities, village nurseries, and hand dug wells. The GOS Buildings Department, utilizing standard GOS procedures, will supervise the construction of Project staff houses, the Project office block in El Obeid, and the central nursery extension facilities by a private contractor.

F. Disbursement of Project Funds

USAID/Sudan will be responsible for disbursing foreign exchange to the Resource Inventory Contractor and the contractor selected to implement the Resource Rehabilitation Component. Disbursements for both contractors will be made by USAID/Sudan Controller on a cost-reimbursement basis. Vouchers will be prepared and submitted to the USAID Project Manager who will administratively approve valid expenses for payment by the USAID/Sudan Controller. If the RSCSSMS is approved by the Assistant Administrator/Africa, its status as a non-profit institution would qualify it to operate on 60-90 day advance. Foreign exchange denominated expenditures will be financed from the appropriated dollar project account. Direct contractor support costs which require Sudanese Pounds (such as contractor housing, utilities, in-country travel and perdiem, and airline tickets for trainees) will be disbursed directly by USAID from the Project Trust Fund. Other local costs associated with implementing the Project will disbursed through the special accounts established by the Project.

The Government of Sudan will be responsible for providing the local currency programmed for use by the Project. The Central Forest Administration will request the Ministry of Finance to place the planned levels of local currency in a special bank account, from which it will make disbursements for the local costs of both contractors. USAID/Sudan will request the MOF to provide local currencies to its Trust Fund for Sudanese Pound expenses associated with the contractor support, evaluations, training, financial reviews and special studies.

F. Logistical Support

Financing from the GOS contribution has been budgetted for housing rental, basic furniture, office space, secretarial support, office equipment, field equipment, and basic office supplies. In addition, funds are provided to enable the Monitoring and Evaluation Section to hire a Sudanese senior officer who will eventually assume directorship of the office. A computer data processor and other support staff will also be hired. The funds will be made available through the CFA Special Account established to disburse local currency.

VI. SUMMARIES OF ANALYSES

A. SUMMARY OF INSTITUTIONAL ANALYSIS

1. Introduction

This analysis describes a) which institutions will participate in the Project and the feasibility of the expected contribution of each, and b) the feasibility of the proposed mechanisms for coordination and collaboration. Further information is contained in Annex A which details the institutional capacity to implement the Project. The Central Forestry Administration (CFA),which is part of the Ministry of Agriculture and Natural Resources (MOANR) will be the lead implementing agency of both components. However, other government departments and regional and local organizations will be involved. Indeed, the Project is dependent upon their active participation in a timely manner.

2. Resource Inventory Component

The Inventory, Reservation and Management Section of the CFA will be the primary unit through which this component will be implemented and coordinated with other key organizations. The National Remote Sensing Center, the Sudan Survey Department and the Soil Survey Administration at Wad Medani will all play a role in the basic image mapping and forest inventory mapping. The experience gained and the results of the Sudan Emergency and Recovery Information and Surveillance System (SERISS) indicate that the design of this component is institutionally feasible.

The ground survey will primarily involve the staff of the Department of Forestry, with assistance from the Remote Sensing Center and the Statistics Division of the Ministry of Agriculture who have experience in sampling and location of these on the ground. Experienced forestry department professionals will train and supervise the staff carrying out the field measurements.

There is a well trained but small core of professional staff within the organizations which will be involved in mapping. Because of this and constraints due to equipment, the initial mapping from the satellite images will be done in the U.S.

The resource inventory component will be pilot tested during the first two years of the project. Based on the results and concrete plans to use the data, it will be extended to cover additional geographic areas in southern Kordofan and southern Darfur.

3. Resource Rehabilitation Component

This component was designed taking into account the existing staffing patterns and constraints. The current capacity of the Forestry Department to implement projects is severely constrained by the number of adequately trained staff as well as inadequate infrastructure, vehicles and other commodities. These constraints are being addressed through efforts of various donors. The Project requires the deployment of Forestry Department staff and, based on discussions in Kordofan Province, it is anticipated that five of the existing agricultural extension workers will be assigned to the Project. Currently, there are only 24 agricultural extension staff for Kordofan Region. The Project, however, expects two to be seconded in year 1 and an additional 4 in the subsequent two years. They will be part of the Rural Council Project Office staff. As the present Kordofan Province extension staff does not include women extensionists, the Project should use other avenues, i.e. school teachers, to recruit women extensionists who will need to be given limited training. The additional Village Council Extensionists will be hired by the GOS and be recruited from the local community which he/she will serve. If the anticipated number and quality of staff is not forthcoming, the component may be revised and the budget adjusted based upon a mutual agreement between USAID and MOANR.

The MOANR will be required to covenant that the staff and project officers will be assigned to work on this Project fulltime. This does not preclude them participating in non-project activities, such as training, which support the overall objectives of the Project.

The core technical and managerial officers will be based at the regional headquarters in El Obeid. From there, they will be expected to work with the agricultural workers and other units to help ensure essential inputs. A strong collaborative link with the Agricultural Research Center in El Obeid is extremely important in terms of applied and adaptive research. Discussions held during the PP design indicate that this will be forthcoming.

The Rural Council Project Officer (RCPO) of the Resource Rehabilitation component will be of an ACF status and will be assisted by three other subject leaders in Agricultural Extension, Forestry Extension and Extension Training. Although the manager will be expected to liase, and be in close communication with the Rural Council, he will be under the direct supervision of the El Obeid Project Office.

While the emphasis is given to upgrading the capacity of the Forestry Department to carry out work in the area, the design recognizes the need for an equally strong village level base to intersect in a dynamic fashion with the government staff on the Project. Thus, the Project proposes to establish and train a cadre of village council extensionists who will be responsible for working in their respective communities. They will be paid by the Project

since it was not considered feasible to expect them to be volunteers or to expect that the GOS could supply trained people for the target 100 villages.

An important element in the success of the agroforestry activities will be the responsiveness of the project personnel to the socioeconomic conditions of the target male and female farmers and to the forces which cause exploitation of existing forests, gazetted and ungazetted. To date, this has not been the orientation of the Forestry Department and the agricultural extension staff. It represents a new direction which they have indicated that they are willing to undertake.

Deforestation and desertification in the Sudan is mainly attributable to the clearing of land for agriculture, especially mechanized farming. While mechanized farming falls under a particular administration and has regulations governing it, the regulations on tree planting are not enforced and farmers do not undertake planting since, when the soil fertility declines, they can move into another area and clear the land. While data are not available on the extent of registered and unregistered mechanized farming in Kordofan Region, the Mechanized Farming Corporation plans to demarcate an additional 500,000 feddans in south Kordofan Province.

4. Mechanisms for Collaboration and Management

The project calls for the establishment of a Central Steering Committee, with two sub committees, each dealing with a project component. Representatives of key organizations will be members. The functions and membership are detailed in the section on implementation arrangements. The functions, membership and frequency of meetings have been carefully planned with the objective of institutional coordination and Project management. At the same time, Project implementation will not be unduly hampered through a cumbersome complex of committees.

The experience under the Sudan Emergency and Recovery Information and Surveillance System (SERISS) has shown that the inter-institutional collaboration anticipated under this Project for the Resource Inventory Component is feasible.

B. Summary of Technical Analysis

1. Forest Resource Inventory and Mapping Analysis

The Forest Resource Inventory and Mapping Component will provide a temporal and spatial framework for assessing the extent, distribution and condition of forest resources in western Sudan. Through development of the human and technical resources the Project will support the development of a methodology for sampling and determining optimal management strategies for stabilization and rational management of existing and future resources.

Satellite imagery, aerial photography and ground-based measuring techniques will be used to develop a quantitative and qualitative examination of the forest resource balance - high potential areas deserving more management attention and deficit areas requiring reclassification and/or immediate remedial action.

The technical and institutional structure supported by this Project is necessary for the Central Forestry Administration to begin the critical process of allocating its resources and coordinating all its efforts. As such the Project will improve the CFA's overall standing and provide a mechanism by which forestry can become a financially autonomous and more effective steward of increasingly important resources.

The recent drought merely accelerated a long-recognized pattern of resource abuse and degredation, bringing forestry's role in overall production to its rightful place. The project, recognizing this role, directly compliments USAID/Sudan-sponsored activities in remotely sensed crop yields (SERISS and FEWS) and agriculture research (WSARP). In addition the Project responds directly to USAID's general mandate to improve environmental stability through forestry, watershed management, agroforestry and biological diversity programs.

The CFA's Inventory and Management Unit, working closely with Sudan's National Remote Sensing Center, Agriculture Statistics Division of Ministry of Agriculture, Survey Department, the Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), will produce base maps for nearly 750,000 square kilometers of western and central Sudan. Assisted by the U.S. Geological Survey and other American institutions, these maps will provide critical and previously unmapped information about the physiographic, administrative and infrastructural characteristics. Thus, the maps alone will be of great value to a wide range of government, donor and commercial interests.

These base maps will provide a structure for developing, refining and putting to practical use methods for measuring and managing the forest resources of Kordofan and Darfur. Through the use of aerial photographs and field survey teams, information from the satellite images will be processed to identify, quantify, and monitor changes in forest cover and the process of desertification. This process (described in Annex D.2.a) will be initiated in five Rural Councils of Southern Kordofan. These same Rural Councils will use this and other information to begin to address the problems and potentials described below.

2. Resource Rehabilitation Analysis (Participatory Forestry)

The Resource Rehabilitation Component begins where the Inventory Component leaves off. The inventory structure facilitates the identification and prioritization of areas requiring action. The Rehabilitation Component seeks to address those priorities through activities originating from an extension network providing technical services, training and material support. These activities will be based in the five Rural Councils south of El Obeid.

Erected essentially through existing institutions at the Rural Council level and supporting the Central Forestry Administrations Regional affiliate, the extension service will assist local communities and individuals become better stewards of forests and agriculture land. Two types of rehabilitation efforts characterize operations: reclamation and improved management of woodlands and maintaining soil productivity through agroforestry technologies. Collectively these efforts are referred to as participatory forestry.

a. Natural Woodland Management

Traditionally forests have been gazetted by foresters and managed for commercial extraction purposes through the various arms of the CFA. While people have always been involved in forest management (planting and harvesting primarily) they have rarely been involved in the decision-making process which determines the objectives of a given forest's management. The extent and condition of forests, determined by ground-truthed remotely sensed data, will determine their potential productive capacity. Needs assessment surveys, land and tree tenure studies, and ethnobotanical investigations will be used to determine the value of these forests to local people. Production potential and local demands will be the principal ingredients defining further action. Abandoned mechanized farms and degraded areas around villages will be reforested. Depending on the legal disposition of the land and the interest of local people management plans will be designed and supported through project staff, equipment and nurseries.

Remnant forests will be allocated to local people with contractual understandings about their role and the responsibilities of the CFA. Mechanisms to reduce and eventually eliminate recurrent costs associated with the provision of seedlings and technical services will be developed as a primary output.

b. Agroforestry

Declining soil productivity, as measured through reduced crop yields, ranks next to water on the problems expressed by the majority of farmers interviewed during the design team's socioeconomic survey. Demographic patterns, mechanized farming and overgrazing, exacerbated through drought, have provoked alarming trends. Reduction of fallow, elimination of crop rotations, wholesale removal of shrub and tree cover are all breaking the efficient cycling of nutrients and reducing the ability of soil to rejuvenate itself. Farm incomes have decreased as a result and supplemental cash has been raised by cutting gum arabic gardens and large expanses of forest for charcoal production. Thus the farm problems have rippled through other resource sectors.

Promulgating improvement and expansion of traditional agroforestry systems is one method of slowing or reversing desertification. Promotion of intercropping configurations, testing and extending windbreaks, production of fruit and shade trees for home gardens, and improvement of gum garden are all viable and proven techniques. Seedlings will be produced in village and larger central nurseries and sold commercially. The existing demand for gum arabic (Acacia senegal) and fruit trees will help generate funds to finance maintenance costs.

C. Summary of Social Soundness Analysis

1. Introduction

A great amount of attention and effort was given during the PP design phase to help ensure that the Project is socially sound. A socioeconomic survey was

conducted in the Project area and information from it has been used in designing the resource rehabilitation component and Project implementation structure. Moreover, since the success and sustainability of the resource rehabilitation component rests upon the active participation of the local people, mechanisms for this have been incorporated into the design.

2. Main Points in Sociocultural Feasibility

Trees and woody vegetation have always played an important role in the domestic economy. However, little labor and effort went into maintaining these resources: production was usually through natural regeneration. Because of recent events, farmers tend to recognize the benefits that can be derived from interplanting trees with crops and from shelter belts and other agroforestry configurations. Moreover, especially because of the current high price for gum arabic, they are keen to plant Acacia senegal seedlings.

The agroforestry component will emphasize Acacia senegal within the zone of its natural distribution because of the market for gum arabic, its nutrient value, its environmental protection role, and its fodder use. From the standpoint of the producer, the main economic value relates to the market system and producer price for gum arabic. Since this fluctuates greatly and the international market is limited, the economics of Acacia senegal production will be analyzed periodically.

Several key issues center around land and tree and grazing rights. Farmers interviewed during the PP design expressed concern about these. Thus, the Project calls for a rapid reconnaissance of villages initially slated to participate in the agroforestry activity. If land ownership is highly skewed so that the distribution of benefits from the agroforestry activity would be highly inequitable, the village will not be included as a participating village. Moreover, land and tree rights and maintenance of ownership must be assured especially in the participatory forestry component prior to launching an activity in a particular site.

Since the local village community or group is expected to be active in the management of community forest and agroforestry activities, it is essential that a formal written agreement is signed that specifies responsibilities, rights and obligations of the forestry department, the participants and any other key parties. This agreement will be based on discussions held with the participating group and should facilitate a clear understanding of the role of each party. A major feature must be a commitment to generating funds that will be used specifically for sustaining the activity.

To help ensure that women not only participate, but actually receive direct benefits, special attention will be given to their involvement. If the CFA is unable to second females to positions, then the project will actively seek to recruit some women to serve on the staff, who will be paid with project funds. At least forty percent of the Village Council Extensionists hired under the Project and fifty percent of the demonstration farmers are expected to be women. The assessments, surveys, monitoring and evaluation will all pay attention to women and data will be analyzed by sex. Funds are available for contracting special studies and analyses. Women will have an equal voice in

the kinds of trees planted in both resource rehabilitation activities so that household fuel needs shall be covered. In these ways the Project hopes to ensure that women receive benefits commensurate to their participation in the resource rehabilitation activities.

While the project centers on the traditional farming sector, the mechanized farming sector will receive due and adequate attention. This is considered essential if the goal of the project is to be achieved. Various ways will be used to address the need for mechanized farms to take actions to reverse the process of desertification in the Project region.

D. Summary of Economic Analysis

Economic and Financial Analysis has been carried out separately for Resource Inventory and Resource Rehabilitation Components. In view of the fact that the Resource Inventory exercise does not yield direct and measurable benefits, the analysis has been carried out to determine the least cost option. Of the three options analysed with major elements as satellite imagery (Option 1), aerial photography (Option 2) and ground surveying (Option 3), it has been determined that Option 1 is the least cost option.

For the Resource Rehabilitation Component, the calculated B/C ratios and financial and economic rates of return obtained under the most realistic assumptions and best available data about the factors which can affect project costs, and benefits, are large enough to be assuring that the project investment is economically worthwhile from the individual (financial analysis) and national point of view (economic analysis).

Resource rehabilitation through participatory forestry, be it natural woodland management or any of the alternate choices of agroforestry, has both direct and indirect impact on the economic wellbeing of the farmer. The analses carried out to determine benefits without and with intervention indicate a favorable Benefit/Cost ratio. Under the Improved Bush Fallow System, for example, although the farmers' net earnings drop for the initial years, these are more than compensated for during the following years, with the additional advantages of sustainability of agriculture and variety of products like fuelwood and gum arabic. On the other hand, if the land is suitable for mixed tree alley cropping, the net benefits are positive right from the beginning of the cropping cycle. In the natural woodland management, sustainable forest products, such as fuelwood, poles, timber, gum, and other products that the farmer has been obtaining from the forests will become available, without any danger of these becoming scarce or vanishing from the scene which is likely to happen if nothing is done.

The sensitivity analysis carried out for various models in the project is intended to lay at rest doubts about the validity of cost benefit analysis in case the assumptions do not prove to be accurate. Even in the worst case scenario, where the costs increase by 25% and the benefits decrease by 25% the benefit/cost ratio still remains more than 1.0. Thus it can safely be stated that the project is economically sound.

VII. EVALUATION AND MONITORING

Several major tenets support the socio-economic justification for undertaking the SRAAD Project. Using satellite imagery, aerial photography and ground surveys the Project will identify specific actions to address resource degredation and rehabilitation. This telescoping of information through several different windows, and eventually furnishing technical and material assistance to obtain action, is a logical but complex set of initiatives. Their integration with other complementary action-oriented components will largely determine the overall project viability. Unforeseen breaks in the information cycle can have repercussions on the actions derived. Inaccurate technical assessment of rehabilitation or remote sensing activities will obviate the Project's replicability to larger areas. Inadequate concern for recurrent costs and the development of inappropriate hierarchical institutions could lower chances for post-project financial viability and actually increase dependence on external services.

The Project needs to actively solicit input and build on the experience and direction of the multi-donor program (World Bank), other projects, and the different activities within SRAADs different components. Including the various players and actions through regular coordination meetings will be necessary. Strategic points will be used to compile and assess progress to date and its implications for future activities. The development of a rigorous monitoring and evaluation framework to build on positive aspects and limit the project's liabilities to externalities beyond its control (policy changes, drought etc.) is required.

Monitoring will provide management with useful information about specific operations while the evaluative format will permit and facilitate deviations from original goals and accomplishments which will likely change. A timely evaluation and review schedule, combined with several quantitative methods for assessing key factors, will provide the iterative information required to support effective and efficient management.

A. Monitoring Tools

The development of systems for continual evaluation of Project progress against baseline conditions and original project goals is an important aspect of implementation. The system developed to track progress should be viewed as an iterative mechanism that furnishes constant and valuable feedback to Project management, allowing fine tuning and reorientation. The monitoring system should, thus, be viewed as an essential tool to guide implementation throughout the life of project. The system will be different for individual components and will be the major source of information upon which the Project will be reviewed after the first eighteen months of operation. The following information should be developed and retained until this review when a streamlining of essential and useful information can be done:

i. Cost Accounting Structures will be instituted within both components. The objective of this analytic costing system will be the: 1) determination of unitary costs for all major outputs for replication purposes; 2) to provide

factual information upon which rigorous economic evaluation can be based; and 3) to support the development of a financial program for cost recovery and "phase-out" which will assure post-project viability of the rehabilitation component.

ii) Village surveys, special studies and annual participant follow-up surveys will be conducted. The socio-economic study conducted during PP design will serve as a baseline survey to provide a statistically significant benchmark against which project impacts can be measured. Information on land, tree, and grazing rights, and a knowledge, attitudes and practice surveys, will provide input to extension training and adaptation of actions to meet local conditions and preferences as discussed in the description of the Rehabilitation Component (III.A.C.2).

iii) Nursery Records and post-planting survivorship showing production statistics, distribution by family size and sex and financial viability at the individual nursery level.

iv) Attendance Lists of Extension Course Participants and demonstration farm visitors by age, gender and date to develop quantitative ideas about the strengths and weaknesses of various extension approaches.

v) Permanent plot and adaptive trials data on the silvicultural trials and the agroforestry demonstration plots respectively. Basic information for evaluating these actions is detailed in Annex D-2. Further detail will be required as specific trials and methodologies are more accurately defined.

B. Evaluation Schedule and Preliminary Measure

The political, ecologic and operational environment of SRAAD deserves consideration annually within internal reviews starting in May 1989. Thereafter these should be scheduled to coincide with the annual report and action plan. The internal Review Committee comprised of the Project Officer, USAID Forester, Project Manager/Counterpart, Director of the Inventory, Reservation and Management Unit, Provincial Forest and National Extension Coordinator, and the Regional Forestry Advisor/REDSO, the Regional Social Scientist and WID Officer. Specific attention during these reviews the first to be held in May 1989 should include:

- Consideration of policy changes with respect to mechanized farming, charcoal and gum arabic pricing and Forest Administration reorganization.
- Operational scales of other donors potential for project replication.
- Development of structures to track, assess and phase out recurrent costs.
- Review of project staffing performance and proposed annual plan

At the end of project and at completion of year three external evaluations will be carried out which concentrate on:

a) the economic viability of the rehabilitation component, especially from the perspective of the producer,

b) progress in enforcing the regulations on tree planting on mechanized farms and in limiting the spread of unregulated mechanized farming,

c) the use of data collected under the project to direct project activities, e.g. training and extension and influence planning, i.e. use of inventory data,

d) the extent to which women's concerns and situations are taken into account and women are actively involved in the project and overall project performance.

e) the extent to which the data and experience obtained under this project can be replicated elsewhere in the Sudan under the larger World Bank or other donor projects.

VII. NEGOTIATING STATUS

A. Current Status

The design of this Project Paper has included significant participation by the Government of Sudan's Central Forestry Administration, the Regional Forest Department, Regional Government, Local Administration, and members of the rural communities in southern Kordofan. There appears to be a strong commitment on the behalf of the CFA and the Government's administration in Kordofan and Darfur to support the Project. Discussions concerning the Project with Central Government authorities in Khartoum are currently underway.

Based upon USAID/Sudan's previous project experience and the recommendations of the design team, the following conditions precedent and covenants are proposed for the Grant Agreement.

B. Recommended Conditions Precedent

In addition to the Standard Condition Precedent on designation of representatives the project grant agreement will contain the following Special Conditions precedent:

(i) Evidence that the Grantee has established a Project Steering Committee at the National level with appropriate representatives.

(ii) Evidence that the Grantee has established a separate local currency account for each component of the Project and has deposited in such accounts sufficient local currencies to meet project requirements for the first 24 months of the Project.

(iii) Evidence that the Grantee has transferred sufficient local currencies to a USAID trust fund account to meet the estimated local currency costs of project technical assistance contractors for at least the first 24 months of their contracts.

C. Recommended Convenants

In addition to the standard covenants on project evaluations, the Project Agreement will include the following special convenants.

(i) Nursery/Extension Centers and Community Reserves. The Grantee covenants to make sufficient land available for the establishment of required Nursery/Extension Centers and community forest reserves.

(ii) Post-Project Management and Financing. The Grantee agrees to convene a meeting of representatives from the Regional Government, Central Forest Administration, the Ministry of Finance and Economic Planning, and USAID prior to the completion of the project for the purpose of formulating a definite plan and identifying sources of funding for maintenance of the Project facilities and services after the end of the Project..

(iii) Local Currency Resources. The Grantee agrees that it will promptly deposit additional local currencies into the special project accounts as required throughout the project and, at the request of AID, promptly transfer such additional amounts to the AID trust fund account as may be required during the project to meet the local currency costs of the project technical assistance contractors.

(iv) Policy Environment. The Grantee covenants to actively promote the continued development of a legal and policy environment which supports the expansion of community and private forestry.

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION

ANNEXES

KHARTOUM
JULY 1987

UNCLASSIFIED

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX A

LOGICAL FRAMEWORK

KHARTOUM
JULY 1987

UNCLASSIFIED

78

PROJECT DESIGN SUMMARY
LOGICAL FRAMEWORK

ANNEX A

Life of Project:
From FY 1987 TO FY 1993
Total US Funding: $8,000,000
Date Prepared: 05/20/87

Project Title & Number: SUDAN-REFORESTATION AND ANTI-DESERTIFICATION PROJECT(650-0082)

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
GOAL: To reverse the process of desertification and declining soil productivity which has led to a reduction of agricultural production and income of traditional farmers in western Sudan.	Measure of Goal Achievement 1. Increase in tree cover. 2. Increased and sustainable land productivity. 3. Increase in production of tree products for domestic consumption and export.	1. Survey of vegetation using remote sensing and ground truthing. 2. Agricutural statistical surveys. 3. GOS trade statistics.	**Assumptions for Achieving Goal Targets:** 1. No major adverse climatic changes. 2. No changes in land use policies detrimental to subsistence farmers.
Project Purpose: 1. To develop a sound information base for planning, managing, and monitoring forest resources through vegetation mapping and forest inventories in Western Sudan.	End of Project Status Method developed for monitoring forest resource degradation and desertification. Improved data base for planning and management in the forest sector. Plans being implemented for development, conservation and management of forest resources resources, based on vegetation mapping and and forest inventories, in 5 southern Kordofan and Southern Darfur.	1. Project reports and site visits. 2. Project final Evaluation. 3. Gum Arabic Company Reports. 4. Detailed vegetation maps for western Sudan.	**Assumptions for Achieving Purpose:** 1. Market prices remain favorable for wood and tre products. 2. No major outbreaks of pests disease.

2. To rehabilitate land and forest in the rural sector of southern Kordofan through participatory forestry.	Demarcated and reserved forests managed on a sustainable basis Increased supplies of tree products, woodfuel, and poles, and improved soil conservation and productivity as a result of increased tree planting and improved forest management. Improved fields of agricultural projects.		
OUTPUTS	**Magnitude of Outputs**	**Means of Verification**	**Important Assumptions**
1. Provision of maps and statistical data on the forests in Southern Kordofan and Southern Darfur regions	1. 2,000 Base Maps produced 2. 500 Forest Maps of Southern Kordofan and Darfur 3. Statistical Tables of total forestry resources and specific detail on selected forests and plantations	1. Project implementation reports and site visits. 2. Agricultural surveys using remote sensing	
2. System of participatory forestry operational	1. 50,000 feddans of woodlands under management including community forests sufficient for needs of local population 2. 25,000 feddan of denuded land reforested 3. Forest management models implemented that are socially socially economically, and technically sound.	3. Project Evaluations. 4. Project Reviews and Annual Reports. 5. Project Surveys and annual monitoring results. 6. Training and staff records.	1. Other projects focus on woodfuel conservation. 2. GOS policy support for appropriate land use. 3. Cooperation and coordination between Regional Government Central Forestry Administration and Mechanized Farming Corporation in the implementation of the program.

3. Sustainable production through agroforestry interventions	1. 60% households in contact villages benefit from increased food, fodder, woodfuel and gum arabic production 2. 50% of participating farmers are female 3. 11,000,000 seedling and 6,000 kgs of seeds produced and planted 4. 50 km of windbreaks and shelterbelts established 5. 25,000 feddans of cropland under various agroforestry systems.
4. Institutional capacity enhanced for nationwide implementation	1. 80 Person months short-term training of project technical staff. 2. 25 Area Coordinators and 100 village Extension staff trained and functioning 3. 100 Self help Village and 5 central nurseries meeting local needs. 4. 20 fellowship for graduate studies to Faculty of Agri.

INPUTS	Implementation Target (Type & Quantity)		Assumptions for providing inputs
Longterm Tech Assistance Shortterm Tech Assistance Commodities Construction Training Logistical Support	1. Long term TA 204PM. 2. Short term TA 29 PM. 3. Materials and Equipment (See budget) 4. Observational tours for farmers and GOS forester. 5. 25 Extension workshops, and conferences. 6. Logistical Support (See Budget)	1. Contractor reports and reviews. 2. Site Inspections. 3. Review of GOS Local Currency 4. GOS Records 5. GOS Records 6. GOS Local Currency Account Records	

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX B

GOS
REQUEST FOR ASSISTANCE

KHARTOUM
JULY 1987

UNCLASSIFIED

02

18 July 1987

MFEP/USAID/16

Director

USAID Mission

Khartoum

Dear Sir,

Subject/Reforestation & Anti-desertification

Project

With reference to the above mentioned subject.

The government of Sudan requests that USAID financing in the amount of US$ 8.0 million and 30 million Sudanese Pounds for Sudan Reforestation and Anit-Desertification Project.

Your assistance is highly appreciated.

Sincerely yours,

Mahasin Hamdoun

Mahasin Mohamed Ali

For/Under Secretary for Planning

Ministry of Finance and Economic Planning

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION

ANNEX C

STATUTORY CHECKLIST

Khartoum
July 1987

UNCLASSIFIED

34

ANNEX C

SC(2) PROJECT CHECKLIST

Listed below are statutory criteria applicable to projects. This section is divided into two parts. Part A includes criteria applicable to all projects. Part B applies to projects funded from specific sources only: B.1. applies to all projects funded with Development Assistance loans, and B.3. applies to projects funded from ESF.

CROSS REFERENCES: IS COUNTRY CHECKLIST UP TO DATE? HAS STANDARD ITEM CHECKLIST BEEN REVIEWED FOR THIS PROJECT?

Yes

Yes

A. GENERAL CRITERIA FOR PROJECT

1. FY 1987 Continuing Resolution, Sec. 523; FAA Sec. 634A.

Describe how authorization and appropriations committees of Senate and House have been or will be notified concerning the project.	The Sudan Reforestation and Anti-Desertification Project is described on page of the FY 87 Congressional Presentation.

2. FAA Sec. 611(a)(1). Prior to obligation in excess of $500,000, will there be (a) engineering, financial or other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?

Yes

Yes

3. FAA Sec. 611(a)(2). If further legislative action is required within recipient country, what is basis for reasonable expectation that such action will be completed in time to permit orderly accomplishment of purpose of the assistance?

No legislative action is required.

4.	FAA Sec. 611(b); FY 1987 Continuing Resolution Sec. 501. If for water or water-related land resource construction, has project met the standards and criteria as set forth in the principles, standards, and procedures established pursuant to the Water Resources Planning Act (42 U.S.C. 1962, et seq.)? (See AID Handbook 3 for new guidelines.)	N/A
5.	FAA Sec. 611(e). If project is capital assistance (e.g., construction), and all U.S. assistance for it will exceed $1 million, has Mission Director certified and Regional Assistant Administrator taken into consideration the country's capability effectively to maintain and utilize the project?	N/A
6.	FAA Sec. 209. Is project susceptible to execution as part of regional or multilateral project? If so, why is project not so executed? Information and conclusion whether assistance will encourage regional development programs.	No
7.	FAA Sec. 601(a). Information and conclusions whether project will encourage efforts of the country to: (a) increase the flow of international trade; (b) foster private initiative and competition; and (c) encourage development and use of cooperatives, and credit unions, and savings and loan associations; (d) discourage monopolistic practices; (e) improve technical efficiency of industry, agriculture and commerce; and (f) strengthen free labor unions.	The SRAAD Project will not increase the flow of international trade or strengthen free trade union. It will foster private initiative to improve agricultural and fuelwood production as well as involve cooperative effort for some activities.

8.	FAA Sec. 601(b). Information and conclusions on how project will encourage U.S. private trade and and investment abroad and encourage private U.S. participation in foreign assistance programs (including use of private trade channels and the services of U.S. private enterprise).	This project will increase U.S. trade and investment abroad only to the extent that project services and commodities are purchased from the U.S.
9.	FAA Sec. 612(b), 636(h). Describe steps taken to assure that, to the maximum extent possible, the country is contributing local currencies to meet the cost of contractual and other services, and foreign currencies owned by the U.S. are utilized in lieu of dollars.	Forty eight percent of project financing is being contributed by the GOS, including the financing of a portion of local costs of U.S.-funded contractors, and U.S.-owned local currencies will be used in lieu of dollars to the extent possible
10.	FAA Sec. 612(d). Does the U.S. own excess foreign currency of the country and, if so, what arrangements have been made for its release?	N/A
11.	FY 1987 Contintuing Resolution Sec. 521. If assistance is for the production of any commodity for export, is the commodity likely to be in surplus on world markets at the time the resulting productive capacity becomes operative, and is such assistance likely to cause substantial injury to U.S. producers of the same, similar or competing commodity?	N/A
12.	FY 1987 Continuing Resolution Sec. 558 (as interpreted by conference report). If assistance is for agricultural development activities (specifically, any testing or breeding feasibility study, variety improvement or	

	introduction, consultancy, publication, conference, or training), are such activities (a) specifically and principally designed to increase agricultural exports by the host country to a country other than the United States, where the export would lead to direct competition in that third country with exports of a similar commodity grown or produced in the United States, and can the activities reasonably be expected to cause substantial injury to U.S. exporters of a similar agricultural commodity; or (b) in support of research that is intended primarily to benefit U.S. producers?	N/A
13.	FY 1987 Continuing Resolution Sec. 559. Will the assistance (except for programs in Caribbean Basin Initiative countries under U.S. Tariff Schedule "Section 807," which allows reduced tariffs on articles assembled abroad from U.S.-made components) be used directly to procure feasibility studies, prefeasibility studies, or project profiles of potential investment in, or to assist the establishment of facilities specifically designed for, the manufacture for export to the United States or to third country markets in direct competition with U.S. exports, of textiles, apparel, footwear, handbags, flat goods (such as wallets or coin purses worn on the person), work gloves or leather wearing apparel?	No
14.	FAA Sec. 118(c). Does the assistance comply with the environmental procedures set forth in A.I.D. Regulation 16? Does the assistance place a high priority on conservation and sustainable management of tropical	Yes

forests? Specifically, does the assistance, to the fullest extent feasible: (a) stress the importance of conserving and and sustainably managing forest resources; (b) support activities which offer employment and income alternatives to those who otherwise would cause destruction and loss of forests, and help countries identify and implement alternative to colonizing forested areas; (c) support training programs, educational efforts, and the establishment or strengthening of institutions to improve forest management; (d) help end destructive slash-and-burn agriculture by supporting stable and productive farming practices; (e) help conserve forests which have not yet been degraded, by helping to increase production on lands already cleared or degraded; (f) conserve forested watersheds and rehabilitate those which have been deforested; (g) support training, research, and other actions which lead to sustainable and more environmentally sound practices for timber harvesting, removal, and processing; (h) support research to expand knowledge of tropical forests and identify alternatives which will prevent forest destruction, loss, or degradation; (i) conserve biological diversity in forest areas by supporting efforts to identify, establish, and maintain a representative network of protected tropical forest ecosystems on a worldwide basis, by making the establishment of protected areas a condition of support for activities involving forest clearance or degradation, and by helping to identify tropical forest ecosystems and species in need of protection and establish and maintain appropriate protected areas; (j) seek to increase the awareness of U.S. government agencies and other donors of the immediate and long-term value of tropical forests; and (k) utilize the resources and abilities of all relevant U.S. government agencies?

The project is for the management forests, but not tropical

15. FAA Sec. 119(g)(4)-(6). Will the assistance (a) support training and education efforts which improve the capacity of recipient countries to prevent loss of biological diversity;	a. Yes
(b) be provided under a long-term agreement in which the recipient country agrees to protect ecosystems or other wildlife habitats;	b. No
(c) support efforts to identify and survey ecosystems in recipient countries worthy of protection; or (d) by any direct or indirect means significantly degrade national parks or similar protected areas or introduce exotic plants or animals into such area?	c. Yes d. No
16. FAA 121(d). If a Sahel project, has a determination been made that the host government has an adequate system for accounting for and controlling receipt and expenditure of project funds (either dollars or local currency generated therefrom)?	N/A
17. FY 1987 Continuing Resolution Sec. 532. Is disbursement of the assistance conditioned solely on the basis of the policies of any multilateral institution?	No

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b), 111, 113, 281(a). Extent to which activity will (a) effectively involve the poor in development, by	a. This project is primarily directed at subsistance farmers in the western Sudan. This assistance will provide resources to allow them to utilize existing forest

extending access to economy at local level, increasing labor-intensive production and the use of appropriate technology, spreading investment out from cities to small towns and rural areas, and insuring wide participation of the poor in the benefits of development on a sustained basis, using the appropriate U.S. institutions; (b) help develop cooperatives, especially by technical assistance, to assist rural and urban poor to help themselves toward better life, and otherwise encourage democratic private and local governmental institutions; (c) support the self-help efforts of developing countries; (d) promote the participation of women in the national economies of developing countries and the improvement of women's status; and (e) utilize and encourage regional cooperation by developing countries?

resource more efficiently and to plant more trees to increase wood products and improve soil productivity.

c. The project will help Sudan become more self-sufficient in fuelwood production and assist in limiting desertification.

d. Most of the project participants/ beneficiaries are expected to be women. The project will improve their income-earning potential.

b. FAA Sec. 103, 103A, 104, 105, 106. Does the project fit the criteria for the type of funds (functional account) being used? — Yes

c. FAA Sec. 107. Is emphasis on use of appropriate technology (relatively smaller, cost-saving, labor-using technologies that are generally most — Yes

appropriate for the small farms, small businesses, and small incomes of the poor)?	
d. FAA Sec. 110, 124(a). Will the recipient country provide at least 25% of the costs of the program, project, or activity with respect to which the assistance is to be furnished (or is the latter cost-sharing requirement being waived for a "relatively least developed" country)?	Yes - Sudan will provide approximately 48% of the costs of the project.
e. FAA Sec. 128(b). If the activity attempts to increase the institutional capabilities of private organizations or the government of the country, or if it attempts to stimulate scientific and technological research, has it been designed and will it be monitored to ensure that the ultimate beneficiaries are the poor majority?	Yes
f. FAA Sec. 281(b). Describe extent to which program recognizes the particular needs, desires, and capacities of the people of the country; utilizes the country's intellectual resources to encourage institutional development, and supports civil education and training in skills required for effective participation in government processes essential to self-government.	The project design is based upon extensive participating of the Government of Sudan and the Rural Communities of Kordofan. It has utilized the University of Khartoum staff during its design and intend to include local consultants in project implementation. The development of village level structures to implement the project will increase local participation in developmental efforts.

92

g. FY 1987 Continuing Resolution Sec. 540. Are any of the funds to be used for the performance of abortions as a method of family planning or to motivate or coerce any person to practice abortions? — No

Are any of the funds to be used to pay for the performance of involuntary sterilization as a method of family planning or to coerce or provide any financial incentive to any person to undergo sterilizations? — No

Are any of the funds to be used to pay for any biomedical research which relates, in whole or in part, to methods of, or the performance of, abortions or involuntary sterilization as a means of family planning? — No

h. FY 1987 Continuing Resolution. Is the assistance being made available to any organization or program which has been determined to support or participate in the management of a program of coercive abortion or involuntary sterilization? — No.

If assistance is from the population functional account, are any of the funds to be made available to voluntary family planning projects which do not offer, either directly or through referral to or information about access to, a broad range of family planning methods and services? — N/A

i. FY 1987 Continuing Resolution. How much of the funds will be available only for activities of economically and socially disadvantaged enterprises, historically black colleges and universities, and private and voluntary organizations — Gray Amendment Firms will be solicited by Requests for Expression of Interest.

which are controlled by individuals who are black Americans, Hispanic Americans, or Native Americans, or who are economically or socially disadvantaged (including women)?	
j. FAA Sec. 118(c)(13). If the assistance will support a program or project significantly affecting tropical forests (including projects involving the planting of exotic plant species), will the program or project (a) be based upon careful analysis of the alternatives available to achieve the best sustainable use of the land, and (b) take full account of the environmental impacts of the proposed activities on biological diversity?	N/A
k. FAA Sec. 118(c)(14). Will assistance be used for (a) the procurement or use of logging equipment, unless an environmental assessment indicates that all timber harvesting operations involved will be conducted in an an environmentally sound manner and that the proposed activity will produce positive economic benefits and sustainable forest management systems; or (b) actions which significantly degrade national parks or similar protected areas which contain tropical forests, or introduce exotic plants or animals into such areas?	No No
l. FAA Sec. 118(c)(15). Will assistance be used for (a) activities which would result in the conversion of forest lands to the rearing of livestock; (b) the construction upgrading, or maintenance of roads (including temporary haul roads for logging or other extractive industries) which pass through relatively	a. No b. No

undegraded forest lands; (c) the colonization of forest lands; or (d) the construction of dams or other water control structures which flood relatively undegraded forest lands, unless with respect to each such activity an environmental assessment indicates that the activity will contribute significantly and directly to improving the livelihood of the rural poor and will be conducted in an environmentally sound manner which supports sustainable development?	c. No d. No
2. Development Assistance Project Criteria (Loans only)	
a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, at a reasonable rate of interest.	N/A
b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete with U.S. enterprises, is there an agreement by the recipient country to prevent export to the U.S. of more than 20% of the enterprise's annual production during the life of the loan?	N/A
3. Economic Support Fund Project Criteria	
a. FAA Sec. 531(a). Will this assistance promote economic and political stability? To the maximum extent feasible, is this assistance consistent with	N/A

the policy directions, purposes, and programs of part I of the FAA?

b. FAA Sec. 620(c). Will assistance under this chapter be used for military, or paramilitary activities? N/A

c. ISPCA of 1985, Sec. 207. WILL ESF funds be used to finance the construction of the operation or maintenance of, or the supplying of fuel for, a nuclear facility? If so, has the President certified that such country is a party to the Treaty on the Non-Proliferation of Nuclear Weapons or the Treaty for the Prohibition of Nuclear Weapons in Latin America (the "Treaty of Tlatelolco"), cooperates fully with the IAEA, and pursues nonproliferation policies consistent with those of the United States? N/A

d. FAA Sec. 609. If commodities are to be granted so that sale proceeds will accrue to the recipient country, have Special Account (counterpart) arrangements been made? N/A

C. STANDARD ITEM CHECKLIST

Listed below are the statutory items which normally will be covered in aid-el in these provisions of an assistance agreement dealing with its implementation, or covered in the agreement by imposing limits on certain uses of funds.

These items are arranged under the general headings of (A) Procurement, (B) Construction, and (C) Other Restrictions.

A. Procurement

1.	FAA Sec. 602(a). Are there arrangements to permit U.S. small business to participate equitably in the furnishing of commodities and services financed?	Yes
2.	FAA Sec. 604(a). Will all procurement be from the U.S. except as otherwise determined by the President or under delegation from him?	Yes
3.	FAA Sec. 604(d). If the cooperating country discriminates against marine insurance companies authorized to do business in the U.S., will commodities be insured in the United States against marine risk with such a company?	It does not discriminate.
4.	FAA Sec. 604(e); ISDCA of 1980 Sec. 705(a). If offshore procurement of agricultural commodity or product is to be financed, is there provision against such procurement when the domestic price of such commodity is less than parity? (Exception where commodity financed could not reasonably be procured in U.S.)	N/A

5.	FAA Sec. 604(g). Will construction or engineering services be procured from firms of countries which receive direct economic assistance under the FAA and which are otherwise eligible under Code 941, but which have attained a competitive capability in international markets in one of these areas? Do these countries permit United States firms to compete for construction or engineering services financed from assistance programs of these countries?	No
6.	FAA Sec. 603. Is the shipping excluded from compliance with requirement in section 901(b) of the Merchant Marine Act of 1936, as amended, that at least 50 per centum of the gross tonnage of commodities (computed separately for dry bulk carriers, dry cargo liners, and tankers) financed shall be transported on privately owned U.S. flag commercial vessels to the extent that such vessels are available at fair and reasonable rates?	No
7.	FAA Sec. 621. (a) If technical assistance is financed, will such assistance be furnished by private enterprise on a contract basis to the fullest extent practicable? (b) If the facilities of other Federal agencies will be utilized, are they particularly suitable, not competitive with private enterprise, and made available without undue interference with domestic programs?	a. Yes b. Yes

8. International Air Transport Fair Competitive Practices Act, 1974. If air transportation of persons or property is financed on grant basis, will U. S. carriers be used to the extent such service is available?	Yes
9. FY 1987 Continuing Resolution Sec. 504. If the U.S. Government is a party to a contract for procurement, will the contract contain a provision authorizing termination of such contract for the convenience of the United States?	Yes
10. FY 1987 Continuing Resolution Sec. 524. If assistance is for consulting service through procurement contract pursuant to 5 U.S.C. 3109, are contract expenditures a matter of public record and available for public inspection (unless otherwise provided by law or Executive order)?	N/A

B. Construction

1. FAA Sec. 601(d). If capital (e.g., construction) project, will U.S. engineering and professional services to be used?	N/A
2. FAA Sec. 611(c). If contracts for construction are to be financed, will they be let on a competitive basis to maximum extent practicable?	Yes
3. FAA Sec. 620(k). If for construction of productive enterprise, will aggregate value of assistance to be furnished by the U.S. not exceed $100 million (except for productive enterprises in Egypt that were described in the CP)?	N/A

C. Other Restrictions

1. FAA Sec. 122(b). If development loan, is interest rate at least 2% per annum during grace period and at least 3% per annum thereafter?	N/A
2. FAA Sec. 301(d). If fund is established solely by U.S. contributions and administered by an international organization, does Comptroller General have audit rights?	N/A
3. FAA Sec. 620(h). Do arrangements exist to insure that United States foreign aid is not used in a manner which, contrary to the best interests of the United States, promotes or assists the foreign aid projects or activities of the communist-bloc countries?	Yes
4. Will arrangements preclude use of financing:	
a. FAA Sec. 104(f); FY 1987 Continuing Resolution Secs. 525,540. (1) To pay for performance of abortions as a method of family planning or to motivate or coerce persons to practive abortions;	Yes
(2) to pay for performance of involuntary sterilization as method of family planning, or to coerce or provide financial incentive to any person to undergo sterilization;	Yes
(3) to pay for any biomedical research which relates, in whole or part, to methods or the performance of abortions or involuntary sterilizations as a means of family planning;	Yes
(4) to lobby for abortion?	Yes

b.	FAA Sec. 483. To reimburse persons, in the form of cash payments, whose illicit drug crops are eradicated?	Yes
c.	FAA Sec. 620(g). To compensate owners for expropriated nationalized property?	Yes
d.	FAA Sec. 660. To provide training or advice or provide any financial support for police, prisons, or other law enforcement forces, except for narcotics programs?	Yes
e.	FAA Sec. 662. For CIA activities?	Yes
f.	FAA Sec. 636(i). For purchase, sale, long-term lease, exchange or guaranty of the sale of motor vehicles manufactured outside U.S., unless a waiver is obtained?	Yes
g.	FY 1987 Continuing Resolution, Sec. 503. To pay pensions, annuities, retirement pay, or adjusted service compensation for military personnel?	Yes
h.	FY 1987 Continuing Resolution, Sec. 505. To pay U.N. assessments, arrearages for dues?	Yes
i.	FY 1987 Continuing Resolution, Sec. 506. To carry out provisions of FAA section 209(d) (Transfer of FAA funds to multilateral organizations for lending)?	Yes

j.	FY 1987 Continuing Resolution, Sec. 510. To finance the export of nuclear equipment, fuel, or technology or to train foreign nationals in nuclear fields?	Yes
k.	FY 1987 Continuing Resolution, Sec. 511. Will assistance be provided for the purpose of aiding the efforts of the government of such country to repress the legitimate rights of the population of such country contrary to the Universal Declaration of Human Rights?	No
l.	FY 1987 Continuing Resolution, Sec. 516. To be used for publicity or propaganda purposes within U.S. not authorized by Congress?	Yes

2131G

102

Attachment C - 1

UNCLASSIFIED

Department of State

INCOMING TELEGRAM

PAGE 01 [illegible]

ACTION AID-00

ACTION OFFICE [illegible]

INFO [illegible]

[illegible]

FM [illegible]

TO [illegible]

[illegible]

[illegible]

AID [illegible]

SECRETARY FOR [illegible]

E.O. 12356 N/A

SUBJECT: SUDAN - REFORESTATION AND ANTI-DESERTIFICATION

PID 650-0082 IEE Project 650-0082

REF: AE AMBASSADOR DIGEST

1. PID IS SCHEDULED FOR SUBMISSION TO AID/W MID JANUARY. FOLLOWING IEE SHOULD BE CONSIDERED AS ATTACHMENT B OF SUBJECT PID.

2. INITIAL ENVIRONMENTAL EXAMINATION (IEE).

- A. FUNDING: FY 1987 U.S. DOLS. 2,000,000

- B. IEE PREPARED BY: JOHN J. GAUDET, REGIONAL ENVIRONMENTAL OFFICER

- C. ENVIRONMENTAL ACTION RECOMMENDED: NEGATIVE DETERMINATION

- D. JUSTIFICATION: THE PURPOSE OF THIS PROJECT IS TO REVERSE THE PROCESS OF ENVIRONMENTAL DEGRADATION CAUSED BY DEFORESTATION AND WIND EROSION IN AN AREA ALONG THE ARID AND HABIL BETWEEN NORTH AND SOUTH KORDOFAN PROVINCES. BY INTRODUCING APPROPRIATE AGRO-FORESTRY PRACTICES SUCH AS SHELTERBELTS, INTERCROPPING WITH NITROGEN-FIXING TREES, AND ALLEY CROPPING AS WELL AS IMPROVED STOVES TO REDUCE WOOD FUEL CONSUMPTION, THE PROJECT AIMS TO MARKEDLY IMPROVE THE ENVIRONMENT IN THE PROJECT AREA. NEGATIVE ENVIRONMENTAL IMPACTS ARE ANTICIPATED TO BE MINIMAL FROM PROJECT ACTIVITIES. ANY CONSTRUCTION, AS WELL AS USE OF AGROCHEMICALS (FOR NURSERIES OR EXTENSION WORK) WILL BE REVIEWED DURING PP DESIGN BY THE REO, TO INSURE COMPLIANCE WITH REG 16.

- E. ACTION REQUESTED BY: JOHN W. KOEHRING MISSION DIRECTOR; DATE: 10/12/86

- F. CONCURRENCE NEEDED FROM: BUREAU ENVIRONMENTAL OFFICER (AFR/TR/PRO) Bessie L. Boyd, AFR/TR/PRO CONCURRENCE: X DATE: FEB 3 - 1987

G.C. CLEARANCE REQUESTED FROM: GC/AFR Clearance: M.A. Kleinjan, GC/AFR DATE: Feb 3, 1987

3. PLEASE NOTIFY MISSION OF FINAL ACTION ON ABOVE ASAP. CONTABLE

UNCLASSIFIED

*103

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX D-1

INSTITUTIONAL ANALYSIS

KHARTOUM
JULY 1987

UNCLASSIFIED

104

INSTITUTIONAL ANALYSIS

Background: The institutional capabilities of the Forest Department, the recipient country implementing agency, must be viewed in terms of the two components that the project comprises - the Resource Inventory Component and the Resource Rehabilitation Component. This is important in view of the relationships that exist, for the implementation of these components, between the Forest Department (FD), other government departments and various regional and local organizations. For the first component, the other government organizations include the National Remote Sensing Center (NRSC), the Sudan Survey Department (SSD), the Soil Survey Administration (SSA) Wad Medani, the Ministry of Agriculture Division of Statistics (MOADS) and the Regional Administrations of Kordofan and Darfur. For the second component, strong relationships exist with Regional Administration of Kordofan (the Governor's office), the local institutions such as district, rural and village councils, Agriculture Research Corporation's research station in El Obeid (presently Western Sudan Agriculture Research Project - WSARP), Forest Research Center (FRC), Soba, the Forestry Educational Institutions (FEI's), the Mechanized Farming Corporation (MFC), the Regional Department of Agriculture (RDA), the Regional Department of Horticulture (RDH) and the Regional Nomadic Affairs Administration (RNAA). (See Chart 7, 8, and 9 for organizational structure of Ministry of Agriculture, Regional Government and Agricultural Research Corporation.

Organization, Management and Staff:

The Central Forestry Administration (CFA), according to the 1932 forestry legislation, is responsible for management and control of all forest reserves and woodland not under cultivation. The Regionalization Act of 1980 vested the control of all forestry activities to Regional Departments of Agriculture and Natural Resources, headed by Regional Ministers. In mid-1985, however, the GOS issued a decree recentralizing responsibility for forestry under the CFA.

CFA, which is a part of the Ministry of Agriculture and Natural Resources (MOANR), is located in Khartoum and consists of Afforestation; Inventory Reservation and Management; Utilization; Gum Arabic; Administration; Planning, and Finance Sections, each headed by a section chief of the rank of Assistant Director. The CFA is headed by the Director, assisted by a Deputy Director and other support staff. The technical staff at CFA headquarters consists of 18 Senior Conservators of Forests (SCF), 16 Conservators of Forests (CF), 57 Assistant Conservators of Forests (ACF) and 37 others.

CFA administers the regions through Regional Directors of Forestry (RDF) of SCF level. The RDFs are assisted by technical and administrative support staff, the strength of which depends on the forestry activities within each region. In Kordofan region, the technical staff consists of 2 SCFs, 1 CF, 18 ACFs and 53 others. In Darfur region, the technical staff consists of 4 SCFs, 14 ACFs, and 45 others. Table 1 indicates the technical staff available in the Forest Department at HQ's and other regions. It is important to mention here that CFA has the powers to transfer technical personnel from one region to the other, depending on requirements of the regions concerned. CFA is planning to reorganize itself into a Forestry Commission, for which initial steps have already been taken. Please see Chart 3 for proposed Organizational Structure of the Forestry Commission.

Under the existing organizational structure (see chart 1), the inventory function is the responsibility of Inventory, Management and Reservation Section (IRM) of CFA. The IRM section is currently staffed by four professionals, three technicians, one draftsman and one secretary. Within the entire administration, however, there are 11 staff with training in photo-interpretation, seven of which are at advanced levels. Six of these have advanced training in remote sensing including satellite imagery interpretation and 3 of whom are expected to be made available to the IRM for carrying out the Resource Inventory Component of the Project.

The National Remote Sensing Center (NRSC)

The Center falls under the umbrella of the National Council for Research (NCR). The building and infrastructure of the Center is housed in the University of Khartoum Faculty of Engineering yet the administration is still under NCR. The SERISS Remote Sensing Project had a substantial input especially with regard to supply of equipment and training to the Center personnel. The existing personnel of the Center is as follows:

		No.
1.	Remote Sensing Specialist	3
2.	Computer Specialist (trainee)	1
3.	Photo lab scientist (trainee)	1
4.	Photo lab technician (trainee)	1

The Center can have input in the project in the two basic compacts.

Basic Image Mapping

The photo lab of the Center can be deployed to generate the images to be used in the mapping. The remote sensing specialist can assist with deciding the proper type of enhancement to be used in the final image map.

Forest Inventory Mapping

The Center has acquired through the SERISS project computer equipment and expertise in the area of image analysis using the computers. This could be very useful to the project. The system has also the geographical information system GIS capability which is important in the forest inventory survey. A Remote Sensing specialist can be deployed in assisting in stratification and image interpretation. The photo lab can be used in generating hard copies of enhancements to be used by the field personnel.

Sudan Survey Department (SSD)

It is one of the oldest departments in the Sudanese government. It was established at the turn of the century. The department is headed by a Director General with two assistants. A number of Sections form the technical

units. These are:

1. Topographical Survey
2. Cadastral Survey
3. Geodetic Survey
4. Computation and Checking

The main section that will be involved in this mapping and forest inventory survey is the topographical survey section. The section has done a number of maps at scales 1,100,000, 1/250,000, 1/100,000 and 1/25,000.

The staff in the section are:

		Approx. Numbers
1.	Survey Engineers	20
2.	Photogrametists	15
3.	Photo interpreters	5
4.	Cartographers	10
5.	Draftsmen	50

The Geodetic Section and the Checking and Computation Section will also be involved in the image mapping exercises since they will supply the basic geodetic control needed to scale the image to the correct scale.

The involvement of the Survey Department in the project will be:

1. Supply the needed basic control from their existing records and maps. (Some field work might be needed in the area of doppler satellite fixing where no control exists).
2. Perform the cartographic work of cultural features, edge information place names etc.
3. Conduct field and office verification and final checking and editing before map printing.
4. Act as map custodian for public distribution.

The personnel are sufficient in number and qualification, the infrastructure is already in place. What might be needed may be some specialized training mostly on the job. Also some additional equipment.

Ministry of Agriculture, Statistics Division (MOASD)

The Ministry of Agriculture Statistics Division has the responsibility to estimate current agricultural production in Sudan. They do this using Area Sampling Frame (ASF), designed specifically for crops. The MOASD has personnel who are experts at sample selection, data collection (for agricultural production purposes) and computer data entry, edit and summary. They have 60 interviewers, 15 cars and 10 persons to edit, enter and summarize data. Although they have their own survey work which requires everyone at certain busy months, MOASD can provide technical support in several areas associated with survey design, survey form design, computer data entry, edit, summary and reporting.

Soil Survey Administration, Wad Medani (SSA)

This is part of the Ministry of Agriculture and National Resources. Its headquarters are in Wad Medani in the Central Region. The staff consist of:

		No.
1.	Soil Scientists	10
2.	Soil Surveyors	30
3.	Cartographers	5
4.	Draftsmen	20

Their support can impact the two major components of the project.

1. Basic Image Mapping
2. Forest Inventory Mapping

Basic Image Mapping

The cartographers and draftsmen in the administration have fairly extensive experience in image mapping using satellite data. As a matter of fact the first image maps of Jebel Marra, Darfur Region at scale 1/1000,000 and the Kordofan feeder road image map at scale 1/500,000 was prepared by staff from the cartographering section in the Administration. Mr. Zein El Abdin Sharif, the head of this section and is particularly qualified for such a job.

Forest Inventory Mapping

This may require input from this administration in the form of photo interpretation work and cartographic work. The soil surveyors in the Administration are particularly qualified in the interpretation of satellite and photographic data. They had a significant input in the SERISS Remote Sensing Project.

The cartographers can assist in preparing the forest inventory overlays in proportion to the forest inventory map.

Research

Forestry research in the Sudan is conducted under the overall control of the Agricultural Research Corporation (ARC) at three research centers, the Forestry Research Center at Soba (Khartoum), the Forerst Research Station (FRS) at Wad Medani (Central region) and the Forest Research Station at El Obeid (Kordofan). The El Obeid Station has been taken over by the Western Sudan Agriculktural Research Project (WSARP) under ARC.

Research work at the FRC Soba is conducted at the following Sections of the Center.

Silviculture Section: Conducts research on silviculture of forestry species with respect to their phenology, biomass production, suitability for various end uses, seed collection, testing and distribution.

Botany Section: Conducts research on performance and evaluation of exotics in the Sudan and assembles information on their botanical characteristics, habitat and distribution. It also works on collection and documentation of information on gum producing plants of the Sudan, their botanical characteristics, distribution and use. The section maintains perhaps the best herabarium in the country particularly as regards forest tree species.

Arid Zone Section: Conducts research on the use of shelterbelts/wind breaks and other devices to control blown sand and shifting sand dunes. It also has undertaken species trials at Soba, El Zeideb, and Dongola.

Wood Technology Section: Conducts studies on wood machining properties of local structural woods, improved charcoal production, suitability of woody species and agricultural residues for the manufacture of building blocks. In addition studies are also conducted on qualitative and quantitative characteristics of wood structures and wood preservation.

The staff strength at the FRC consists of 2 Ph.D Scientists, 7 M.Sc Researchers, 11 B.Sc Researchers and 12 Diploma holders.

The Forestry Research Station at Wad Medani has been established to support forestry research in the Central and Eastern regions.

The El Obeid Research Station, now under the control of WSARP, primarily works on Gum Arabic (Acacia senegal). Major areas of research include silviculture, management and tree improvemenmt programs.

The forestry research in the Sudan is inadequately funded, under staffed, poorly housed and lacks adequate infrastructure in terms of materials and equipment. Qualified personnel, however, do exist in the ARC who are capable of executing forestry research programs once the above mentioned constraints are removed. The El Obeid Research Station is now housed in the WSARP complex and has adequate facilities to conduct appropriate research programs. Specific funding, however, shall have to provided to address specific research problems. Some research work on Acacia senegal has been initiated with available resources.

Forestry Education:

Technical Forestry Training:
Forestry education in Sudan started in 1946 with the establishment of a forestry school in Khartoum within the Forests Department. The school offered a two-year Certificate in Forestry to students who had completed eight years of general education. In 1960 the course was improved, the entry requirements raised to completion of 12 years of general education and graduates were awarded a diploma in forestry after two years of study. In 1973 the College joined the Department of Higher Education in the Ministry of Education. In 1975, the College became "The Forestry Technicians Division", one of three Divisions in the College of Agricultural Studies in the Khartoum Polytechnic. The duration of study was increased to three years. Since 1960 the College has been located at Soba.

A second intermediate level forestry education facility came into being in 1977, when a Department of Forestry was established in the Yambio Institute of Agriculture. The Forestry Department of the Institute offers a two-year course leading to an award of a diploma in forestry. The minimum entry requirement is the satisfactory completion of the Sudan School Certificate or equivalent.

Professional Forestry Training:

Prior to 1975, professional forestry training was not available in Sudan and was undertaken in overseas universities, mainly in U.K. In 1975, the Faculty of Agriculture of the University of Khartoum established a Department of Forestry. The Department offers a five-year course leading to the degree of B.Sc (Forestry) Honours.

In 1977, the College of Natural Resources and Environmental Studies of the University of Juba started to offer a course in forestry besides other specializations. The course duration is five years and leads to an award of B.Sc Honours.

The University of Khartoum, Juba University and Khartoum Polytechnic, together with other national universities in Sudan are controlled by the National Council for Higher Education (NCHE). Entry requirements are determined by the Higher Education National Admissions Board (NAB). Yambio Institute of Agriculture is controlled by the Regional Ministry of Agriculture, Juba. Entry requirements are determined by the latter. Further details are given in table 2.

Forestry education in Sudan at both technical and professional level concentrates on traditional forestry practice. The need to shift the emphasis to contemporary concepts, e.g. agroforestry, community forestry, desertification, integrated rural development etc. and cater for other land-using sectors such as wildlife, range and pasture, fisheries etc, is felt. Some Institutes have already embarked on curricula revisions, e.g. Forestry Technicians Division, Soba and Forestry Department, Faculty of Agriculture, University of Khartoum. Considerable institutional support in the way of buildings, equipment, vehicles, staff development and operational costs are required for this purpose.

Regional administrative set-up:

Regional administrative set up is particularly important for the Resource Rehabilitation Component of the Project. In Kordofan, the Regional Director of Forestry (RDF) is assisted by 1 CF, one for each province (North Kordofan and South Kordofan). In view of higher percentage of forest area in South Kordofan, the technical staff assigned is higher (9 ACFs and 27 others). (See Chart 2).

Regional Governor is the administrative head of the region who is assisted by a Deputy Governor and Regional Ministers for various departments such as Agriculture, Public Works, Animal Husbandry, Range and Pasture, Horticulture, Local Administration etc. Each department is headed by a Regional Director. Although the RDF is technically responsible to the CFA, he has definite administrative responsibility to the Governor.

The local administrative structure consists of the Secretary General to the Regional Government who reports to the Governor. At the provincial level, there is a Provincial Council, headed by a Provincial Commissioner. The provinces are divided into districts, each district having a District Council headed by the District Executive Officer. The districts are further sub-divided into Rural Councils, each headed by a Rural Council Administrative Officer. At the village level, there exist village councils (in some cases, a group of villages has only one village council because of lesser population). Towns are administered by Town Councils.

The current capacity of the Forest Department to implement projects of this nature on their own is severely hampered by inadequacy of infrastructure, vehicles, equipment, and to some degree adequately trained staff. Some of these constraints are, however, now being addressed through efforts of various donors including USAID, the Dutch, Finnish Aid, FAO and UNDP. Action has also been initiated by the Forest Department itself in terms of organizational re-structuring, policy and legislation, and greater coordination among various agencies involved in forestry and natural resource development programs. Other organizational constraints are likely to be addressed through the World Bank led multi-donor forestry development project. The Forest Department, through assistance from FAO, has also initiated efforts for the creation of a National Forestry Extension network. Obviously, the Forest Department will need technical assistance for the implementation of this project. (See proposed implementation organization for details).

Proposed Implementation Plan Organization:

For the implementation of project activities including the Resource Inventory and Resource Rehabilitation components, a Central Steering Committee will be constituted. This Committee will meet every 6 months and will be responsible for evaluating the implementation plan and monitoring project activities. The Constitution of this Committee will be as follows:

Undersecretary, Ministry of Agriculture and Natural Resources	- Chairman
Director CFA	- Secretary
Director USAID	- Member
Chief Technical Advisor (Inventory)	- Member
Co-Project Director (Inventory)	- Member
Project Leader (Resource Rehabilitation)	- Member
Co-Project Manager (Resource Rehabilitation)	- Member
Director National Remote Sensing Center	- Member
Representative RCSSMRS, Nairobi	- Member
Representative Ministry of Finance and Economic Planning	- Member
Representative MOA, Division of Statistics	- Member
Representative, ARC	- Member
Forestry and Natural Resources Advisor USAID	- Member

Please see Chart 3 for organizational structure.

Resource Inventory Component:

The Resource Inventory component of the project will be implemented by the Inventory, Reservation and Management (IRM) section of the Central Forestry Administration (CFA) with assistance from Regional Center for Services in Surveying, Mapping and Remote Sensing (RCSSMRS), Nairobi.

Technical assistance (full-time), training, procurement of materials and equipment will be handled by the contractor (RCSSMRS) in addition to logistics within the Sudan. The contractor will use all the facilities and personnel available in the Sudan for execution of the work assigned. The fieldwork will be conducted by the IRM under the guidance and supervision of the contractor.

A Steering Sub-Committee based in Khartoum (CFA) will be constituted and will consist of the following members.

Director, CFA	- Chairman
Co-project Director Inventory	- Secretary
Chief Technical Advisor (Inventory)	- Member
Director, National Remote Sensing Center	- Member
Representative, Sudan Survey Department	- Member
Representative, Soil Survey Administration	- Member
Representative, MOA, Division of Statistics	- Member
Representative, USAID	- Member
Representative, Ministry of Finance and Economic Planning	- Member
Project Field Officers	(2)

The Steering Sub-Committee will meet once every month and will steer and monitor project performance.

Field organization will comprise project field officers and field teams responsible for execution of field work. The field officer will report to the co-project director on a regular basis and communicate progress. It must be emphasized that the co-project director will spend at least 15 day each month in the field guiding and supervising field work. (See Chart 5).

Resource Rehabilitation Component

For this component of the project, the implmenetation plan calls for the creation of a Steering Sub-Committee at the regional headquarters, El Obeid (Kordofan), with the following members:

Governor or his representative	- Chairman
Co-Project Manager	- Secretary
Regional Director, Agriculture	- Member
Regional Director Forestry	- Member
Regional Director Horticulture	- Member

Regional Planning Representative	- Member
Gum Producers Association Representative	- Member
Project Leader (Ex-pat)	- Member
Project Extension Specialist (Ex-pat)	- Member
Project Extension Coordinatior (Dept. of Agriculture, Horticulture or Forestry)	- Member
Representative (WSARP) - El Obeid Station	- Member
USAID Representative	- Member
Executive Officer, Dilling District	- Member
Executive Officer, Um Ruwaba District	- Member
Executive Officer, El Obeid District	- Member

The function of this steering committee will be to evaluate and approve implementation plans and schedule, monitor project progress and make suggestions for improvement of project performance (should that be necessary). The committee will meet once every 3 months. Regional Governor must chair the annual meetings.

The implementation of the project activities will be the responsibility of the project team consisting of the Project Manager (Agroforestry) and Co-project Manager at the top, assisted by Forest Rehabilitation Coordinator (ACF), Extension/Training Specialist, Extension Coordinator and Monitoring & Evaluation Coordinator. This team will be assisted by a Rural Council Project Officer (RCPO) for each Rural Council. It is expected that at least one of the RC officers will be seconded from the Regional Horticulture Department and the remaining from the Forest Department (ACFs). Each RCPO will be assisted by 3 Forestry Extension Officers (FEOs) (FR or junior ACF level) one Forest Ranger for rehabilitation and management of forests, and one each nursery supervisor/overseer, all seconded by the Forest Department. Each FEO will be assisted by Area Coordinators (AC) also seconded by the Forest Department. RCPOs will work at RC level and in close coordination with RC Administrative Officers and the ACs will work in close coordination with a group of village councils. At the village council level a Village Council Extensionists (VCE) will work for the villages in each village council in close contact with the village contact person (VCP). Close coordination at these levels is critical to the success of the project. See Chart 6.

See Table 3 for Technical Personnel needed for project implementation.

Project Implementation Committees

For development and implementation of project programs and activities, project committees will be set up at HQs, Rural Council and village levels. The composition and frequency of their meetings is given as under.

Project Committee (HQs) - Meet Monthly

Project Leader	- Chairman
Co-Project Manager	- Secretary
Project Extension Expert	- Member
Project Extension Coordinator	- Member
Rural Council, Project Officers	- Member
Forestry Extension Officers	- Member

Rural Council Level Project Committee
(Meets monthly, one week before HQ's meeting)

Administrative Officer, Rural Council	- Chairman
Rural Council Project Officer	- Secretary
Forestry Extension Officers	- Member
Members of the Rural Council	- Members
Project Leader or his Counterpart	- Observer

Village Level Project Committee
(Meets every month, one week before Rural Council Meeting)

Village Council Chairman	- Chairman
Forestry Extension Officer	- Secretary
Forest Extension Worker	- Member
Other Members of the Village Council	- Members

Table 1 Existing Professional Technical Staff
Forest Department

	Dir/Dep.Dir	SCF Sr.	SCF	CF	ACF(Sr)	ACF	OTHERS	TOTAL
H.Qs CFA	2	4	14	16	7	50	37	130
Northern Region								
H.Qs	-	1	1	2		1	1	
Nile Province				2		3	42	
Northern Prov.					3	1	11	
TOTAL		1	1	4	3	5	57	71
Khartoum Region	-	2	1	1	1	2	33	39
Central Region								
H.Qs	-	1	1					
Blue Nile Prov.			11	8	5	15	217	
White Nile Prov.			2	2	2		15	
Gezira Province			3		1	8	13	
TOTAL		1	17	10	8	23	249	312
Kordofan Region								
H.Qs	-		1		2	2	6	
North Kordofan		2		1	3	2	30	
South Kordofan					3	6	27	
TOTAL		1	1	1	8	10	63	49
Darfur Region								
H.Qs	-	1	3		7	1	11	
South Darfur					7		14	
North Darfur						2	20	
TOTAL		1	3		14	3	45	66
Eastern Region								
H.Qs	-	1	1				32	
Kassala Prov.			2			11		
Red Sea Prov.								
TOTAL	2	1	3			11	32	47
GRAND TOTAL	2	9	41	32	52	106	446	749

Table 2. Institutes of Higher Education in Sudan, with a Forestry Option

Institute	Faculty/College	Status of Forestry Training	Location	Entry Requirements	Duration of Study	Award	Annual Intake
University of Khartoum	Faculty of Agriculture	Department	Shambat	Sudan School Certificate	5 years	B.Sc.(For) Hon.	20
University of Juba	College of Natural Resources & Environmental Studies	Course	Juba	"	5 years	B.Sc.Hon.	15
Khartoum Polytechnic	College of Agricultural Studies	Division	Soba	"	3 years	Diploma	40
Yambio Institute of Agriculture	Institute	Department	Yambio	"	2 years	Diploma	24

Chart 1

Organizational Chart - Central Forestry Administration

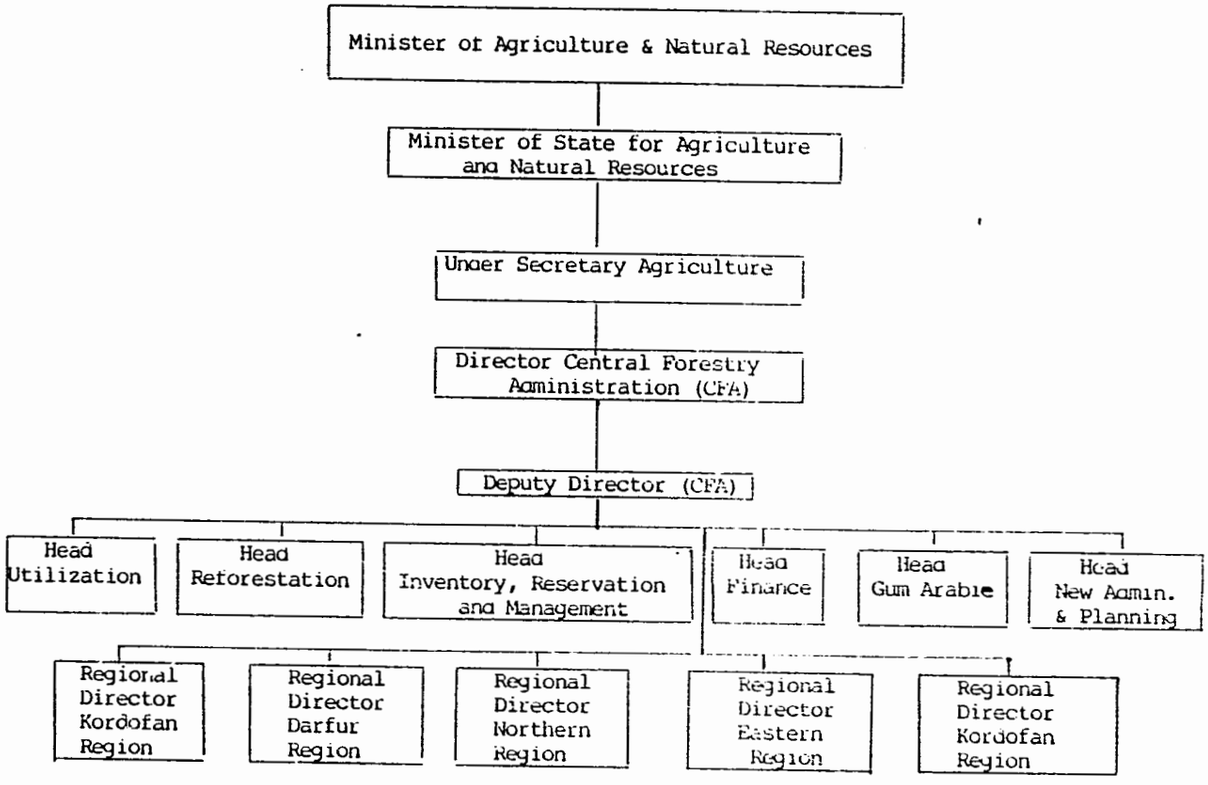
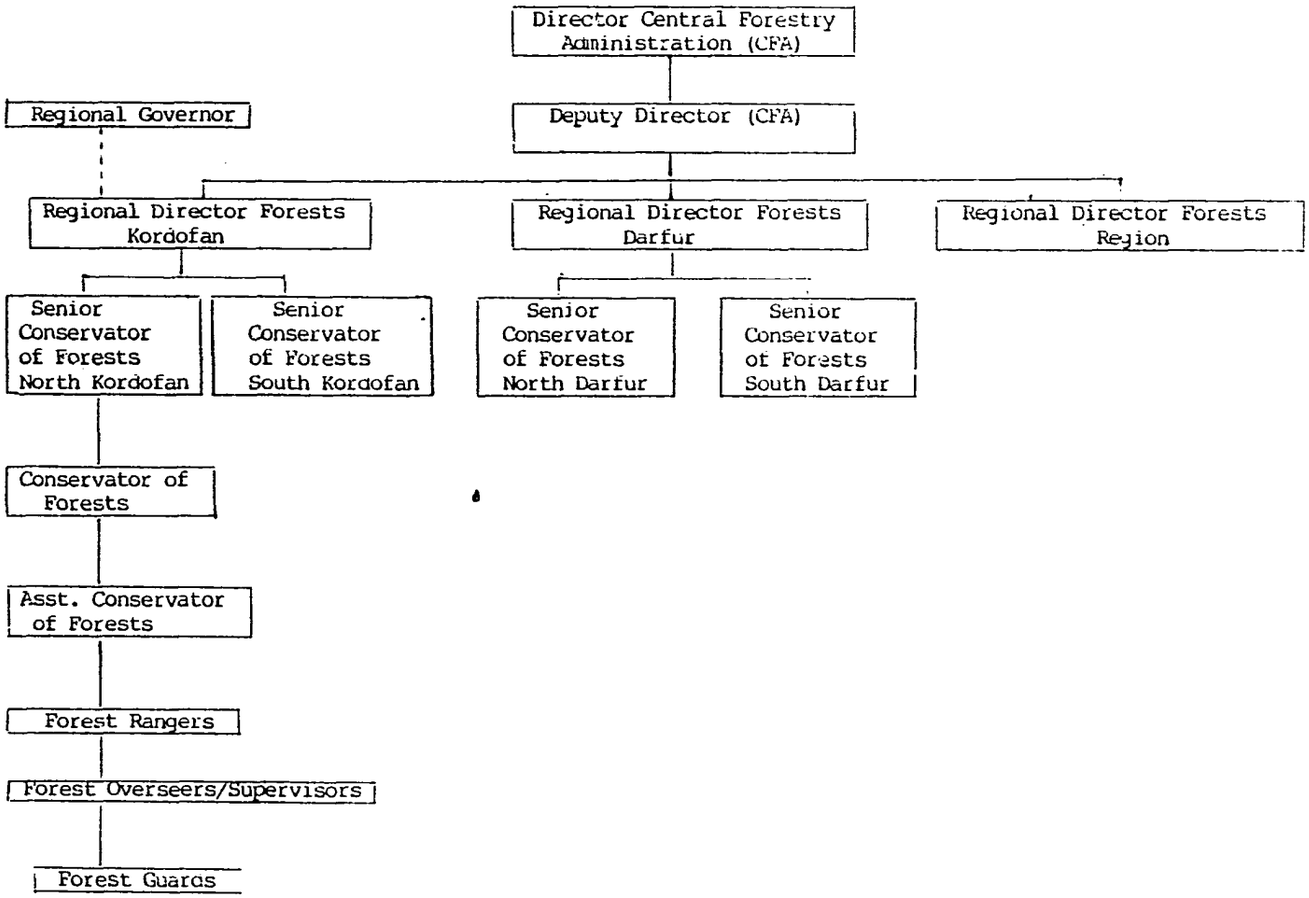


Chart 2

Organizational Chart - Forestry Administration
(Regions)



18

Chart 3

THE ADMINISTRATIVE SET UP OF THE PROPOSED FORESTRY COMMISSION

Minister

Board of Directors

Planning Council

Director General

Forest Research (DDG) | Legal Advisor | Int. Audit | Information Public Relations

Planning Division (DDG)

1. PLANNING SECTION (ADG)
a) Forest Res. Planning
b) Sector & System Planning
c) Long & Midterm Planning
d) Information and data
e) Statistics

2. PROJECT SECTION (ADG)
a) Project identification formulation, monitoring and coordination
b) Preparation of Tariff rates

3. FOR. MANAGEMENT SEC. (ADG)
a) Inventory
b) Lands & Reservation
c) Management Planning

Silvicultural Division (DDG)

1. AFFORESTATION SECTION (ADG)
a) Seeds & Seedlings Procurement
b) Nurseries
c) Plantations
d) Silviculture

2. DESERT CONTROL SECTION (ADG)
a) Conservation & Protection
b) Shelterbelts & Agroforestry
c) Desert Control Measures

3. GUM ARABIC SECTION (ADG)
a) Restocking of Gum Belt
b) Other Gum Producing Spp.
c) Promoting Production & Marketing of Gum & minor forest products

Utilization Division (DDG)

1. UTILIZATION SECTION (ADG)
a) Logging
b) Supply of woodfuel, poles, sawn timbers and Railway Sleepers
c) Control of wood Assortment Prices

2. ENGINEERING SECTION (ADG)
a) Workshops, Machinery; equipment & Technical
b) Saw doctoring
c) Maintenance of Sawmills
d) Seasoning & Processing

3. FOREST INDUSTRIES SECTION (ADG)
a) Regular supply of raw materials to industries
b) Establishment of new industries
c) Running of Sawmills & Workshops

Extension Division

1. EDUCATION/TRAINING SECTION (ADG)
a) Training of Extension Personnel
b) Backstopping Region Extension Work
c) Forestry education in Schools and in teaching training Institutes
d) Liaison w/Agric. Ext.

2. COMMUNICATION SECTION (ADG)
a) Forestry on T.V., Radio, films, newspapers and liaison w/ FRC disseminate research results
b) Printing

3. SOCIAL FORESTRY (ADG)
a) Backstopping

Administration and Finance Division (DDG)

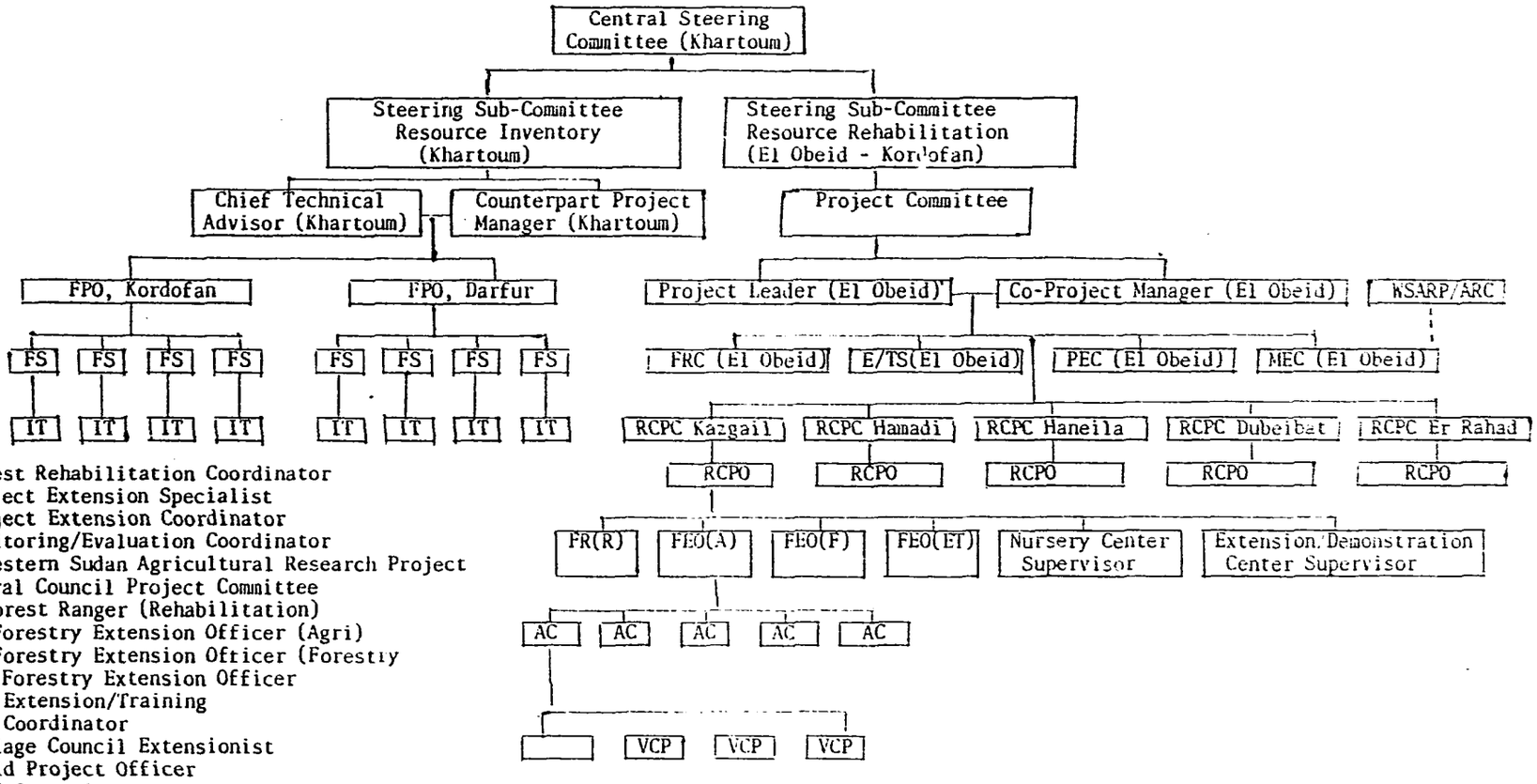
1. PERSONNEL SECTION (ADG)
a) Personnel Services and Management
b) Institutional Development
c) In-service Training

2. FINANCE SECTION (ADG)
a) Budget, Accounts & cost calculation
b) Purchases
c) Financial results

3. ADMINISTRATIVE SECTION (ADG)
a) Property, Building, maintenance and general services
b) Logistics
c) Telecommunications
d) Computer control

Chart 4

PROPOSED PROJECT ORGANIZATION



FRC - Forest Rehabilitation Coordinator
PES - Project Extension Specialist
PEC - Project Extension Coordinator
MEC - Monitoring/Evaluation Coordinator
WSARP - Western Sudan Agricultural Research Project
RCPC - Rural Council Project Committee
FR(R) - Forest Ranger (Rehabilitation)
FEO(A) - Forestry Extension Officer (Agri)
FEO(F) - Forestry Extension Officer (Forestry
FEO(ET) - Forestry Extension Officer Extension/Training
AC - Area Coordinator
VCC - Village Council Extensionist
FPO - Field Project Officer
FS - Field Supervisor
IT - Inventory Team

Chart 5

Proposed Project Organization (Resource Inventory)

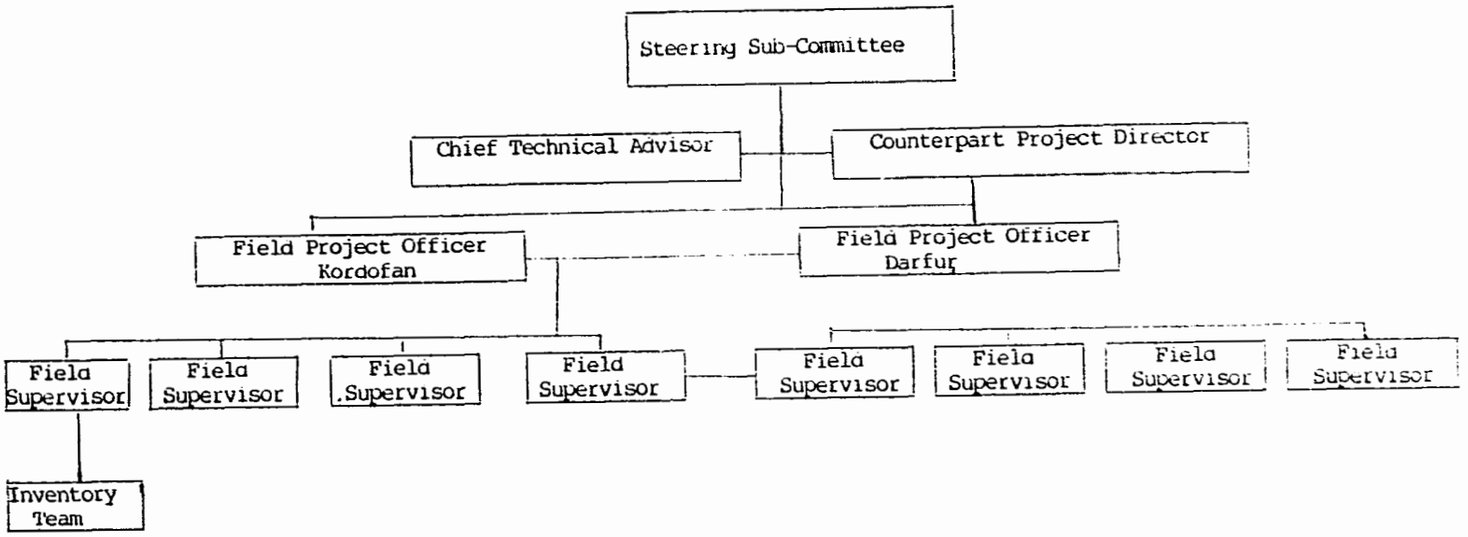
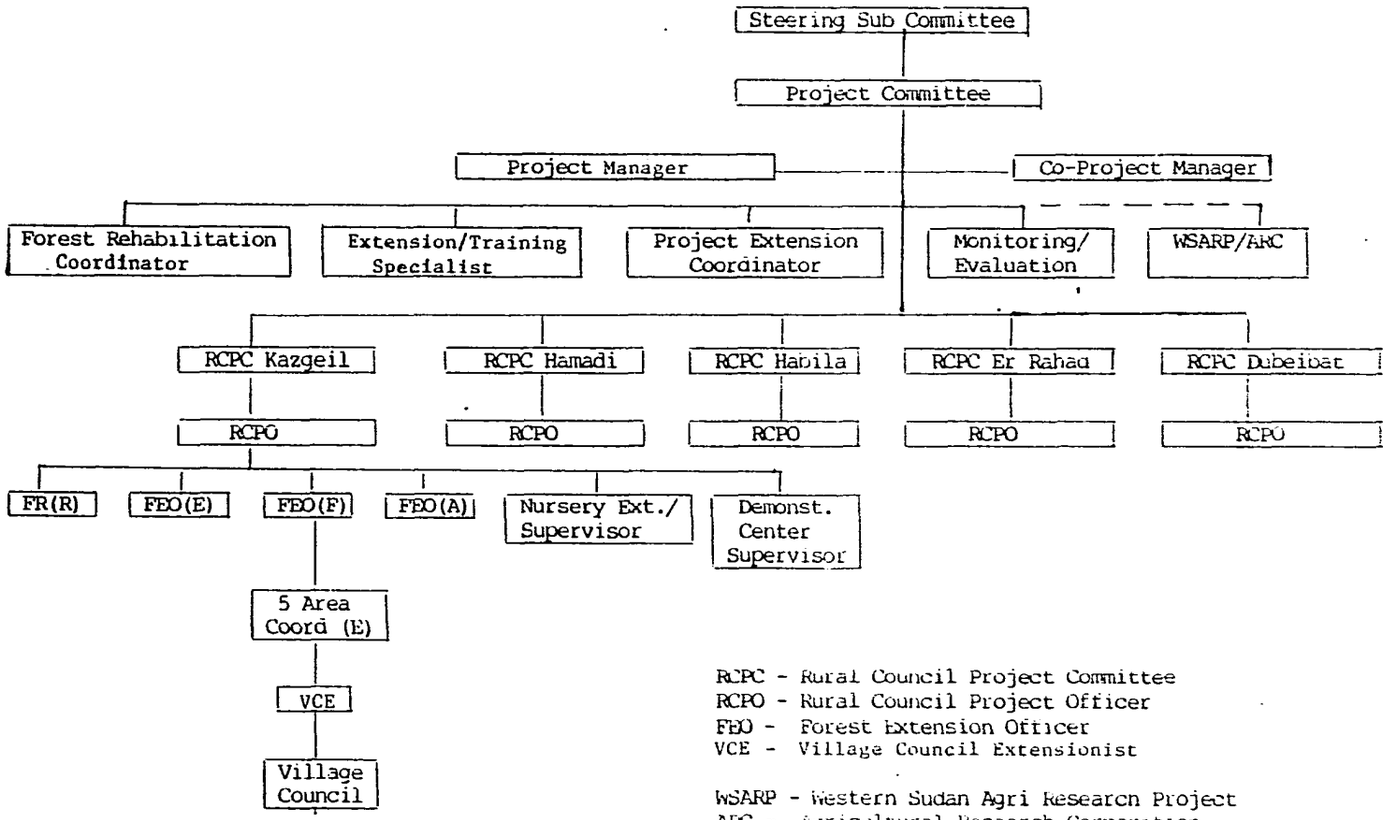


Chart 6

Proposed Project Organization (Resource Rehabilitation)



RCPC - Rural Council Project Committee
RCPO - Rural Council Project Officer
FEO - Forest Extension Officer
VCE - Village Council Extensionist

WSARP - Western Sudan Agri Research Project
ARC - Agricultural Research Corporation
FR(R) - Forest Ranger (Rehabilitation)

Chart 7

ORGANIZATION OF THE MINISTRY OF AGRICULTURE

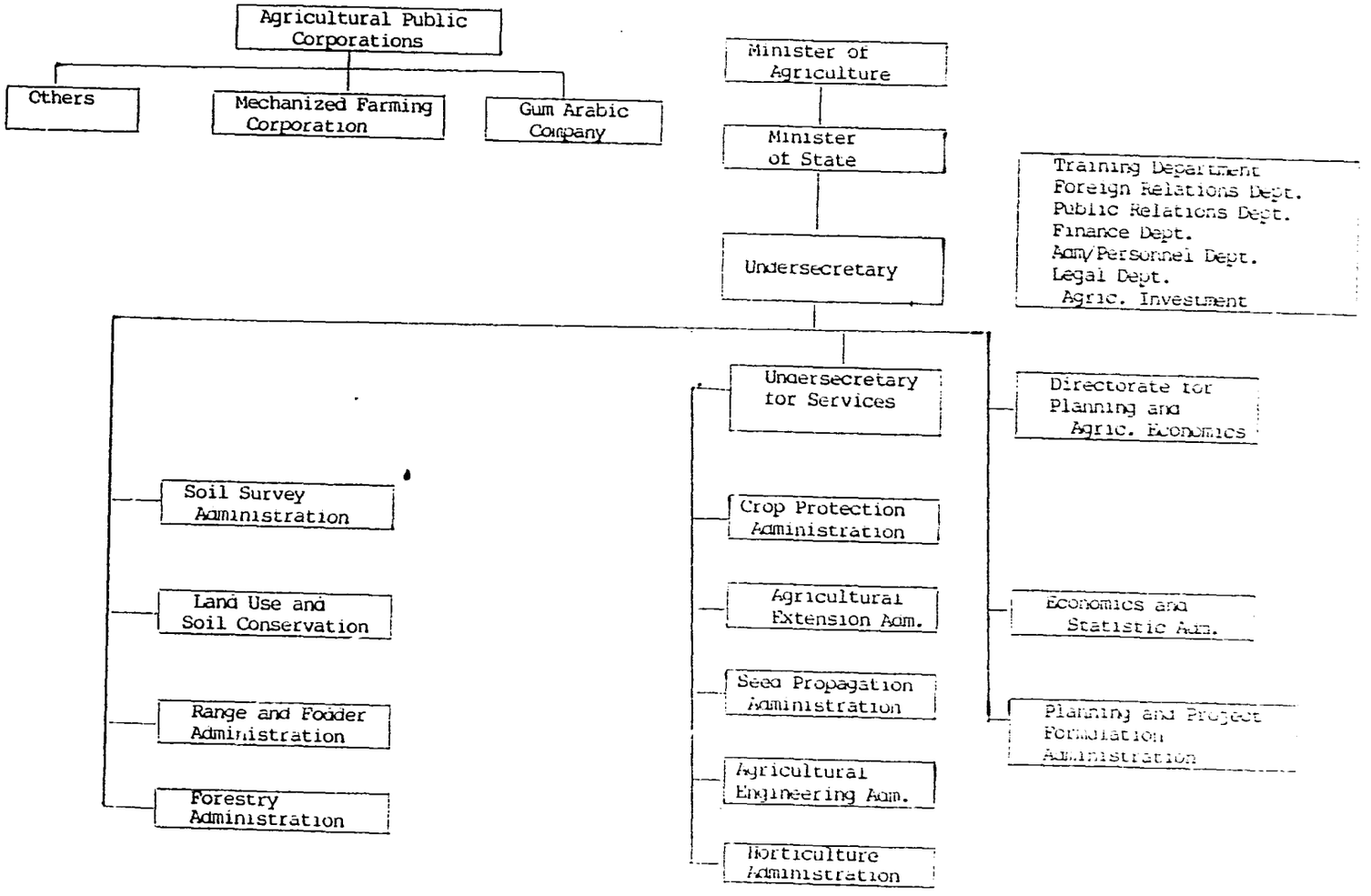


Chart 8

Regional Government Organization

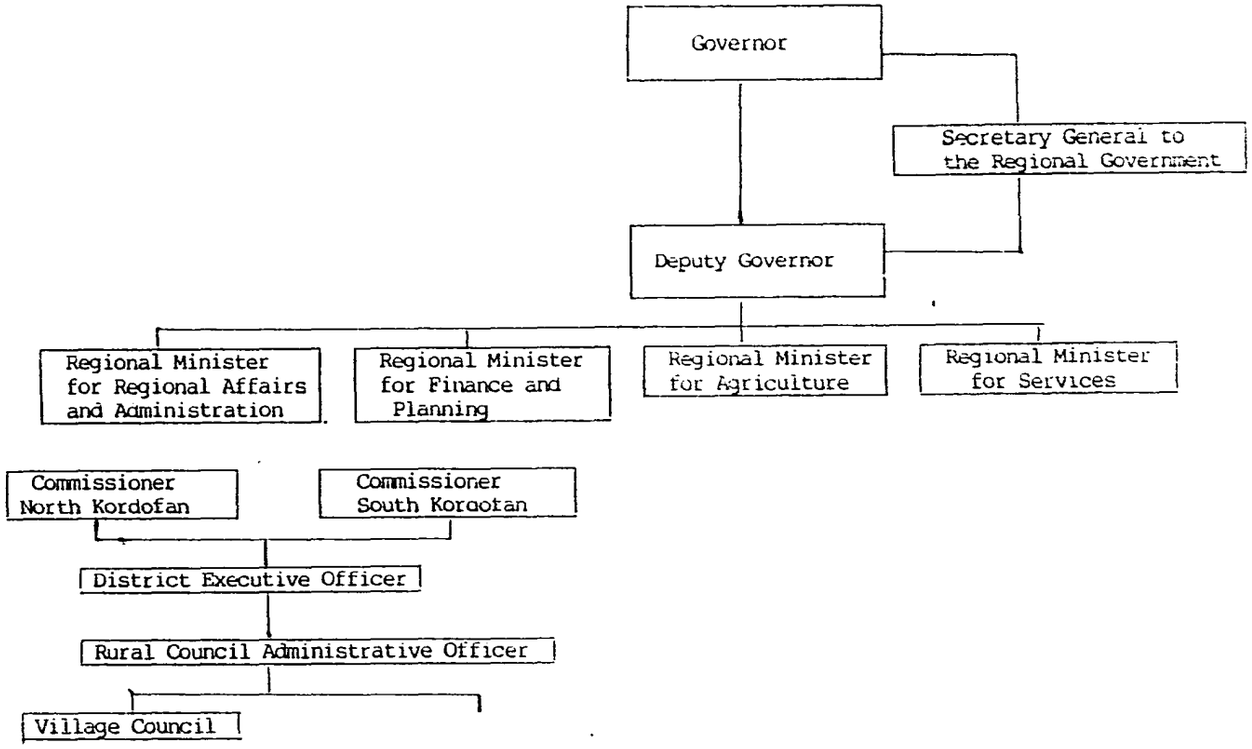
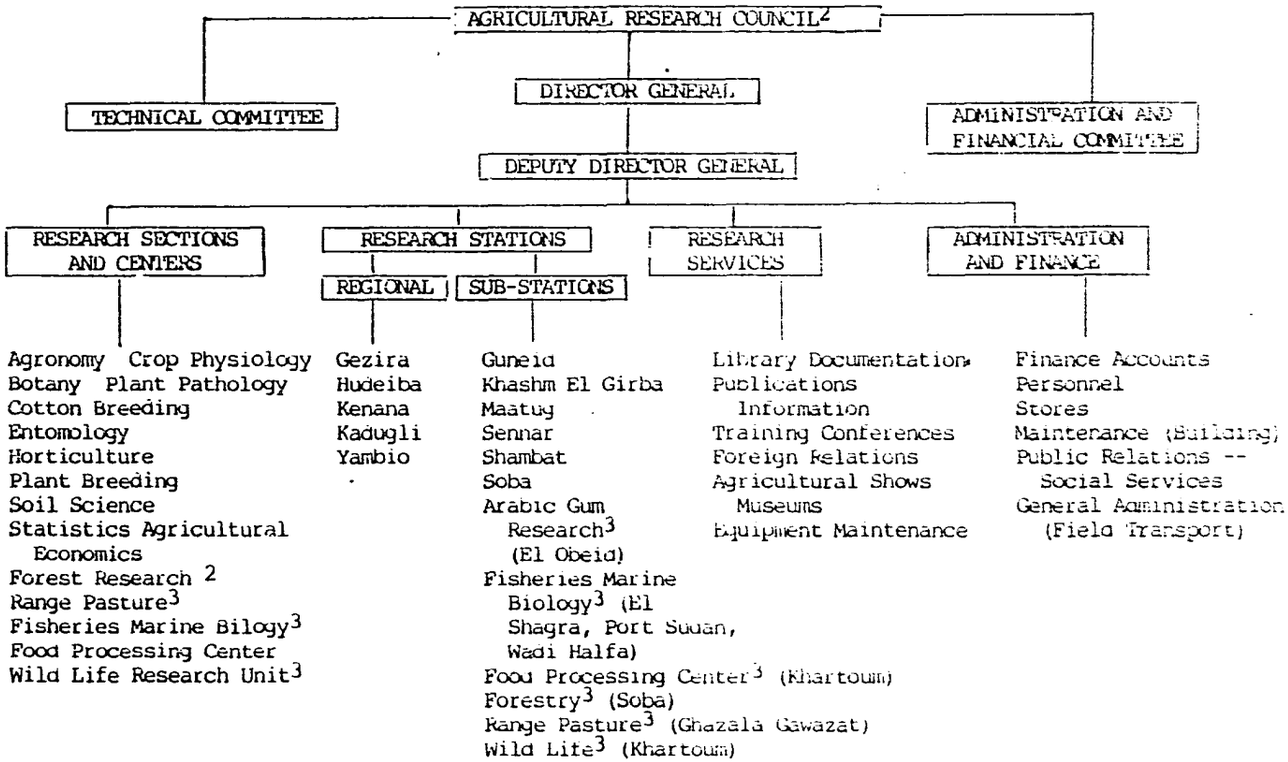


Chart 9

Agricultural Research Corporation[1]



---

1 The ARC is under the Ministry of Agriculture, Food, and Natural Resources

2 Also referred to as "BOARD OF MANAGEMENT"

3 Transferred to the ARC in 1975

125

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX D-2(A)

FOREST RESOURCE INVENTORY AND VEGETATION MAPPING

KHARTOUM
JULY 1987

UNCLASSIFIED

124

FOREST RESOURCE INVENTORY AND VEGETATION/PHYSIOGRAPHIC MAPPING COMPONENT OF THE SUDAN REFORESTATION AND ANTI-DESERTIFICATION PROJECT (650-0032)

INTRODUCTION

The Forest Resource Inventory Component of the Sudan Reforestation and Anti-Desertification Project will provide a map showing the distribution of the forest-related resources of Kordofan and Darfur Provinces as well as quantitiative estimates of these resources with physical descriptions. This inventory will identify and help prioritize forest-related projects, which will begin concurrently with mapping, and will address the resource opportunities and constraints. More intensive surveys will provide quantitative estimates and descriptive information about forest resources. The inventory component is divided into three major sets of actions:

1. Development of satellite-image base maps showing administrative and physical infrastructure, physiographics and some vegetation detail.

2. Development of a multistage sampling design for forest resource inventory analysis and mapping using a combination of satellite imagery, aerial photography and ground survey teams for a small region in South Kordofan.

3. Refinement and adaptation of the forest resource inventory so that it can be efficiently and effectively expanded to all of Kordofan and Darfur regions.

Forest Mapping and Forest Resource Inventory are based on three integrated techniques of land-use classification and subsequent assessment: Landsat imagery, aerial photography and ground-level enumeration. While the latter two are well known and have been practiced in Sudan for several decades the use of satellite imagery adds a new dimension to the process of forestry information acquisition and use. It must be stated from the outset that although satellite imagery has been of great assistance in monitoring agriculture productivity and determining physiographic and administrative distribution, this type of imagery use is relatively new in the field of forestry. This is particularly true in Africa and especially relevant in the open Acacia woodlands typical of Kordofan and Darfur. These types of forests provide new challenges for the remote sensor and forester as their physical and biological attributes make them difficult to discern from certain types of ground cover. Considerable adaptive testing and refinement of the methodology will thus be a major requirement of the forest mapping.

It is anticipated that the Regional Centre for Services in Survey, Mapping and Remote Sensing (RCSSMRS) will be contracted to facilitate implementation of the forest mapping. RCSSMRS will be responsible for procuring all goods and services necessary to execute this technically complex and logistically difficult action. In addition they will be responsible for required short-term training. While the Central Forest Administration (CFA) will provide a full-time technical counterpart, RCSSMRS will provide a qualified expatriate to furnish technical and administrative support. Additional short-term experts will be contracted through the same prime contract.

I OBJECTIVES

The main objectives of this contract will be to produce maps and develop quantitative estimates of the forest resources of Western Sudan. These products will be produced using remote sensing technology and multistage sampling survey design which will be implemented by CFA with technical support from RCSSMRS. Some help can be obtained from the Agriculture Statistics Department, the Survey Department, the National Remote Sensing Center, Khartoum and the RCSSMRS, Nairobi. Maps, statistical tables and a digital geographic information database will be produced (see Stauffer et al 1987). Funds will be provided by the Government of Sudan, Ministry of Agriculture and Natural Resources to the National Remote Sensing Center and the Forestry Department supplemented where necessary to establish an internal capacity to manage forest inventories into the future but the initial set up will be funded by USAID/Khartoum.

The objectives of this component of the project are as follows:

A. Image Mapping - Produce 1:250,000 topographic base maps of Western Sudan (10°N - 16°N and 22°E to 33°E showing:

1. Terrain heights for salient physical features.
2. UTM, latitude and longitude grid lines and associated annotations and titles.
3. Cultural overlays, transportation and communication corridors.
4. Place names.
5. Region, Province, Area Council, Rural Council administrative boundaries.
6. International boundaries.
7. National parks, reserves and irrigation areas, and other legal boundaries.

B. Forest Mapping:

1. Produce 1:250,000 maps of Southern Kordofan and Southern Darfur showing the extent of forested lands 100 ha. and larger.
2. Digitize the mapping for use in Geographic Information System and resource inventory.
3. Produce 1:1,000,000 scale composite image forest maps.

C. Resource Inventory:

1. Conduct a pilot forest resource inventory survey covering 5 rural councils in S. Kordofan to determine species, composition, volume and conditions.
2. Complete a forest resource inventory survey of the Southern Kordofan and Southern Darfur provinces to determine the species composition, distribution, volume, and conditions.
3. Develop a set of statistical tables for each Rural Council showing area (ha.) and volume (M^3) for each major forest type. Compute for province. Volume estimates at the province level should be at $\pm$ 20% at the 95% probability level = 10% CV.
4. Establish frame for operational inventory.

D. Other:

1. Develop volume and biomass (M^3) equations for major tree and shrub species in the area.
2. Determine annual growth rates for major trees and shrubs (M^3/year).
3. Determine depletion rates (ha/year) on major forest types.
4. Determine regenerative capacities of major tree and shrub species upon which management plans can be based.
5. Establish a base for monitoring major changes in the extent of the forest resources.

E. Institution Building: Expand the capabilities of the existing Sudan Department of Forestry by providing limited equipment, training and operational support so that they can carry out, analyze and maintain the inventory, and databases and maps. Finally, the inventory component will provide the framework to develop, test and eventually extend forest management options for sustained yield of forest resources.

F. Givens

1. For mapping projects, use existing Landsat imagery taken during October - November 1985 and September - October 1986 to the extent possible.
2. For inventory use the field forms, definitions, sample unit configuration, encoding, and displays as in the CIDA Inventory of the Blue Nile region.
3. To the extent appropriate, use the same sampling design as developed under SERISS to capitalize on existing software, data processing techniques, and available resource data.
4. Use existing SERISS project aerial photography to train interpreters and to test mapping and sampling schemes using landsat imagery.

G. Schedule:

The preparation of image maps from the satellite data can be done independently of the forestry inventory. The image maps should be used as the base for the final compilation of the forest survey results. Thus the work can proceed efficiently by scheduling the map work in the same sequence as the forestry inventory and producing both maps and forest analyses for a given area simultaneously.

II IMAGE MAPPING FOR SUDAN USING LANDSAT TM DATA

A. Background:

Existing map coverage of Sudan is complete at the 1:1,000,000 scale and the 1:250,000 scale. However the 1:250,000 map coverage is out-dated and in need of revision. It also lacks detail of terrain height and morphology. By using data from the Landsat, satellite image maps will be produced (see Rauch 1987).

B. Materials available:

For the central agricultural zone of Sudan between 10° and 16°N and 22°E to 33°E data have been gathered by the Thematic Mapper (TM) on board Landsat - 5, in October-November, 1985 and September/October, 1986. The data collected in 1985 were purchased under an AID financed project and are available through the Environmental Research Institute of Michigan (ERIM). The data collected in 1986 were purchased under an AID financed project and are available through the Regional Centre for Services in Surveying, Mapping and Remote Sensing (RCSSMRS). These 1986 tapes are currently with the US Geological Survey (USGS) Earth Resources Observation Satellite (EROS) Data Center in Sioux Falls, South Dakota. For mapping purposes the data must be available for the whole of the area to be mapped. The data must be cloud-free and they must be compatible by season and feature content.

C. Priority Mapping:

Because of the size of the task and the immediate need by the pilot project area, these maps for 5 Rural Councils in S. Kordofan would be completed first, followed by the rest of S. Kordofan and lastly S.Darfur.

D. Implementation:

Providing funding for the mapping through the Sudan Anti-Desertification and Reforestation Project is the most logical and efficient solution.

Implementation of the mapping exercise will use the services of 5 different agencies in the U.S. and Africa. USAID/Sudan would be the overall project manager, since funding would come through the Reforestation and Anti-Desertification Project. The Regional Remote Sensing Center in Nairobi would be in charge of coordinating between the different agencies and would be the prime contractor for base map. Both the USGS and ERIM would be sub-contractors to the Regional Center in Nairobi, and provide the satellite tapes, processing of tapes and printing of maps. The fifth agency involved will the the GOS' Survey Department which will be responsible for supplying area control, help in preparing the cartographic overlays and final approval prior to printing.

The Nairobi Center, in addition to coordinating the inputs of each agency, will provide the technical expertise and training of Sudanese personnel. The Sudanese personnel will provide their input either in Sudan or by sending their personnel to Nairobi where they will receive additional on-the-job training.

E. Cartographic Preparation:

The processing of satellite data into map-corrected images by USGS provides a valuable set of image products which will be used for mapping. To turn these into usable image maps requires further annotation. This includes place names, communications (roads, railroads, etc.) administrative boundaries, international boundaries, and such items as national parks, reserves and irrigation areas.

To adequately prepare such annotation the project will use Sudanese cartographers in the design of the map, verification of place names and spellings, and determination of the level of detail shown on the map and the categorization used in the key. The preparation of such annotation will require some two weeks of compilation and drafting per quad using the map-corrected image materials available. This should be done at RCSSMRS in Nairobi where equipment and materials plus advice and support for design work are available.

F. Map Products:

The area to be covered, 10°N - 16°N and 22°E to 33°E, is coincident with 36 quadrangles of existing 1:250,000 scale published mapping. To meet the same index as the published maps, a total of 36 Landsat images or more may be required.

G. Compilation:

Compilation of the map products will be as follows:

1. Satellite images will be used from the available data sets whenever possible.
2. New data acquisition would be undertaken as necessary for the physiographic mapping and to support the multistage sampling for forest inventory.
3. Information to control the processing of true color images for scale and correct latitude and longitude location will be supplied by the Department of Surveys, Sudan.
4. USGS will supervise the processing of the tapes into scaled, position corrected images using control information from Sudan and USGS selected combination of radiometric and geometric processing at their discretion.
5 The quadrangles at 1:250,000 scale will be prepared for color printing as a series of 18" x 26" B&W film masters. USGS will prepare the graticule and collar for each master showing UTM, latitude and longitude grid lines and associated annotation and title.
6. Sudanese activity will produce the feature annotation, cultural overlays and communications, place names, etc.
7. The Ministry of Agriculture and the Central Forestry Administration should be consulted to help assure that the maximum amount of forest resource and vegetative cover depiction can be included on the base maps.
8. The completed map design will be proofed and approved for printing by the Sudanese Department of Surveys.

9. 2,000 copies of each approved map will be printed on standard image map offset paper by USGS.
10. The printed maps will be shipped by airfreight to Khartoum for distribution and use by the Sudan Survey Department.

II. Cost estimates:

USGS estimate a total cost for their involvement including printing and delivery of all 36 quad sheets to be:	U.S. $546,000.00
(approx $15,500 per quadrangle or $7.75 per copy)	
Satellite data costs should be minimal if available data are suitable and are used.	
USGS suggests an additional US$99,000.00 may be required for purchase of new data:	U.S. $ 99,000.00
Cartographic preparations, including materials, travel costs, allowances, overhead and proofing per sheet $4,000 x 36:	U.S. $144,000.00
Estimated total cost	U.S.$789,000.00
Cost per quadrangle	U.S.$ 21,016.66

III FOREST MAPPING

The forest resource mapping activities represent the operational aspect of the Inventory Component. Taking advantage of the cartographic framework provided through the base maps, the resource mapping exercise's objectives delineate the actions to be undertaken in the Resource Rehabilitation Component. The Forest Mapping exercise's goals are thus threefold:

1. Develop extensive forest resource information in Southern Kordofan and Southern Darfur Provinces with explicit emphasis in denoting deficit and surplus distribution patterns;

2. Provide an analytic tool to allow more intensive investigation and monitoring of forest resource dynamics - location, condition, volume, and regenerative capacity; and

3. Provide a spatial perspective for the development of specific management actions based on biological fact and resource supply/demand dynamics, to support the stabilization and rehabilitation of the area's overall productive resource base-forestry, range and agriculture.

This mapping component provides the intermediate step between satellite-based imagery supporting general maps and the recognized need to begin to assess the resource condition in terms of its capability and the region's priorities. In areas of little or no forest cover clearly emphasis is required in reforestation and on-farm forestry actions. In surplus areas the logical goal would be increasing production and market infrastructures such as roads. In the simplest terms the forest mapping will support a better understanding of present resource allocation. In its most complex terms these maps will provide the blueprints to direct intensive investigation into forest dynamics which will help to identify ways of maximizing their ability to provide a wide range of products in a sustainable system. As such the maps are just that: tools for direction of human and financial resources to deal with the process of deforestation and desertification.

For the mapping and inventory phase, forest is defined as a community of woody vegetation, 100 ha. in size or larger, containing trees and shrubs at least two meters in height and having a minimum crown density of 10 percent.

In the west of Sudan, forests are in large blocks and smaller blocks interspersed with agriculture. Thus there are several problems: 1. identifying the large homogeneous blocks of forests and estimating their attributes. 2. identifying the small blocks of forests which are interspersed with agriculture and estimating their attributes. 3. monitoring these forest lands, (an on-going activity for years to come.) 4. categorizing woodland content of rangeland and bushland to identify any areas of interest for forestry purposes.

The establishment of a mapping system may be a difficult and challenging task that will require interdisciplinary expertise, some of which will be found in the Forest Administration. Other expertise will be found through external consultants or elsewhere in Sudan. The definition of the required descriptors of the forest regions must be clearly established and available information established. Once this is done, a multistage sample design and survey forms are developed.

The success of the forest mapping portion of the project depends on how well forest land can be identified and delineated from the Landsat imagery.

Preliminary evaluation of the Landsat 1:250,000 photographs from the SERISS project suggests this may be a difficult task. Indeed, each step of the mapping and inventory phase must be tested before implementation.

Given the practical problems anticipated in fully utilizing and field testing the imagery within the Operational Forest Inventory it is suggested that a phased approach, broken by a strategic and objective review, be used to implement this part of the inventory exercise. Kordofan should be undertaken first so that the information can be made available as soon as possible to guide the prioritization and localization of concurrent extension services development. A comprehensive review should then be undertaken to determine the technical validity of the various inventory tools, refine or change the strategy and relative input from each inventory tool, and define the actions and timeframe best suited for the undertaking of Southern Darfur. The internal review will be undertaken approximately 18 months after project implementation or upon completion of Kordofan. The review will be based on a pilot resource inventory to be conducted first. It is described as follows:

Forest Resource Inventory Pilot Zone

The inventory component will first be implemented in a pilot zone. The purpose in using a small, trial area is several fold. First and foremost will be the assessment and refinement of the entire remotely sensed window to sampling framework with regard to the stated project goals.

While the satellite imagery techniques have been successful in the identification of area and yields of temperate forests and crops in Sudan the use of such imaging techniques is largely untested in the Acacia woodlands of Africa. Determining how much "training" and ground truthing of the imagery through the use of aerial photography and ground truthing will provide valuable information about the sampling intensity and overall accuracy. Discussions with specialists and the experience of the CIDA Blue Nile Project indicate this procedural examination and refinement over a small area is invaluable to guiding the larger forest mapping exercise.

The second rationale for examining the process on a more local scale is the practical necessities of overall project management and the need for immediate information on the extent and distribution of forests in the five Rural Councils (pilot area) where resource rehabilitation activities will begin concurrently with the Inventory Component. Without unforeseen technical

problems or delays the inventory component will take approximately four years to complete: the extension activities of both the agroforestry and forest rehabilitation are to begin in FY 88 thus approximate coverage, if it is to be of assistance in determining the spatial and thematic issues to be addressed, needs to be available as soon as possible.

Finally, as the World Bank and other donors are expected to provide financial support for similar efforts elsewhere in Sudan in FY 89 it is critical that the shortcomings and strengths of this type of inventory exercise be known. AID's support for this work will thus be important for the rest of Sudan's inventory process.

The proposed Pilot Zone includes the area depicted in six Landsat images covering the five Rural Councils, approximately 31,500 square miles earmarked for extension activities. The area contains the majority of forest types found in Southern Kordofan and Darfur where extrapolation of inventory lessons will occur.

The approximate time frame required to obtain imaging, determine PSU's, establish sampling criteria, ground truth the PSUs, and produce forest maps is as follows:

- image procurement	4 months
- initial image processing	4 months
- PSU determine/aerial coverage and ground truthing	6 months
- production of maps	4 months
Total	18 months

A. Landsat Evaluation:

According to the Canadian work (CIDA 1984a, c, d) on the Blue Nile, the optimum season for obtaining imagery for forest delineation is when the woody trees and shrubs are still with foliage and the grass is dry. This occurs in late October thru the end of December.

B. Survey Unit Mapping:

On the assumption that Landsat imagery is usable proceed as follows:

1. Define survey and mapping unit boundaries. For the first part of the project there will be two survey units. The first (and highest priority) is the Southern Kordofan province and the second is the Southern Darfur Province. As stated above these provinces will be undertaken consecutively with an internal review scheduled between.

2. Obtain the necessary enchanced imagery at 1:250,000 and enlarged prints for interpretation covering each survey unit. Order new imagery where coverage is lacking. Imagery covering most of

Southern Kordofan, Southern Darfur, Central Region and the southern part of Kassala province exists in Sudan, acquired by USAID for a crop assessment program in MOA. This imagery is recent, from fall 1985 and fall 1986, with much of the area covered by multitemporal images. Digital tapes of the satellite information from 1986 will also be available in Sudan at the National Remote Sensing Center in Khartoum. Although most of the imagery already exists for the initial priority areas, several additional scenes will be required to cover the parts of Southern Kordofan and Southern Darfur which are outside the SERISS project area, and to cover those parts of Central and Eastern Region for which TM imagery is still lacking.

3. Transfer political boundaries including international, regional, provincial, rural and village council to the image maps.

C. Forest Delineation:

The Ministry of Agriculture's SERISS program has delineated areas under agriculture. However, because of the coarseness of their mapping, much of the delineated agriculture lands probably contains considerable amounts of forest area. Consequently, this previous mapping may not be usable in the forest mapping effort. (This needs to be double checked to be sure.). If the prior mapping is usable, then only the lands designated as non-crop areas under SERISS need further interpretation. If the prior mapping is not usable, then interpreters will have to look at the entire Landsat coverage.

Skilled air photo and image interpreters will analyze the enlarged images and do an initial visual or computer stratification of forest cover for areas 100 ha. and larger. The lack of a sufficient number of skilled staff within the forest administration, able to interpret air photos and satellite images, poses only minor problems. Skilled staff do exist in other government agencies and can be seconded to work on the forest inventory project. This arrangement has worked successfully in the SERISS project and in a rangeland assessment project within the Range and Pasture Administration. Several skilled interpreters with field knowledge exist within the Soil Survey Administration at Wad Medani. In the long term, training for forest administration staff in air photo interpretation, remote sensing, and inventory techniques will alleviate the skill shortage problem.

The Remote Sensing Center in Khartoum has a computer-based image-processing system which can be used to assist in the interpretation of the images. The Center is also establishing at this time a photographic and image reproduction lab which can be used to enlarge imagery for interpretation purposes. These data and processing capabilities also exist at the Regional Center for Services, Surveying, Mapping, and Remote Sensing (RCSSMRS) in Nairobi. The Regional Center supports the development of national remote sensing and GIS capabilities and will be called upon to assist in forest inventories. While the Forestry Department should have the final authority in the mapping and inventory work, the Nairobi Center should be the implementing unit for this work.

D. Crown Cover Mapping:

As a minimum, area mapped as forest, will be further delineated based on crown cover as follows:

Category A - 0 to 25%.
Category B - 25% to 50% woody cover
Category C - 50% to 75% woody cover
Category D - 75% and over woody cover

These classes will later form sampling strata for the inventory. To the extent possible the interpreters and image processors should consider overlaying forest cover with predominant soil classes. It would be extremely useful if coincidence of forest and soil classification signatures could provide information on what type of forest was there as well as what is there now. This could assist the CFA in site indexing criteria establishment.

While exact delineation of physiographic and vegetation classes will vary with the quality of imagery used it is suggested the inventory contractor consider the following stratification scheme:

1. Vegetated (10% canopy cover or greater).
   a. Crop land.
   b. Non-cropland

   (i) Woody. Greater than 10% canopy cover.
     (a) Natural
       (1) 25% - 50% canopy cover
       (2) 50% - 75% canopy cover
       (3) 75% and over canopy cover
     (b) Plantations

   (ii) Non-woody. Greater than 10% canopy cover
     (a) Palm
     (b) Swamp
     (c) Grass

2. Non-vegetated (less than 10% canopy cover)
   a. Urban, Built-up, transportation routes.
   b. Bare land
       (1) Rock
       (2) Sand
       (3) Soil
         (a) Sandy Goz
         (b) Gardud, non cracking clays
         (c) Vertisols or cracking clays

For visual interpretation, construct an imagery interpretation key to the various cover classes using the sample satellite imagery and copies of the SERISS aerial photography similar to that developed for the Blue Nile Inventory (CIDA 1984c). Additional sample photography may have to be obtained to illustrate some crown cover categories. Note that during the key construction phase or during computer analysis, it may be necessary to combine some of the categories as they may not be distinguishable.

During this stratification process, forestry experts, knowledgeable of the area being studied, will be used to assist with the interpretation. Additional delineation of broad species categories may be attempted from the expert's knowledge of the area, collaborated by limited ground verification, aerial reconnaissance, and existing large scale aerial photography.

E. Final Products:

The reconnaissance level stratification will work with a minimum threshold of approximately 100 ha. in the Dahra forest areas; however, this threshold may be decreased in riverarian or plantation areas. The information will eventually be transferred from the enlarged satellite images to the proposed 1:250,000 image maps. For Southern Darfur, the 1:250,000 image maps prepared by Hunting Technical Services under ODA funding may be used, if available.

Information will also be represented in 1:1,000,000 scale maps which more closely approximate the areas of forestry regions. These will be compiled from the 1:250,000 and will be printed in multiple copies through arrangements with the Nairobi Center and the Sudan Survey Department.

IV FOREST INVENTORY

A. Background:

Forest and woody biomass are an important resource in Sudan as a source of wood products for construction, energy for cooking and industrial purposes, as well as fodder for livestock, fertility for the soil, and protection against wind and water erosion. Finding solutions to problems of forest resource degradation and developing strategy recommendations to ameliorate some of these conditions are exacerbated by the lack of reliable base data on extent of existing forest resources, rates and patterns of depletion, volumes and biomass estimates, and regeneration capacities. Those data which do exist are often in disagreement; forest resource estimates, for example, differ by as much as a factor of three.

An inventory program to collect the requisite base data for developing resource management strategies and to enable medium and long term planning and monitoring is essential. Forest resources are constantly changing therefore an inventory program should be able to accommodate their dynamic nature. An inventory has to be an on-going process to keep the information about the resources current. The kinds of information, and the levels of detail determine how the data should be collected and processed.

The Forestry Department has the ultimate responsibility for the inventory, but the Nairobi Remote Sensing Center will be the implementing unit at least through the sampling frame construction, sample unit selection and aerial photography acquisition.

B. Objectives:

Broadly, the objectives of the forest/fuelwood resource inventory are:

(i) to develop a base of information for monitoring, planning, and managing the forests and fuelwood resources in Sudan;
(ii) to develop a monitoring method for assessing forest resource degradation and the attendant process of desertification.
(iii) to estimate inter-regional fuelwood supply/demand parameters.
(iv) to provide a framework for identifying, monitoring and evaluating alternative silvilcultural practices for maximizing forest production on a sustained-yield basis.

Area in forest is derived from image maps and aerial photography and volume and other detailed information is derived from aerial photography and survey teams. Sample surveys will be conducted on a province basis and will strive for an accurancy of ±20% at a 95% probability level. Biomass and volumes for sample areas will be determined by non-destructive measurements. Regression analysis will be used to establish relationships between physical parameters of the trees such as crown diameter, height, and volume, etc. Recent studies of certain species in Sudan and elsewhere have shown strong correlations between crown diameters and biomass (Lund, 1985 and Heliden, 1985). This permits sample measurements to be made quickly and easily.

From measurements in sampling units and regression analysis, area-related biomass or volume statistics will be produced and, together with the sampling technique's expansion factors, total biomass or volumes will be calculated for each region.

Statistical tables will be developed on a regional and sub-regional basis identifying areas within the strata areas currently under reservation, and biomass estimates. Areas will be measured from the 1:250,000 maps by planimeters or other appropriate area-gauging techniques. This has to be done prior to sampling when the mapping - PPS scheme is used.

C. Priorities:

Sudan is a very large country, making an incremental approach necessary for the development of a national forest inventory. Forest regions and sub-regions will be prioritized according to need, and in a systematic fashion, the entire country will be covered. The inventory will focus initially on the high priority areas.

The criteria for prioritizing the areas are:

(i) areas that are currently experiencing serious resource degradation and severe environmental pressures; and

(ii) areas where considerable forest vegetation still exists so that sustainable management strategies can be applied.

On the basis of these criteria, two priority areas are identified where the inventory program should begin. They are Southern Kordofan, where pressure from mechanized agriculture, urban fuelwood demands, and recent droughts is causing serious resource degradation, and Southern Darfur where considerable forest resources can be better managed before they too succumb to the external pressures. A phased approach will be used to maximize experience and minimize logistical problems associated with operating ground sampling teams. Thus, after completion of the pilot zone Southern Kordofan will be completed After completion of Kordofan, S. Darfur will then be monitored.

D. Information Needs:

Data required in the inventory, based on the needs for developing management strategies, include:

Geographic extent of forest: A baseline description of what forest resources exist and where they are found. This reconnaissance level of information would be sufficient at a relatively small scale and derived from the forest mapping component.

Forest species: The spatial distribution of various species, particularly those of importance, and their general condition, e.g., mature stands; dense growth, etc. This distribution will later be complemented with more intensive, stand specific, ethnobotanical investigations.

Biomass and volume: The amount of biomass, or total weight of herbaceous materials that can be used for fuel purposes, and the volume of timber and construction materials, available by geographic area.

Growth, grain, and regeneration rates: Information about rates at which the trees and shrubs are being depleted, as well as their regenerative capacities and their annual growth rates. These estimates will later be tested under alternative silvicultural prescriptions to determine the real growth potential under various management objectives.

Land capability: Identify the capability of the land to support sustainable forest development. This includes information about soils and climatic variables and will be derived through a GIS.

Legal status: Information about the legal status of areas of concern. Land in forest reservations, plantations and ungazetted natural forests should be identified and marked on maps.

E. Expected Products:

The inventory program, together with the mapping component, will produce the following data and products:

(i) Maps at a scale of 1:250,000 showing the extent of forest resources and the location of forest reserves.

(ii) Individual, larger-scale maps of the forest reserves and plantations showing distribution of forest by species, age, density, size and relation to population centers and transportation networks.

(iii) Statistical tables, produced on a regional and subregional forest administration basis, detailing total area of forests; area under unique and mixed species; area of non-forest; estimated volume/biomass; areas under reservation; and, areas and rates of depletion.

(iv) Statistical tables, produced on a forest reservation basis detailing the amount of area in reserve; condition of forest by area; and volumes and biomass; estimated growth and depletion rates.

F. Inventory Program:

Inventory program follows several guiding principles. First, the inventory program is "dynamic" in the sense that it is an on-going continuous process providing not only base-line data but also providing periodic, up-dated information to be used in developing and monitoring management strategies.

Secondly, the inventory program attempts, where possible, to build on and extend existing information and programs rather than to discard all that has come before and start again. Included is the extensive work done in collaboration with CIDA, which resulted in inventories of the Blue Nile and Bahr El Ghazel provinces and which developed methods, techniques, and approaches for conducting forest inventories in Sudan. These efforts produced valuable operational manuals for conducting field surveys and interpreting aerial photo's and satellite imagery as well as producing a dendrology manual for species identification. Much of this information is incorporated in the large inventory program.

Thirdly, there is a conscious attempt to coordinate the data gathering activities of the forest inventory with those of other government agencies. This has the benefits of producing consistent, comparable resource information for national level planning, and contributes to the development of a national geographic information system, called for in the government's "National Plan" to combat desertification. It also reduces the costs of overall data collection, when data sources can be shared.

Fourthly, the inventory program is designed to be executed by Sudanese staff with support, only as required, from expatriate technical assistance. This approach builds in-house capability and strengthens the forest administration's self-reliance. This is opposed to the alternative of contracting the work to an outside agency which would be expensive and would not facilitate an on-going, recurrent data gathering process.

141

G. Extensive Inventory Design:

The following are based on the recommendations by Falconer (1986), Lancaabe (1987) and Wigton (1986).

To execute an area sampling frame, it is necessary to establish strata. This is an activity for the image interpreters and foresters and when complete should leave all land assigned to a category. This will be done during the mapping phase using the canopy cover classes as sampling strata. These strata are then divided into sampling units based on political physical boundaries where possible Each unit is numbered and its area measured and recorded. Each of these units is a Primary Sampling Unit (PSU) and is identified by a physical location on the ground which can be visited and surveyed. Every point within the survey area must be within a PSU. PSU's are numbered and measured and a random selection of a series of PSU's is done with selection proportional to the area of the PSUs. Large scale aerial photography is obtained of the selected PSU's. Each PSU selected may be further divided into smaller sampling units. These sampling units (SUS) are constructed using physical boundaries. A sample of these units are selected for detailed ground survey work. The selected units are called segments.

Data collection methods will be developed using standard techniques which have been developed for obtaining forest resource information. Several techniques will be evaluated and modified for conditions in Sudan.

H. Mapping PPS Sampling:

Landsat TM imagery will be appropriate for first level stratification. Forest land can be separated from desert and cropland. Probably forest lands themselves cannot be separated to the detail desired so aerial overflights might be necessary.

1. Additional Mapping

Political boundaries are put on map next. Important political boundaries beginning at Rural Council level are used as strata boundaries.

Once strata are defined, PSU's are constructed within the strata to be sampled. Where possible, physical boundaries are fixed for PSU's and all further subdivisions.

2. Primary Sampling Units (PSU).

Each PSU is numbered and the land inside is measured with a planimeter or digitized and the area for each stand is determined.

Sampling intensity depends on user requirements of the summarized data.

3. Alternative Designs

If the Landsat imagery is not adequate, then the only choice is to conduct a systematic sample across the entire survey unit. This will be nearly twice as costly as the above design. Formulation for a systematic sample is given in Freese (1962) and Lund (1987a). The desirable feature of a systematic sample is that photography and field work can start almost immediately, whereas with the mapping - pps strategy, considerable advanced preparation is required. (3 to 4 months is all).

4. Refined Mapping and Database

The utility of information that is produced via the mapping - pps scheme or that produced from a systematic stratified scheme may be refined by digitizing existing soil maps and climatic information and putting that ancillary information together with the inventory data into a GIS.

5. Inventory Sequence

The inventory sequence is usually to define the primary and secondary sampling units (if necessary). Select the sample. Visit the sample in the field and make measurements. Compute statistics and expand the sample data back to the survey unit. This is followed by reporting the results.

If Landsat mapping, either through visual interpretation or computer classification is done, then the sequence is usually stratification, then sample selection. This is usually followed by acquisition of aerial photography to assist in locating the primary sample unit in the field.

Establishment of secondary samples, field measurements, expansion back to the primary samples, sampling strata and finally to the survey unit. The desirable feature of this system is that inventory estimates of volume, age, condition etc. can be extrapolated to each and every hectare that was mapped.

If Landsat is not presently useful, a systematic sample has to be used. This could be multi-stage starting with a grid superimposed across the Landsat scene, followed by aerial photography and interpretation of every ith grid point followed by field sampling of every nth photo point. This last sample could be a stratified sample through interpretation and classification of the aerial photography. The field sample is expanded to the photo sample which is expanded to the Landsat sample. Maps may be produced through "training" of the Landsat tapes using the field and photo samples (see Ambrosia et al 1987).

5. Field Samples:

The forest inventory will use a field sampling strategy and survey teams drawn from the Forest Administration. These teams will visit selected field sites (secondary sampling units) and gather information as defined by the foresters involved in the project.

Secondary sampling units within each area will be selected according to normal statistical techniques described above and field teams will be deployed to record data from the sample areas. Large scale, 1:20,000 black and white aerial photography will be acquired from the Sudan Survey Department as necessary within the sampling units to assist with the location of sample sites and to help with data measurements. At this point considerations of the project logistics are also pertinent and samples can be clustered to facilitate data collection if several teams can work conveniently from one vehicle access point. In all cases the appropriate statistical considerations must apply.

The Forest Inventory Field Sampling Manual (CIDA 1984b) prepared for GOS under the ICDA Blue Nile Inventory project provides excellent detailed instructions on how to select sample sites (0./2 ha. in size) collect data and calculate important statistics and should be modified as needed to meet the conditions of the west. Stem diameter, crown diameter and crown ratio should be added as variables to be measured as they have been found to be frequently significant for developing biomass equations (Lund 1985).

Data gathered from each sample location is expanded to give a reliable statistical description of the characteristics of each stratum and the province. The data will also be summarized by Rural and Area Council but at these levels the reliability of the estimates is reduced as the sample is not drawn for each of these cases. In simple terms the recompilation of the data by administrative regions, districts, soil types or any other locational parameter will give a larger coefficient of variation (C.V.) because the sample size will not be drawn in proportion to these areas at a desired level of accuracy. However, it provides a rapid, objective and defensible set of measurements for these and other specified areas of interest.

The composition of the field crews will vary, depending on the type of data to be collected. Typically, several field crews will be sent into one area and work out of one base camp. Therefore, it will be possible to share some of the resources, such as camp facilities. Also, the field specialist in tree identification, surveying, and photo interpretation can support more than one crew in a base camp. Typically, a field crew will be composed of a photo interpreter, a surveyor and/or a compass man, a dendrologist or tree identifier, and one or more casual laborers.

The field teams require appropriate equipment and supplies to facilitate their work. In general, this includes 4-wheel drive vehicles, 7-ton lorries, camping equipment, communications equipment, and surveying and mensuration instruments. (See Sec. VI Institution Building).

6. Additional Inventories:

The above designs will prove very reliable at the survey unit (province) level. However, additional surveys are needed to develop management plans and are definitely needed for developing project plans.

Detailed information is required for specific forested areas to assist with the development of management strategies. The operational and management level inventories are expected to cover up to 575,000 km^2 when fully implemented. The reconnaissance level surveys will help identify which areas should be considered in more detail. The information required includes species identification, growth and regeneration rates, depletion rates, volumes, biomass, and soil characteristics.

The maps and statistics derived during the extensive inventory will be used to prioritize areas for further investigations. The 5 Rural Council areas in Southern Kordofan is the first priority area for more detailed surveys.

Partial aerial coverage at 1:20,000 should be obtained of this area. At this stage, it would also be desirable to develop aerial photo volume equations. This can be most easily done after the extensive inventory by measuring the average crown diameter, estimating canopy coverage and vegetation heights from the aerial photos at the locations field plots were established then develop volume equations using the interpreted data and the volume calculated for the field sample.

The use of these aerial photo volume equations or tables will be particularly useful in management, operations on project inventories. In other words, as the operations inventories are conducted, the same variables would be interpreted from the aerial photography and volumes predicted for each stand. These predicted volumes can be used as they are or to stratify the mapped stands for further sampling. Lund 1984 and 1987a contains some information on this technique.

Using the photography, the area should then be typed mapped using criteria appropriate to the type of management anticipated. Hopefully, the first cut at map boundaries will conform to those produced by the forest mapping phase (i.e. forest land, crown cover, political and physical boundaries). Additional divisions may be made on forest type, stand size etc.).

These mapped stands should be photo interpreted and then numbered, areas determined and sub sampled using the area sampling frame previously described. The same type of field plot, encoding can be used. Additional data regarding soils or other environmental factors can be collected.

V. OTHER

1. Volume and Biomass Determination:

In order to build the necessary volume and biomass equations, it will be necessary to do destructive sampling. This can be done on the sample plots, but can perhaps be more easily done by going to areas where vegetation removal is in progress or is planned in the near future. This offers the advantage of easy access, and lessens potential statistical problems of purposely destroying part of the sample.

Procedures for destructive sampling are given in Lund (1983) and other references listed in Appendix I.

Biomass may be measured in terms of weight rather than volume; both may require some destructive sampling (i.e., cutting the trees and shrubs) and the measuring or weighing of the vegetative matter. Distinctions need to be made between the mass of the main stems and branches and that of the twigs and leafy material because of the different uses of each. Twigs and leaves of some species, for example, can be used for animal fodder, and the larger pieces of the plant or tree for fuelwood or charcoal.

The equations will be developed using regression techniques available in Freese (1962). Ideally, the equations should be developed prior to the inventory, so that only the variables that prove to be significant are measured in the inventory.

If the equations are developed during or after the inventory, then the inventory crews will have to collect data on all probably variables. A listing of these may be found in Lund (1983).

The dominant independent variable influencing total plant mass may vary between species and therefore each will have to be dealt with separately. Complete information on these relationships do not exist at present, but should be developed as part of a collaborative research effort between the forest research institutions and the inventory unit.

Conditions in Sudan support a wide variety of woody vegetation species. Some of these are appropriate for supplying merchantable timber (e.g., Acacia Nilotica - "Sunt"), others as sources of fuelwood and charcoal (e.g., Acacia Senegal), and others as sources of fodder for animals (e.g., Acacia Albida). The following lists the prominent species to be found in Sudan excluding fruit trees for which volume and biomass equations need to be developed.

Acacia albida	Eucalyptus microthera
Acacia mellifera	Eucalyptus tereticorins
Acacia nilotica	Ficus spp.
Acacia senegal	Grewia spp.
Acacia seyal	Haloxylon salicornicum
Acacia tortilis	Kaya senegalensis

Acacia tumida
Adansonia digitata
Albizia lebbek
Anona
Atriplex numularia
Azadirachta indica
Balanites aegyptica
Bauhinia rufescens
Boscia senegalenses
Cassia auriculata
Cassia siamea
Cassia sturtii
Conocarups lancifolius
Cordia africana
Dalbergia sissoo
Eucalyptus citriodora
Leptodenia pyrotechnica
Leucaena leucocephaba
Parkinsonia aculeata
Pithecollobium dulce
Prosopis chilensis
Psidium guavaja
Salvadora oleoides
Salvadora persica
Sueda monoica
Sueda fruiticosa
Tamarindus indicus
Tamarix aphylla
Tephrosia spp.
Thespesia garkeana
Ziziphus mauritania

2. Growth, yield and regeneration rates:

To measure growth and regeneration rates, information must be collected at different time periods. This requires the establishment of "permanent" sample plots. These plots will be approximately 0.2 ha in size and will be precisely located on the enlarged satellite image. They will also be clearly marked on the ground so that they can easily found for subsequent resurveys.

The permanent plots may be established as part of the forest inventory or as a separate study. Because stratified sampling with unequal probability sampling will be used for the forest inventories data from any of the remeasurement of permanent plots establish during the inventory should only be used for establishing trends and growth rates, but <u>not</u> for compiling the statistics of a re-inventory.

Permanent plots can also be established independent of the inventory for research purposes to determine the effects of treatment. For example, if a stand of trees is going to be logged or thinned, then it would be desirable to establish a permanent plot in the stand to measure before and after effects.

Curtis (1983) is an excellent reference on measuring permanent plots.

Resurveys of these permanent sample plots will occur at intervals not exceeing 5 years. This data will be collected and reported by trained forestry staff in the regional administrations.

3. Monitoring and Re-inventory:

The Inventory Unit in consultation with the Management Unit will decide on appropriate reinventory schedules for the selected areas. These are expected to range from 2 to 4 years depending on the rate of change within the forest.

Interim (between surveys) monitoring of forest clearing will be done by detecting change in forest cover from high resolution satellite imagery. This will be effective primarily in areas where clear-cutting is practiced; however, this source of information will not show the result of ad hoc harvesting or general tree thinning.

The Sudan Survey Department does have old photo coverage of Southern Kordofan and Southern Darfur. It would be of benefit to the Ministry of Agriculture to map the forest cover to current standards as it existed on the old photo coverage and then compare it with the forest maps that will be developed during this project. This will give an excellent estimate of past rates of change and can be used to predict trends. Future monitoring by satellite imagery would then be used to improve predictions.

4. Geographic Information System:

The successful use of the mapping and inventory system requires that the data from the mapping project and sample survey are entered into a geographic information system; such a system is available at the National Remote Sensing Center. This is done by using the digitizing table and accessories provided or the data can be entered in tabular form. Once this is done the system begins to operate as a geographical database and it can accept a variety of data inputs. These inputs should also include such variables as soil types, climatic regions, forest management zones and economic infrastructure such as roads and settlements. The distribution of government installations staff and the distribution and composition of the population may also be entered into the system so that patterns of demand for woodfuel can be mapped.

A GIS is available at the National Remote Sensing Center in Khartoum. Initially, it is highly desirable to use this facility. However, as usage of the NRSC increases, it may be necessary for the Forestry Department to obtain their own GIS.

VI INSTITUTION BUILDING

A. Existing Structure

Under the existing arrangement, the inventory function is the responsibility of the Inventory, Management, and Reservation Unit (IRM) within the Central Forest Administration in Khartoum. This small unit of nine people has the responsibility of identifying areas of forest for which they will develop management plans and prepare the necessary surveys to reserve the areas as gazetted forests. A staff of this size can not realistically handle the enormous amount of work involved in each of these activities. The annual budget for the entire IRM Unit is approximately LS 600,000 of which LS 400,000 is earmarked for inventory work. Because of difficulties with purchasing equipment such as four-wheel drive vehicles which require substantial foreign exchange, the Unit is not able to expend its current budget.

148

1. Existing Staff:

The IRM Unit is currently staffed by four professionals (Graduates), three technicians, one draftsman, and one secretary. The distinction between professional and technician levels is blurred as the grade levels tend to overlap. Junior professionals, for example, are at lower grade levels than senior technicians.

Within the entire administration, there are eleven staff with training in photo interpretation, seven of which are at an advanced level (one is currently doing an MSc degree). Only two of these (one at the advanced level and one at the basic level) are currently working in the IMR unit. Two of the eleven (one of which is currently assigned to IRM Unit) have received basic training in the use of satellite remote sensing resource management.

Because of current staff and skill shortages, it will be necessary to obtain technical assistance and advice from a forest inventory expert during the first four years of the project. This specialist will assist with the staffing and development of the inventory unit, advise on appropriate inventory methods and techniques, provide inventory management training, and assist with the planning of inventory operational work. Also, additional technical advice and support will be required in the first three years of the project on short term basis to assist with the establishment of inventory data handling, and statistical procedures. This technical advisor will assist with the development of computer data-handling capabilities and provide data-management training to Unit staff.

2. Existing Equipment:

The present IRM unit has only limited equipment and facilities to carry out its functions. It is housed in one of the former army barracks now used by the Central Forest Administration in Khartoum. The operational facility contains one large room for air photo interpretation, map compilation, drafting, and materials storage, plus two smaller offices and a common reception area. The facility contains approximately 120 m^2 of space, most of which is air conditioned, however, because of the close proximity of a dirt road immediately behind the building, excessive dust blows into the rooms whenever vehicles pass by. Dust is a problem in the drafting process; is harmful to optical equipment such as mirror stereoscopes; and is destructive in the storage of aerial photography imagery. Only limited storage facilities exist for the safekeeping of materials used and produced in the inventory process, such as map manuscripts, air photos, and reports.

The IMR unit has only one four-wheel drive vehicle and one 7 ton lorry. It is in very short supply of basic equipment needed to carry out its work - from saws and scales, which it now borrows from other departments, to drafting pencils which are often acquired as a donation from one of the local aid agencies. It has four mirror stereoscopes for photo interpretation and one sketchmaster, but does not have proper tables on which to use them. It has limited supplies of such equipment as measuring chains and tapes, compasses,

calipers, and height gauging instruments, and sprayers, flagging tape, and markers. It lacks basic camping and communications equipment which poses particular problems for doing field work.

While the CFA and USAID recognize the constraints of present facilities and proposes limited infrastructural support, AID alone cannot afford to promote all aspects of forest inventory and planning work. It is suggested that a multi-donor effort to house and equip the IMR Unit should be undertaken. AID anticipates renting office space until more appropriate quarters are secured or constructed.

A. FIELD CREW FOR SOUTHERN KORDOFAN AND SOUTHERN DARFUR FOREST INVENTORY

The area to be inventoried lies between 10°N and 16°N latitude. The total area is estimated as 36,000,000 ha. It is estimated that about 25,000,000 ha are forested. While the implementing inventory crew will determine sample frequency roughly 0.05% to 0.1% of the forested area should be sampled. This figure is tentative and will be the object of considerable cost-benefit debate once imagery is complete.

The time estimated to cover this area is estimated to be 4 years of 150 workable days per year. In the Blue Nile Region CDIA inventoried 2,711,151 ha. with 2,773 secondary sample units or the established one sample unit per 1,000 ha. approx. Assuming halving the same sample intensity, we can anticipate needing about 7,000 secondary sample units.

Each crew should be composed of the following.

1 Field Supervisor
1 Recorder/Aerial photo interpreters
2 Measurers
1 Compassman
1 Back chainman
1 Helper
1 Reserve
1 Guard
9 Total

The total number of people required for 4 teams are:

Duty	No.	Per diem	Wages
Field supervisors	2	LS 30,000	
Recorders/aerial photo interpreters	4	45,500	
Measurers	8	90,000	
Compassmen	4	45,000	
Back chainmen	4		LS12,000
Helpers	4		12,000
Reserve	4		4,800
Guardsmen	4		6,000
Car Drivers	6		36,000
Total per year		LS395,000	LS65,800

Budget estimates do not allow for inflation. According to ongoing rates of FAO and other similar U.N. and other projects, Grade 5 and above = LS.100, Grade 6 and under is LS.75.

5. Equipment

Item	No	Unit Cost $ U.S.	Total Cost $ U.S.
Field Equipment			
Sunto Clinometer	10	45	450
Calipers	20	80	1,600
Metric Diameter Tapes	10	20	200
Back Packs	25	35	875
Inverted Tip Markers	50	5	250
Chainsaw	5	370	1,850
Sunto Compass	20	20	400
First Aid Kits	5	125	625
First Aid Kits	10	90	900
First Aid Kits	10	40	400
First Aid Kits	20	10	200
First Aid Kits	20	5	100
Knives (Old Timer)	12	25	300
Sportsman Axe	6	15	90
Fibre Glass Tapes	24	50	1,200
Chain Pins - Steel (10 Units)	30	15	450
Cased Tapes	12	20	240
Cased Tapes	12	25	300
Transits	10	460	4,600
Ranging Poles	10	40	400
Augers, hole diggers	10	25	250
Binoculars	10	80	800
Bark Gauger	10	30	300
Shovels	10	25	250
Hand Saws	10	100	1,000
Flagging Tape			400
			18,430
Camp Equipment			
Tables	20	120	1,200
Tents	10	200	2,000
Tents	10	340	3,400
Tents	10	275	2,750
Govt. Cots	60	40	2,400
Extendable Rods	10	50	500
Generators	3	1,850	5,500
Plastic Water Tanks (800 gals)	6	250	1,500
			19,250

Item	No	Unit Cost $ U.S.	Total Cost $ U.S.
Vehicles			
4 WD Pick Up Vehicles (Diesel)	4	15,000	60,000
4 WD Station Wagons (Diesel)	2	20,000	40,000
			100,000
Other			
Petrol	12,000 gals. x 4		48,000
Office and Lab Equipment			
Tables for mirror stereoscopes	6	125	750
Drawing tables	4	185	740
Flat Files	6	305	1,830
Pantograph	1	25	25
Precision Pantograph	1	540	540
Planimeter	2	110	220
Photocopier	1	1,220	1,220
Map copier	1	1,850	1,850
Micro computer	1	2,440	2,440
Supplies	1	2,440	2,440
Pocket Stereo	10	125	1,250
	Sub total		15,285
	TOTAL		US$198,965

4. Budget

	U.S. Dollars
Image Mapping (36 quads)	800,000
New Satellite Image Acquisition 20 new image s @ $ 5,500 each including handling, etc. processing images $1,000/image	130,000
Forestry Consultants 4 visits per year for 3 years = 12 visits Costs/visit:fees, 20 days @ $250 =$5,000 Travel etc. =$2,445 Per diem 26 days @ $180 =$4,680 $12,125	
For 12 visits	145,500

	U.S. Dollars
Long Term technical Assistance Project Coordinator per year $250,000 x 3 = $750,000 Total	750,000
Vehicles	100,000
Field Equipment	18,430
Camp Equipment	19,250
Office and lab. equipment	13,285
Petrol	48,000
Consultants	145,000
Operating Costs	132,000
Imagery Processing/Acquisition	930,000
Aerial Survey	300,000
Sub Total	2,454,715
Overhead (20%)	490,943
Sub Total	2,945,658
Contingency & Inflation (15%)	441,848
TOTAL	US$3,387,506

5. Implementation (from Luscombe 1987):

The inventory function will be centralized within the forestry administration initially to develop a comprehensive and coordinated inventory program and to establish a core of qualified staff. Once established and operating, some of the inventory functions, particularly the monitoring and updating of information, will be decentralized to the regional offices. Within the regional offices, this function will be absorbed by the management unit, in which one or more individuals will have the responsibility of collecting data on existing managed forests and coordinating major inventory or resurvey work with the central Inventory Unit. The regional office will collect data for their own use as well as feed the information back into the central information system.

Recognizing that Sudan's forest administration has limited absorbtive capacity to implement an inventory program of this magnitude, it will be necessary to phase the program in over several years. Implementation will proceed according to the following schedule.

The following is the proposed sequence of events for the Forest Mapping and Inventory. The sequence for Image Mapping has been previously discussed.

Year 1

- Establish Inventory Unit within Planning Section, Department of Forestry.
- Contract with Nairobi Regional Remote Sensing Center to acquire and process imagery for interpretation and mapping.
- Develop core and field staff.
  - Technical Advisor (Inventory Specialist)
  - One Field Operations Supervisor
  - Two Image Interpreters
  - One Forest Statistician
  - One Computer GFS Specialist
  - Two Field crews
  - Two Administrative Support Staff
- Acquire office, field, camp equipment and vehicles.
- Acquire building space
- Start training in Nairobi on image interpretation
- Staff training on inventory techniques - mensuration
- Develop image interpretation keys and test publish
- Develop Inventory Plan
- Develop field manual and test and publish
- Develop field farms and test and print
- Field crew start on volume and biomass equation development
- Start on software. For sample selection (may be already available at Nairobi or Ministry of Agriculture, Statistics Department).
- Start image interpretation and mapping of Southern Kordofan - 5 Rural Council area. (Pilot zone only)

Year 2

- Continue developing core and field staff. Add all interpreters and three field crews
- Complete image interpretation of Southern Kordofan
- Digitize mapping with assistance of National Remote Sensing Center and with assistance of Nairobi Remote Sensing Center and Ministry of Agriculture, Statistics Center. Select PSU's of Southern Kordofan.
- Order photography of PSU's
- Establish procedures for inventory quality control and test
- Initiative field sampling of 5 Rural Councils.
- Start interpretation of Southern Darfur.
- Complete software development and test
- Complete volume and biomass equation development for 5 Rural Councils in S. Kordofan.
- Review/evaluate accuracy and cost-benefits of inventory exercise to date. Results will determine operation and sampling framework for rest of Kordofan and later Darfur.

Year 5

- Complete building of core and field staff.
- Complete field inventory of Southern Kordofan.
- Establish growth and yield plots in Southern Kordofan.
- Initiate volume sampling of Southern Darfur.
- Complete mapping of Southern Darfur and select PSU.
- Order photography of PSU's
- Start data processing of Southern Kordofan Inventory.
- Start inventory of Southern Darfur.

Year 4

- Complete processing of Southern Kordofan
- Enter Southern Kordofan data into GIS.
- Start on report and final forest maps.
- Complete volume and biomass estimation equations for Southern Darfur and test.
- Complete inventory of Southern Darfur.
- Establish growth and yield plots in Southern Darfur.
- Start on data processing of Southern Darfur.
- Complete processing of Southern Darfur
- Enter Southern Darfur data into GIS
- Complete report and maps and issue on Southern Kordofan.
- Prioritize areas for operations inventory (5 Rural Council pilot area for highest priority).
- Schedule aerial photography of areas.
- Start on report and final maps on Southern Darfur.
- Develop operations inventory photokeys, manuals, forms, software etc. and test.

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX D-2(B)

TECHNICAL ANALYSIS

RESOURCE REHABILITATION THROUGH PARTICIPATORY FORESTRY

KHARTOUM
JULY 1987

UNCLASSIFIED

RESOURCE REHABILITATION

1. Background

1.1 Historic review

Up to 1930, there seems to have been little evidence of over-use of land in Kordofan except in the immediate neighborhood of small towns and villages where trees were hacked for firewood and all plants exept for Calotropis procera were consumed by goats in their daily coming and going. By then deterioration from overgrazing was being observed. The extent of forest resource degradation in Kordofan including the project area, can be correlated to the growth of human and animal populations and to the excessive tapping of some natural resources at the expense of or disregard to others. The population of Kordofan has multiplied sixfold in 80 years, from just under half a million in 1903 to more than 3 million in 1983. The population growth in Kordofan which came as a result of infrastructural development that attracted people from the Northern Province, Darfur and West Africa, was only second to that of the Blue Nile (which includes present day Gezira Province).

The increase of human population has been accompanied by an even greater increase in the animal population. This in turn has multiplied sevenfold in 27 years, from 1.5 million in 1957 to ten million head in 1984. This rise started in the early fifties. Prior to that, and in apprehension of the consequences of an undue increase in the flocks and herds, the policy was to mitigate the effects of epidemics, i.e., to stabilize numbers and reduce privation by preventing disasters. Since then however, influenced by the appearance of earth-moving and drilling equipment to augment water sources, the government decided to maximize the application of proven methods of disease prevention, on the assumption that animal numbers could be safely increased to support a growing human population and create a surplus for export.

Demographic changes, growth of animal populations and lack of resource management have ultimately led to forest resource degradation in most of Kordofan Region; the project area being no exception. The growing demand for land for cropping was met by horizontal expansion and reduction of land rotation and fallow. The former measure meant clearance of natural forest to give way to agriculture while the latter left the tree (particularly A. senegal) out of the traditional fallow system. The recent introduction of mechanized rainfed farming in the southern parts of the project area (Habiella R.C.) meant wholesale tree clearance from extensive areas. Demographic changes created a separate demand for wood for local consumption and for sale outside the region, i.e. Omdurman, thus more denudation of tree cover. The growth of animal population on the other hand has another direct bearing on tree cover. Trees in general are an important source of browse. Excessive browsing and grazing of natural regeneration are detrimental to trees. The cumulative effect of agents of tree removal is evident throughout the project area. In many areas only a few mature trees can be seen with practically no natural regeneration.

1.2 Trends - rates of depletion and socio-economic impacts.

Socio-economic studies commissioned by the project have shown that the human influx from North Kordofan into the project area, prompted by the recent drought is now receding. The majority of those displaced into the area have returned to their domains or left the project area for somewhere else. None the less, the area is likely to be the refuge for human and animal protection in the likely events of repeated droughts. The studies also indicated no appreciable animal losses within the project area because of the drought. However, the area has historically attracted West African settlers and nomadic groups. Stock routes to Khartoum and the Gezira cross the area creating repeated transitional pressure. The normal human population and animal growth rates conform to the general trend, i.e. being high. The demographic changes are more demanding on the ecosystem; being more toward urbanization, sedentarization and cash-economy orientation. As a result, more agricultural expansion which leads to more tree clearance, more deforestation for wood harvesting and more excessive grazing are likely to be encountered in the foreseeable future which all amount to further forest resource degradation.

Recent studies have indicated that steady deforestation has reduced the forest area in the Sudan by at least 20% and has been a contributory cause of accelerated desertification. Both causes and effects are more pronounced in the project area. The forest inventory and vegetation mapping and needs assessment survey are expected to quantify the phenomena.

The socio-economic impacts of forest resource degradation are as evident in the project area as they are elsewhere in Kordofan. Women and children have to walk or ride longer distances to fetch fuelwood and water. Those who purchase them are paying more for them. Areas which used to be gum producing are no longer so with the consequence of income loss. The loss of indirect forest benefits is being felt even more than the loss of direct benefits as evidenced by the declining soil productivity, desertification and increased aridity. Many towns, villages and water points in the project area, e.g. Er Rahad town are encircled with belts of destabilized dunes and loose sand which are hardly motorable. These mini desert spots are indicators of the inherent weakness of the ecosystem. Hence, any notions of settling people from Northern Kordofan in those areas must be considered with due concern.

1.3 Mitigation strategies proposed

The need is more pressing than ever before to work out and adopt an integrated landuse policy, whereby land is allocated equitably to the various land-using sectors. Within the framework of such a policy, the forestry resource should be managed on scientific, socio-economic and environmental considerations to best meet the needs of the people on a sustained basis.

1.4 GOS priorities

With the ending of the worst drought in living memory in 1985, the highest priorities of the Government of Sudan have been to restore agricultural production and to rehabilitate drought-affected areas. Rehabilitation plans have been drawn by GOS for the purpose.

The newly appointed Governor of Kordofan has discussed with USAID his desire to obtain support for his efforts to scientifically assess resource potential in order to prepare effective development plans. Such support has earlier been provided to Kordofan through funding with CIP local currency generations of a general resource inventory for the region.

Central and regional government development priorities coincide with the objectives of this project. The latest Three Year Public Investment Program allocates the bulk of public investment to projects intended to restore agricultural production capacity and to meet the energy needs of the population. The GOS has now accepted the recommendations of the World Bank-led Forestry Sector Assessment as the basis for development of the forestry sector.

2. Major constraints/issues needed to be addressed

2.1 Inventory of forest resources:

The forest resource in the project area needs to be quantified in terms of area, biomass, other potential, depletion rate and regenerative capacities. Sizeable areas of existing woodland need to be demarcated and gazetted. These, together with already gazetted areas and reforestable abandoned areas, need to be managed to meet local, regional and national requirements. This is a direct responsibility of CFA.

2.2 Administrative issues

In spite of its important role in maintaining agricultural productivity, providing the fuelwood and charcoal needs of about 75% of the country's population, meeting a significant part of other timber needs and providing a vital export commodity (gum arabic), the forestry sub-sector has been seriously neglected and under-funded. Beside the meagre funding, the standing of the administration in the MOA has been steadily on the decline to the extent that it is relegated to a small department in one of the administrations in the ministry, whereas it was the first administration to be created in the agriculture sector early this century. The final blow to the CFA was dealt in the early seventies with decentralization. The fragmentation which came about as a result of the Forests Rangers College joining higher education, the Forest Research Section joining the ARC, the establishment of the Forestry Department in the University of Khartoum, and the Energy Administration in the Ministry of Energy, have all contributed to depriving the weakling CFA of the majority of its experienced staff. The cumulative effects of lack of recognition, inadequate funding, and drain of experienced personnel have resulted in an administration with modest capabilities in forest management, silviculture and extension.

The CFA has always had to battle with cumbersome legislation to acquire land. The paradox is that other landusing sectors which practice large-scale deforestation, eg. irrigated and mechanized rainfed agricuture are not obliged to follow these same legislative steps to acquire land.

Lack of enforcement of forest law

The current laxness in enforcement of forest law is not due to inherent weakness in them or a disregard on behalf of the forestry personnel. It is due largely to the immobility of the latter. If efficient means of mobility are provided together with necessary funds for operation, the patrolling can be tightened and more lorry owner/drivers and other culprits brought before the law. The magistrate courts in El Obeid have recently forfeited several lorries and fined these drivers for violating forest laws.

Rejection or delay of creation of an autonomous forestry commission

Such an act should not have any negative bearing on project activities. The staff and other inputs on behalf of CFA were worked out on the assumption that the CFA is centralized and it is. A rejection of the idea of a forestry commission or a delay in its creation does not necessarily negate any of CFA's existing powers.

Lack of increased regulation of mechanized farming

a) Failure to enforce regulatory measures on existing mechanized farming areas does not appreciably affect the level of forest resource degradation. It will however reduce the areas in question to expansive abandoned lands with bleak chances of natural regeneration. The situation need not arise however. Th bulk of Habeilla schemes (old Habiella) will reach the end of their term of lease (20 years) by the end of 1988, having been started 1968. Reinstating the tree strips around and across schemes can be used by MFC as a prerequisite for another lease.

b) Failure to enforce regulatory measures on new schemes will be disasterous to the forest resource, agriculture in general and the environment at large. The assumption however is valid. This supports the need to expedite the measures prescribed, i.e. participatory forestry including natural woodland management. i.e. to reserve some 25,000 feddans of A.seyal/Balanites with the objective of managing them to supply El Obeid with fuelwood to relieve the illicit cutting in the environmentally fragile North Kordofan.

2.3 Technical issues

Inadequate management and silvicultural information to permit CFA to take advantage of new information

Such inadequacy could be addressed by drawing on information and experience elsewhere. Adaptive research has been prescribed to address such anticipated shortages. Trained technical incapacity (agents unreceptive to new "social forestry" approach). Agroforestry, social or community forestry, etc. are new terms to old practices. The move by such training institutes as Forestry Technicians Division-Khartoum Polytechnic to revise their curricula for both pre-service education and inservice refresher course by accomodating these new terms, should be commended and supported. Education and extension are the remedy for erasing the "illiteracy" in this respect of all concerned.

Pests

This includes rodents whose populations have risen to alarming proportions this year together with termites, lepidopterous caterpillars, bugs and others. The cumulative effect of pest damage to such crops as groundnuts, sesame and millet this year amount to total loss in some places in the project area. A.senegal seedlings donated by various agencies in other parts of Kordofan or transplanted by RFA or WSARP have been girdled to death. The problem is cited by many farmers interviewed and is likely to be brought up in any gathering, eg. training course.

Rodents and bugs are considered as "national pests" and their control is the responsibility of the Plant Protection Department, a central organ of MOA. The latter should be supported by donor agencies to organize national campaigns. Other pests are nobody's responsibility. This is how the traditional sector has been neglected. It is therefore suggested that the project procures some pesticides, eg. seed dressings and sells them to farmers in the project area at cost price or provide loans to farmer associations the necessary funds for the purpose as an extension outreach component. It is not effective to tell the farmer what to do about minimizing seedling mortality without their having access to where to purchase the necessary pesticide.

Difficulty in finding tools to monitor real impact of forest management on local people

The difficulty is genuine. The questionnaire to be prepared for the needs assessment or ethnobotanical survey should carefully address this issue to ensure that real impact of forests management on local people is quantified as far as possible.

3. MAJOR OPPORTUNITIES/ACTIONS PROPOSED TO ALLEVIATE CONSTRAINTS

3.1 Administrative Reform and Action

The past two years have witnessed many serious moves in support of the forestry sector.

a. In August 1985, the GOS recentralized the Forests Administration, whereby technical personnel, central forest reserves and some assests reverted to CFA.

b. The Forest Policy statement of 1932 was revised. The revised version is pending endorsement by the Constituent Assembly. The new policy recognizes five forms of forest ownership - Central Reserves, Regional Reserves, Institutional Forests, Community Forests and Private Forests. The previous policy only recognizes the first two.

c. A new Forest Ordinance was drafted, which is also pending endorsement by the Constituent Assembly. The new ordinance vests wide powers in the Director CFA-especially penalties for illicit cutting and trading in forest produce. The new ordinance replaces both Central Forests Ordinance and Provincial Forest Ordinance and amalgametes them into one. It also abolishes the Royalty Act and proposes realistic strumpage value for products removed from Central and Regional Reserves.

162

d. In October 1986, World Bank's ESMAP team appraised the Sector Review of April 1986. An "Aide's Memoire" was produced which proposes reasonable monetary and other support for the forestry sector across the board, particularly fuelwood production.

e. University of Khartoum, Juba University and Khartoum Polytechnic are now producing a pool of professional and technical foresters for CFA to make use of.

f. Many International Organizations, (FAO, UNDP, UNICEF), Donor Agencies (USAID, FINNIDA, GTZ, CIDA), and NGOs (CARE, CONCERN, ETC.) are currently implementing forestry projects in Sudan.

g. An extension section has been established in CFA as a subsidiary of FAO's "Fuelwood Project for Sudan." Extension is also being taught in Forestry Technicians Division Khartoum Polytechnic. The latter is in the process of revising its curricula to cater for such new concepts as extension, community forestry, agroforestry, desertification control and rural rehabilitation and development.

h. Data are gradually becoming available on the forest resource through donor agency activities, eg., forest inventory for Southern Blue Nile and Bahr El Ghazal funded by CIDA.

3.2 Information Acquisition and Use

The Project's Resource Inventory/Vegetation Mapping and needs assessment survey are expected to furnish data conducive to participatory forestry. Ethnobotanical information will be gathered under the Project. It will also fund some adaptive research, and make use of experiences gained elsewhere in the Sudan or in countries with similar agro-ecological conditions.

a) The Resource Inventory component will provide information on the extent of existing resources, their rate of depletion and regenerative capacities. It will also derive basic data from the inventorized areas about marketable timber, building materials, and woody biomass as a source of energy. As regards secondary forest products the resource inventory will map the current limits of the gum belt in view of the contemporary environmental and socio-economic changes. It will also map the locations of forest trees known for their valuable fruit such as; Tamarindus spp., Cordia rothii, Balanites aegyptiaca, etc., together with these that have a valuable fiber crop such as Borassus aethiopum, Adansonia digilata, etc.

The Resource Inventory will start with the five rural councils (R.C.) which make up the operational plan area - Kazgail, Hamadi, Ed Dubeibat, Habiella and Er Rahad.

b) A survey to supplement already available data from KORAG, Western Agriculture marketing Road and SERISS projects as well as from the Resource Base Inventory/Development Prespective implemented by IES of U of K will result in an assessment of the needs of the population in the

project area with respect to food, fodder, fuelwood, charcoal and other forest products. The survey will also assess the attitudes and practices of the inhabitants of the project area. Willingness to participate in forestry activities or desire to have private land put under private forest will be assessed.

c) Ethobotany information will be collected to determine on scientific and statistical basis, people's preferences of trees, uses of tree products, myths or beliefs. The survey will also endeavour to quantify the products other than wood and gum, derived by the people in the project area for own use or for trading.

d) Sudanese foresters have acquired considerable experience and have gathered immense data on individual indigenous and exotic tree species and their silviculture. However, information on the regeneration and management of certain tree species is lacking. Information on recent activities such as agroforestry is also meagre. For instance, Sudanese researchers and foresters have mastered the silviculture of A. senegal (nursery techniques, transplanting, espacement, tapping, etc.). However, the use of that tree in alley cropping or shelter belts has not been experimented upon. The project will therefore support some forms of adaptive research within the project area, in collaboration with WSARP.

e) The package of information deemed necessary for the implementation of the operational plan (Resource Rehabilitation) through participatory forestry will be developed into material for dissemination to target groups. Training of the extension agents and ultimately of the individual farmers will therefore be an important component of the project.

4. Resource Rehabilitation through Participatory Forestry

4.1. Participatory Forestry

As the name indicates, this component involves the approach of peoples participation in the management of natural resources and addresses the problems of degradation and desertification of natural woodlands through involvement of local populations in forest management and protection; devastation of gum gardens through reforestation by the people themselves; and decline in soil productivity through various forms of agroforestry. Participatory forestry obviously adds the peoples dimension to various rehabilitation and management efforts. This calls for a strong extension network, beginning at the village level all the way up to the regional level. This network, it is expected will serve as a model for adoption not only in the project areas but also areas outside of the project. In view of the fact that forestry extension has just recently (1983) been introduced in the Sudan, training of staff at all levels, is essential.

A training program will therefore be developed and implemented for officers and staff working on the project. The program will consist largely of a series of in-service courses for each job category taking into account job responsibilities and functions and previous training and experience. The courses will cover technical topics communication techniques, and relevant management skills. Attention will be given to methods for facilitating

participation of men and women in activities and benefits derived from them with the view of influencing attitudes and practices of the project personnel. Data collected by Monitoring and Evaluation Section will be incorporated into the courses and will help determine the course content. Various teaching techniques will be used that are appropriate for adult learners. Field trips will be conducted to other village based forestry and agroforestry project areas in the Sudan for a limited number of staff selected on the basis of good performance and hence the trips will serve both as a reward and a learning opportunity.

In addition, local leaders, village nursery supervisors and village extension workers will be trained. Training will be based on appropriate methods of adult education and incorporate "hands-on" experience. A series of courses will be given for the nursery supervisors and extension workers incorporating feedback from supervisors and the Monitoring and Evaluation Section. Field trips inside and outside the project area will be made by members of this cadre. To promote the involvement of women, visits will be made to sites of related projects which focus on women's participation.

Other activities that will be taken up under this component of the project are summarized below. Details can be found in various sections that follow:

1. Development of a village-based forestry extension network throughout the 5-Rural Council area.

2. Development and initial implementation of management plans for 25,000 feddans of natural woodland, under the supervision of forestry administration.

3. Allocation of adequate area (approx. 25,000 feddans) or woodland to village communities for protection and management under the technical guidance and supervision of CFA. These areas would be declared as community reserves.

4. Establishment of 5 central nurseries, one in each RC for production of seedlings, each with a capacity of 500,000 seedlings annually.

5. Establishment of 5, 20-feddan demonstration centers along-side each nursery, depicting various agroforestry models.

6. Construction of seed production, collection and processing facilities at each nursery site.

7. Establishment of 200 feddans of seed production stands of improved (high gum yielding) strains of Acacia senegal (gum arabic).

8. Establishment of 100 village self-help nurseries with the production capacity of 5000-10,000 seedlings annually.

9. Establishment of 100 mini-demonstration plots for various agroforestry models on farmers fields.

10. Assistance in reforestation of 25,000 feddans of degraded gum gardens through active participation of people.

11. Promotion of agro-forestry interventions over an area of 25,000 feddans.

12. Assistance to Agricultural Research Council, El Obeid station (NGARP) for carrying out demonstrations and adaptive research in the project area, on gum arabic (production) and agro-forestry.

13. Assistance to Faculty of Agriculture, University of Khartoum through fellowships for graduate students, to conduct research for their degree, in the project area. 4 such fellowships are scheduled each year for 5 years.

4.1.1 Natural woodland management

The forest resources of Sudan have never been properly inventoried. The inventory of the Southern Blue Nile and Bahr El Ghazal implemented recently by CIDA is a valuable start. When the Resource Inventory component of this project covers Southern Kordofan and Southern Darfur, only the Southern Regions (minus Bahr El Ghazal) of the parts of Sudan with forest potential remain to be inventoried. The data thus gathered will provide CFA for the first time with objective information as to how much is there in the way of woodland area, its current content of biomass, and regenerative capacity. CFA, should then and in view of other available information such as demographic changes, projected requirements for wood, gum, fiber and other forest effects and in the light of agricultural expansion and increase in anumal population, come out with a plan of action.

The practice of traditional forestry by CFA throughout this century, judged by the total gazetted forest estate, indicates the need to adopt other means. Beside involving public institutions in the process (institutioned forests) such as agricultural schemes, the people need to be involved in their capacity as individuals (private forests) and as communities (community forests/village woodlots). The plan of action by CFA should therefore deploy the necessary personnel and funds to:

1. Demarcate and manage sufficient area of woodland to meet national needs. These include fuelwood for areas of deficit (cities and towns), industrial wood as well as protection of catchment and watershed areas.

2. Provide technical assistance to Regional authorities, public institutions, communities and individuals to quantify their needs for forest products and benefits and management of areas allocated for the purpose.

The needs assessment and ethnobotanical survey that will be carried out will provide information to further the ends of CFA within the above framework. The information will be used to prescribe management plans for the forest resource in the project area and be used as baseline against which the project will be continually evaluated. However, the activities under this component of the project (participatory forest management), need not wait for the

results of these surveys. While the survey is being carried out actions for the participating forest management can be initiated. While conducting the surveys and during development of operational plan, the following observations should not be lost sight of.

1. It is evident from observations that the areas around towns, eg., Er Rahad, major villages, eg., Ed Dubeibat and many water yards, have been denuded of tree and vegetation cover to the extent that they have been reduced to desert rings. The once stabilized dunes are now on the move. The resulting loose sand is hardly motorable. These towns, villages and water yards need to be identified, the socio economic and legislative aspects resolved and the afforestation of these rings for town/village perimeters, community and private forests or woodlots planned and implemented.

2. The three northern most R.C. in the project area; Kazgaii, Hammadi and Ed Dubeibat are obviously areas of deficit in direct forest products (fuelwood, gum arabic, shade etc.) and indirect benefits (being arid and destrified etc). Er Rahad and Habiella R.Cs are likely to be areas of surplus at least in direct forest products. Plans need to be drawn to address these aspects, i.e. productive forests in the south and protective area in the north.

3. Certain areas within the project area have been gazetted as Central or Regional forest reserves. Once inventoried, these need to be given priority for the development of appropriate management plans and their implementation.

4. There is a continuous decline in soil productivity year after year. This is because the traditional bush-follow system is no longer applied in areas where it is applied, the fallow periods have reduced from 20 to 5 years. In most cases continuous cropping is practices to the point of absolute degradation of the soil and its abandonment thereafter.

5. Similar is the case with mechanized farming, where continuous cropping is practiced and the land abandoned after it has lost the productive capacity. One abandoned mechanized farming scheme in Habiella (No. 41) has been assigned to CFA for reforestation. An appropriate reforestation plan needs to be worked out for it.

6. Certain tracts with good stands of A. seyal are known to exist in Habiella and Er Rahad R.Cs. These need to be surveyed and proposed for reservation. These are perhaps the only remaining source of fuelwood for large population centers such as El Obeid.

7. Legislative measures need to be taken to compel future mechanized farmers to convert wood from trees on their holdings into charcoal, instead of burning it to ashes, and either leave wooded strips as shelterbelts or establish shelterbelts where such strips do not exist.

4.1.2. Natural Woodland Management Packages

Using existing knowledge derived from local experience or that of other countries of comparable agro-ecological conditions, the following participatory management packages are prescribed (Table 1). The results of the Inventory/Vegetation Mapping, Needs Assessment and Ethnobotanical Surveys will help locate forest sites, type of ownership and produce/benefits required from the forest. These parameters together with the acquired information on ecological/edaphic factors will help determine the appropriate silvicultural and regeneration methods. The following are a few examples of management precriptions to illustrate some of the packages in Table 1, and are by no means to be taken to cover the entire range of possible prescriptions or alternatives.

1. State forests (Central or Regional forest reserves)

The participation of people in the management of state forsts encompasses the employment of people in all forest operations together with the right of the people in the vicinity of the forest to collect fallen wood for personal use, grazing of their livestock when such an activity is deemed to be harmless to the forests, beside helping to extinguish forest fires.

1.1 Reserves on Goz (Stabilized dune sand):

1.1.a. Acacia Senegal low Rainfall Woodland Savannah. Duebibat Forest Reserve is an example of such reserves.

The silvicultural/exploitation method prescribed is that of clear cutting (1). The regeneration method deemed feasible is that of plantation (5). The other uses (beside the ultimate fuelwood/building poles) envisaged are gum production (3) and/or itinerant grazing (1), hence the package was designated by the symbols 1-5-3/1.

162

1.2 Reserves on cracking clay:

1.2.a A. Seyal/Balanites Low Rainfall Savannah. 70,000 feddans are proposed as Central or Regional reserves (at Er Rahad and Habeilla R.Cs.). The prescribed package is that of clear cutting (1), planting (5), and itinerant grazing beside the ultimate fuelwood (1), hence 1-5-1.

2. Institutional Forests

These are depicted by scheme No. 41 assigned by MFC for CFA to reforest. It is on the cracking clay plains. Here again popular participation is the same as in 1.

Two packages are envisaged:

i. Clearcutting, regeneration by planting with gum (Talh) and itinerant grazing as other uses 1-5-3/1.

ii. Strip/patch cutting, natural regeneration enhanced by firelining fencing and guarding and the same set of other uses as (i). Hence 3-3-3/1.

3. Community Forests

Popular participation in this category goes as far as ownership of the land, the resource, the produce and the decision making regarding the whole concept.

3.1. Combireturn Kordofanum/Dalbergia/Albizzia on Goz.

3.1.a. A coppice/Bush management system was prescribed on account of the tree species coppicing ability. Regeneration is expected to be effective through guarding, fencing and firelining and all types of other uses are envisaged. 5-3-1/2/4/5.

4. Private Forestry

The term is self-explanatory as regards popular participation. Any such holding to be identified in the Boswellia papyrifera, Sterculia Combretum/Anogeissus association, can be managed on a selection felling system, with good protection to promote natural regeneration. Gum (Frankensence) and/or medicinal, fruit and other benefits could be drawn. 1-5-5/5.

170

Natural

Table 1 Proposed ~~Proposed~~ Woodland Management Packages for Forest Associations under Various forms of Ownership

Legal Status (Ownership)	Vegetation Zone / Soil / Tree Associations	LOW RAINFALL WOODLAND SAVANNAH					
		Goz(Stabilized Dune Sand)		Non-Craking Clay	Cracking Clay	Hill Catena	Flood Plain
		Acacia senegal	Combretum Cordofanum/ Dalbergia/ Albizzia	Acacia Mellifera	A. Seyal/Balanites	Boswellia papyrifera Sterculia Combretum Anogeissus	A. albida A. [illegible]
State: Central Reserves Regional Reserves		1-5-3/8	4-2/4-5	1-5-1	1-5-1	4-4-3 4 5	4-4 3-1 3 1-3-1 3
Institutional				3-3-3/1			
Community/ Village		2-1-2/3 3-3-1/2/3	4-3-1/2/4/5 5-3-1/2/4/5	1-5-1/2/5	1-5-1/2/5	4-3-3 5	4-3-[illegible] 1-5-[illegible] 5
Private		3-3-3/2	4-3-4/2/5	1-5-2	1-5-1/2 5	4-3-3 5	4-4 3-3 2 1-3-[illegible]

Participatory Mangement Packages

Forestry Estensive — Management Intensity — Farm Intensive

A. Silvicultural/Exploitation Methods:

/ 1 / Clearcutting / 2 / Mother tree/shelterwood / 3 / Strips/patch cutting / 4 / Selection / 5 / Coppice Bush Management

B. Regeneration Methods:

/ 1 / Natural regeneration- no management inputs / 2 / Forest guards / 3 / Guards + Fence Fire breaks / 4 / Enrichment Planting (Bush fallows) / 5 / [illegible]

C. Other Uses:

/ 1 / Itinerant grazing / 2 / Local grazing / 3 / Gum production / 4 / Agriculture / 5 / Medicinal, Fruit Ornamental Shade [illegible]

171

4.2 AGROFORESTRY/EXTENSION

2.1 The Role of Trees in Land Use Systems

Increased tree planting, especially under agroforestry systems of land use, is believed to contribute to sustainable development. A configuration of appropriate trees/shrub species, and their effective management in relation to food crops and livestock production, will optimize the service and economic role of agroforestry systems of land use. Moisture conservation, reduced tillage and weeding requirements as well as soil fertility maintenance of agroforestry/forestry systems of land use are considered as service roles which also reduce production costs such as fertilizer use, weed control, and land preparation. The economic role of agroforestry systems, is that such systems provide multiple products from the same unit of land such as food, energy, livestock, and a host of other products and by-products ie, gums, resins, fiber, vegetable tannins, oils, fiber, etc. which also make the overall farm enterprise more dynamic and profitable.

The agroforestry and tree-based program will initially be based on improving existing traditional agroforestry systems within the: a) gum arabic gardens, b) horticulture (trees in home gardens), d) forest establishment systems, e) as well as in the traditional farming system (shifting cultivation and/or bush fallow systems), which are detailed in section 2.3.

In all of these, trees/shrubs play a pivotal role, as evidenced by the disasterous effects when trees and shrubs disappear under heavy pressure of crop farming, livestock production and deforestation in general. The breakdown of these age-old or traditional systems of land-use heralds desertification or destruction of the biological potential of an area. These results are more in evidence on the northern end of the project area but there are active trends in all of the 5 Rural Councils areas, especially in and near villages/townships, water yards, and on the mechanized commercial farms. The case of the wooded savanna fallows in the Sudan zone of Mali illustrates this issue where reducing the fallow period to less than three years and adding grazing intensity on it bring complete degradation.

The agroforestry program goals (research, demonstration, training, extension and technical services) will be the development and improvement of tree-based systems by employing an optimum temporal and/or spatial relationship of the tree system to the crop and/or livestock system. Where livestock is a preferred occupation, and grazing resources are limited, especially during prolonged dry season or during drought years, the production of fodder and browse trees/shrubs or perennials insures the sustainability of the system and minimizes livestock loss. In the case of seasonal movement of the nomadic and semi-nomadic (transhumans) systems the establishment of grazing corridors with improved range also minimizes land use conflict between these two major production systems and makes their economic and social linkages more durable and mutually supportive. Rotational grazing schemes need to be attempted and this may be the most cost-effective method to protect the environment.

Commercial mechanized agriculture, more active in the southern and southeastern parts of the project area (Habila and parts of Er Rahad and Kazgail) is also proving environmentally problematic and destructive. This trend needs to be reversed and the damage already inflicted needs repair. The

establishment of shelterbelts and windbreaks, with east-west orientation for SE-NW) appears to be possible and essential. Some farms are already selectively retaining indigenous trees such as, Balanites aegyptiaca which do not appear to depress crop yields or obstruct mechanization. But the retention of natural strips during initial land clearing to form a regular windbreak and for natural re-seeding, must be part of the policy and practice of the Mechanized Farming Corporation. It is presently a statutory requirement to leave 15% of the farm by each farmer under forest must be implemented. Unfortunately this regulation is never enforced.

2.2. The Rationale for Agroforestry Interventions in the 5 Rural Council Areas

2.2.1. General:

The 5 Rural Councils themselves are not uniform in their resource base either and the resource rehabilitation interventions they will need, will vary. Thus, the interventions detailed in subsequent sections are based on diagnostic analysis of the resource-base, its state of degredation and the principal causes. Against these local and zonal senarios are the proposed interventions, both corrective and preventive which form the core agroforestry interventions.

2.2.2. Abbreviated Diagnostics and Design (D&D) method used

A detailed D & D is usually prescribed to investigate the problem and design the required interventions. An abbreviated D & D method was used (instead of the ICRAF's method, which is detailed and expensive) to generate the technical data and to select the agroforestry interventions. This was accomplished as follows:

1. Existing data-base was consulted and synthesized and these included:

   a) The D & D of this project

   b) Kordofan Resource Inventory and Development Perspective by Rural Councils (1985)

   c) Results of more recent socio-economic surveys in the project or adjacent area such as the recently completed Save The Children. Um Ruwaba and the CARE - El Obeid surveys.

2. Official and informal interview and technical meetings with GOS and Donor agencies involved in the region.

3. Field: Visits and in the five Rural Councils. The results of this abbreviated D & D is summarized below and expanded in the Agroforestry intervention sections which also provides adequate technical details for implemention.

2.2.3. The Five Rural Councils: Relationships and Differences

The 5 Rural Councils are economically and geographically linked to El Obeid and through it, to Khartoum, which services as the market for agricultural and

173

livestock products and for woodfuel. As it creates demands for food and energy, it also acts as a source of population watershed and creating more cultivation and grazing pressure. The more arid zone of the stabilized sand defines the N.W. front of the five local councils while Lake Er Rahad and the Khor Abu Habl provide the environmental and economic features of the S.E. ends of the project area. The Nuba Hills (mountains) to the south of the zone are also important features of the resources base of these local councils especially the alkaline (cracking) clays zone with more rainfall and the associated nomadic pastoralism and the mechanized farming area.

Based on the available data the Five Rural Councils can be divided into two zones:

Zone I - Northern Belt

Central Belt zone , Zone IA to include:
- Southern Kazgail
- Hamadi
- Central Dubeibat
- Central Rahad

Northern end zone, Zone IB to include:
- Northern Kazgail
- Northwestern Dubeibat
- Northern Er Ranad

Zone II - Southern Belt

Southern Belt zone, Zone II to include:
- Southeastern Dubeibat
- Southwestern Er Rahad
- Habila

The Central Belt Zone -Zone IA

This zone has the highest population density and is highly sedentarized but is also used as the dry season grazing by the Hawazma. The area is also severely deforested due to shortened bushfallow system as well as charcoal production, being an important seasonal (dry season) activity.

Agriculture is largely based on Goz sands which are easy to cultivate and bushfire is widely used for land preparation which destroys all the potential and available organic matter. The use of alluvial soils and wadis as well as the non-cracking claying gardud lands is limited. Hashab gardens have been on the decline but there are current efforts to reverse this trend.

Resource degredation is most severe in and around villages and on Goz lands farms, the latter are also the source of destabilized sand affecting villages and water courses (wadis and streams). The water yards are also affected by overgrazing as production of small ruminants and to some extent, camel rearing is significant.

174

The over exploitation and degredation of the goz lands, the relative under utilization of the clay (gardud) soils, and mixture of alluvial flood plains and village perimeters largely define the problem, issues and opportunities. This zone is also close to the market and has relatively good rural infrastructure, including roads and railway.

Northern End Zone - Zone IB

A distinction for a sub-zone, IB is made to cover the northern end of the general zone I, north of the Railway lines which is very water deficient, more degraded due to intensive cultivation and overgrazing and deforestation. The Kazgail - Dubeibat part of this sub-zone have more Goz lands while N. Rahad has clay soils alternating with Goz sands and water shortage is more acute. Crop yields are very low and highly unreliable due to the low and relatively uncrealiable rains.

Zone II

This zone makes the southern half of the project and represents quite different land use systems. Resource base and development infrastructure are poor. Population is generally low and agricultural land use is dominated by mechanized farming and nomadic livestock production. These two activities are based on the more reliable rainfall and cracking clay soils. Major drainage systems such as the Khor and the Nuba uplands are also important and define nomadic movements.

The zone currently has a surplus of woodfuel and will continue to supply zone I and El Obeid, particularly as the roads improve. The economically important and dominant woody species include Acacia senegal. A. polycantha, A. mellifera, Balanites aegyptica and Boscia senegalensis. On rocky outcrops, the economically important species are Baswelea africana and Commiphora spp. These are the source of frankinsena and myrh but their exploitation is negligible at this time.

2.2.4 Zonal Approach for the Agroforestry Interventions

The 5 Rural Councils which make up the project area were classified into two major zones, namely Zone I making the project's northern half and Zone II, the southern half. This zonation clearly shows these two zones are dissimilar in terms of land use and type and scale of degredation. Zone II is largely made up of Habilla with parts of Debeibat (south) and Er Rahad (sw) and the rest going into the Central Belt and Northern end zone (Zone I).

Zone I has a long East-West axis and is more or less parallel with the Railway line. Goz, gardud and alluvial lands alternate with more Goz lands frequently to the West while gardud and alluvial soils are more frequent towards the east. Thus, the ecological problems of Goz lands in its western half and the opportunities to exploit the gardud and alluvial soils as well as the foothills and the good water resources in the eastern half of the zone clearly indicate the type of agroforestry and related tree-based land use systems. Thus, the degradation axis into this zone is from the Northwest and generally south into the project area.

The Diognonis and Design (D&D) methodology which resulted in the above zonation and description also clearly identified the following intervention target sites, namely:

1. village and water yards
2. Goz sands
3. Alluvial plains and wadis
4. Gardud soils (non-cracking clay depressions)
5. cracking clay plains

The scale of degredation follows the above list (1 most severe and 5 least severe). The frequency of these sites follows the zonal classification, where cracking clay soils are largely confined to zone II. Sites 1 to 4 are dominant in zone I with an east-west secondary frequency in evidence. Sand dunes in older and larger villages and degredation on Goz sands and around water yards is the most serious and the biggest challenge for the project.

In these sites, degredation is not limited to the physical absence of organic matter and vegetation cover, but that the biological basis of the environment or habitat is gone. Surface (ground) temperatures for the hot months (April-June) reach 60°C, enough to sterilize the soil. With the destruction of their physical structure, their water holding capacity is also destroyed. In short, it will be an uphill task to rehabilitate these two types of sites but the battle must be fought to save the villages and improve the quality of life.

The problem of degredation in the cracking clays is largely caused by non-compliance of the regulations required by MFC by the large scale farmers. There exists a strong correlation that the Rural Councils with the most severe degredation also make the western half of the project area and fall largely in zone I. These are Kazgail, Hamdi and Debeibat with Central Rahad making the eastern flank. As the Rural Councils and their respective village councils will be the basis of implementation of the project, the scale of the degredation and the optimal target number of people to be reached viz a viz this zonation dictates that the project begin its implementation in the western half and proceed east and southward. Thus, the time frame of implementation is suggested as follows:

Implementation plan for the 5 Rural Council Programs 1988-1993

Rural Councils	1988	1989	1990	1991	1992	1993
Kazgail	X	X	X	X	X	X
Hamadi	-	X	X	X	X	X
Debeibat	-	-	X	X	X	X
Rahad	-	-	X	X	X	X
Habila	-	-	X	X	X	X

Year 1 (1988) will be devoted to initial procurement, staff recruitment and the development of field structures and thus, only one Rural Council program (Kazgail) will be implemented. Development of the Central and Village Council nurseries and the associated demonstration plots is the foundation of the field program on which training extension will depend. The siting of their physical field units should be made in such a way that they are easily accessible and are representative of the intervention sites (i.e. Goz, gardud, alluvial soils, etc).

A generalized field plan for the nursery is given in Fig. 1 which is suggested to be used as the standard design for all Central and Village nurseries.

Agroforestry as an aggregate technology of choice to adopt to mimic the old and once stable long fallow or shifting cultivation and the pivotal role trees/shrubs play in this technology has been presented in Section 2.1. The D & D used during the project design finds the absence of trees/shrubs from the landscape and preventing those few standing from effectively regenerating (seedlings are browsed/grazed) as the principal root of degredation. Thus, putting back trees/shrubs into the landscape and productively managing them is the corner-stone of the agroforestry effort. When the traditional systems, which are also all tree-based systems, are still operative, it will be best to begin re-inforcing and further improving these, both as a preventive and a curative effort.

At present, the continued retention of these traditional agroforestry systems is being eroded because of the heavy exploitation of the woody component for domestic construction and for fuelwood and charcoal especially in zone I. The prominent traditional agroforestry practices systems include:

a. The gum gardens on Goz sands and clay sands and natural bush fallows.
b. Acacia albida, A. tortillis, Adansonia digitata, Balanites aegyptiaca, Tamarindus indica mixed intercropping on wadis and gardud soils.
c. Balanites aegyptiaca and Acacia spp. mixed intercropping in the Mechanized Farming on cracking clay soils, and;
d. Trees in (Home) Gardens

The effectiveness and productivity of these traditional practices systems is based on the density of the trees per unit area and/or the length of the rest (fallow) period. The effectiveness of the fallow period is further weakened by the complete removal over a wide area, of adult individuals of those species that are important as seed sources. One cannot help but notice the complete absence of adult and young Acacia spp., Balanites aegyptiaca, Tamarindus indica from the landscape between El Obeid and Debeibat due to clear-felling for agriculture and cutting for charcoal and fuelwood. Indeed wood cutting and sale of charcoal and woodfuel for urban centers and District and Local Council Headquarters continues to be an important dry season activity for many rural dwellers. These activities reach their maximum during drought years, when nature is also at its weakest equilibrium and thus, the shift to desertification easily attained and the rehabilitation process made more difficult and costly.

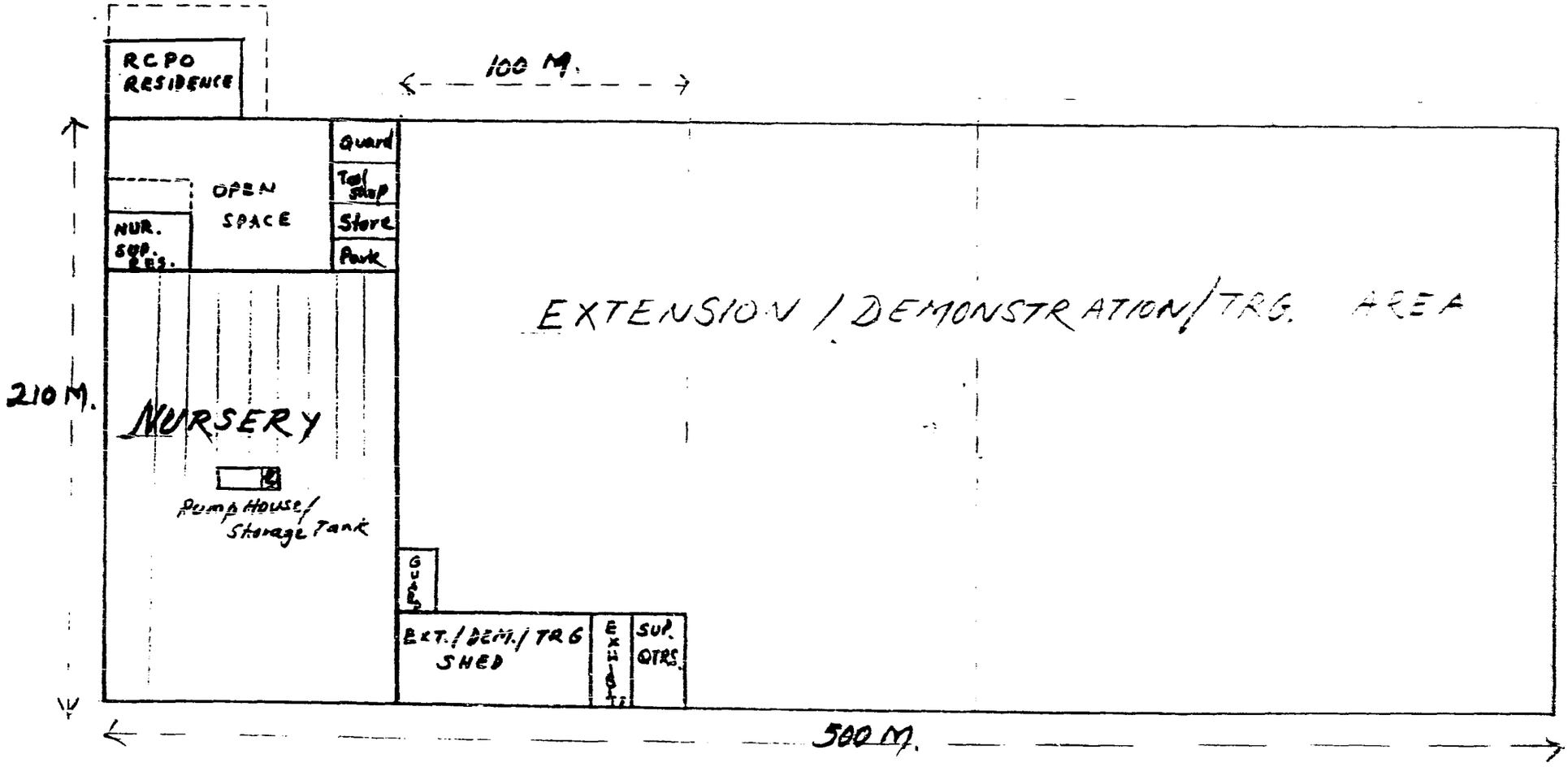


FIGURE 1. SKETCH PLAN FOR NURSERY/EXTENSION CENTRE (25 FEDDANS)

In situations where the traditional agroforestry systems are no longer operative and the environment has been subsequently destroyed, new agroforestry and related tree based systems need to be identified and demonstrated. The key element in this effort will be identifying the most suitable tree/shrub species that can literally grow on sand, withstand or escape grazing/browsing by domestic animals and damage by rats. Reducing or eliminating the land use pressure of grazing, bush fires, cutting green wood, is considered as important as tree/shrub planting efforts in these fragile lands (Goz and Village peripheries). Newly developed agroforestry systems (i.e. Hedgerow/Alley Cropping as well need to be demonstrated and introduced for early adoption in the project area, after a determination has been made about its technical feasibility, species of trees and crops and its social acceptance.

Based on field visits to the project area, after having evaluated the general physical and socio-economic conditions, certain suggestions are made regarding the likely agroforestry interventions that show promise.

Table 2 summarizes the agroforestry interventions and their specific sites of application, while the recommended species and management prescriptions are given under the appropriate sections that follow. These interventions, as stated, are based on a very preliminary evaluation and assessment of the project and should by no means be considered as binding and final. Further analysis is required to be done before a decision is made about the suitability of a particular agroforestry intervention at a particular site.

Table 2 Suggested Agroforestry Interventions in the Project Area

Agroforestry Interventions	Intervention Sites in the Rural Councils	Zone I Villages Wateryards	Goz Sands	Alluvials soils	Zone II Gardud soils (Non-cracking days)	Alluvial soils	Cracking Clays Degraded	Cracking Clays Non-Degraded
1. Improved Bush Fallow			X	X		X	X	X
2. Participatory/ Social Forestry			X	X	X	X	X	X
3. Mixed tree Alley Cropping				X		X	X	X
4. Live fence/ boundary planting		X	X	X		X	X	X
5. Wind breaks/ shelter shelterbelts		X	X	X		X	X	X
6. Horticulture/ Home Gardens		X	X	X	X	X		X

18

[illegible] The Agroforestry Intervention: Description and Implementation Plan

The range of agroforestry interventions is complex and should be based reflecting the degree of environmental damage and degradation stage manifested. The villages and worst sands are the most affected and implementation of any type of rehabilitation should not be based on activities and measures that prohibit sanctioned use of these sites but rather should combine protective (repair) and productive roles and where the end product has benefit to the community at large. Most of the activities may be forestry and forestry-related activities such as short rotation woodlots, shelterbelts and windbreaks.

The key to the agroforestry intervention for rehabilitating degraded lands such as the Goz lands is to identify the most appropriate woody species. It is suggested that shrubs and small trees be considered for the initial stage of rehabilitation, i.e. Prosopis spp., Cassia spp. (especially native selections), Acacia spp (shrub species, both native and exotics), Buscia senegalensis, Dalbergia spp. Erytarina spp, Ziziphus spp. Many of these species are good fodder/browse species and need to be protected during their establishment but also include those that will withstand heavy browsing effects.

The second stage of the rehabilitation should incorporate more large trees and more economically important species including Acacia albida, A. senegal, Tamarindus indica, and other popular fruit trees depending on the site being rehabilitated (Goz, alluvials, etc.)

No specific design can be given but the rotation alley cropping described in the next section (Mixed Tree Alley Cropping) can be used by using it in reverse order, i.e., as crop intercropping can not be expected in the initial rehabilitation stages. But later, the density of the trees can be reduced to establish the mixed intercropping system described already.

In summary, the activities and stages of the Agroforestry interventions for resource rehabilitation include:

Step 1. Collection and brief species evaluation/screening efforts
Step 2. Establishment of prototype demonstration (especially for Goz soils) through
- a) small trees/shrubs for initial stage
- b) interphase with large trees and harvest (partial) the small trees/shrubs
- c) establish/operate mixed intercropping (re-introduction of crop/livestock farming).

The rehabilitation phase (1-2b) may take five or more years before the rehabilitated land re-enters the agricultural phase, stage 2c, above.

Potential species for this intervention is provided and should form the basic resource guide as given in Table 3.

Table 3 Suggested List of Tree/Shrub Species (Agroforestry)

Species	Intervention Sites					
	Goz Sands/Villages		Alluvial Soils: Water Yards		Cracking Clays Garduf Soils	
	Stage I	II	Stage I	II	Stage I	II
Atriplex humilis	x		x			
Opuntia vulgaris (spineless)	x		x			
Acacia albida		x	x			
A. laeta	x		x			
A. mellifera	x		x		x	x
A. auricuformis	x		x			
A. saligna	x		x		x	
A. zanthophloa			x	x		
A. holoserica	x		x			
Albizia sericiophala				x	x	x
Azanza garkeana			x		x	
Anona spp.		x	x	x		
Azadirachta indica		x		x		
Anacardium occidentals		x	x	x		
Balanites aegyptra	x	x	x	x	x	x
Bauhinia spp	x		x		x	
Boscia senegalensis			x		x	
Caesalpina spinox	x		x		x	
Cassuarina spp	x	x	x	x		
Cassia spp (loc)	x		x		x	
Cassia spp (int)	x	x	x	x	x	
Cordia spp (loc)	x		x			
Dalbergia spp (loc, exotic)	x	x	x	x		
Ficus spp (loc)			x	x	x	x
Flemingia mecrophylla	x	x	x	x		
Lausonia inermis	x		x	x		
Moringa (loc, exotic)	x	x	x	x		
Parkea spp		x	x	x		
Prosopis africana		x		x		
Prosopis juliflora	x	x	x	x		
Prosopis chiliansis	x	x	x	x		
Ptecerlobium dulce	x	x	x			
Pilostigma spp	x	x	x	x		
Sesbania sesban		x	x	x	x	
Tamarindus indica				x		
Tephrosia spp	x	x	x			

182

2.5.1 Improved Bush Fallow System

The traditional practice of bush-fallow where the land was cropped for [illegible] years and left fallow for 20-25 years has broken down. Under the traditional system, farmers would encourage regeneration of gum arabic and other fodder trees, would return to clear it for farming (usually 20-25 years later) thereby obtaining a continuous crop of gum arabic and fuelwood and fodder from time to time. This system no longer operates and at present, the farmers cultivate the land for [illegible] to 10 years or when the soil has lost its productivity completely and then the farmer moves on to clear another area. The farmer may return to this area 10-15 years later when he can find no more new land to clear. The productivity of this land is still low, not having received sufficient rest to rejuvenate.

The obvious problems therefore are low productivity, soil degradation, no off-season employment (for gum arabic collection), no fodder or fuelwood resources, all leading to environmental degradation and related consequences.

Application and Description of the system:

As indicated in Table I, the improved bush fallow system or agroforestry can be applied in both Zone 1&2, although the exact nature and species combinations will vary from site to site. This system aims at revival of the traditional bush fallow system with some modifications and is referred to have as "Improved Bush Fallow System".

Under this system the farm-land will be cropped for a period of 5 years and thereafter left for fallow for a period of 20 years. At any particular point in time, the farmer will have 4/5th of his land under crops and 4/5th under fallow.

During the fallow period, restocking of gum arabic and other economically important trees will be encouraged, with artificial planting or sowing, if necessary. The fallowed area will yield fodder and fuelwood to meet the family's needs and gum arabic from year 6 onwards to provide the family with additional income.

For successful implementation of this system, attention needs to be paid to the following:

a. Provision of improved varieties of crop seeds to the farmers.

b. Collection/production and distribution of improved seeds of Acacia senegal and other economically important tree species.

c. Design and production of technical, extension, training resource materials on improved bush fallow system for farmers in an easily understandable language.

Traditionally, the tree species utilized during the fallow period have included Acacia senegal (highest proportion), followed by Balanites aegyptiaca, Ziziphus spinachristi, Acacia mellifera, etc. During the fallow period, due attention must be paid to the role each of these species plays in the socio-economic well being of the farmer and what influence these have on soil characterstics.

The long fallow period under this system will result in a slight reduction of total earnings for the farmer during the initial 5 years. After this period, however, the initial losses sustained would be more than compensated. Besides, once the system is in place, the continuity of cropping, with higher crop returns per unit of land would be ensured. In view of the fact that farmer's tendency is likely to be looking at short-term returns, extension will have to play a significant role in bringing home to the farmers the real advantages of following this system. The indirect benefits of fallow in terms of reduction/elimination of decline in soil productivity, check in desert creep and desertification, environmental stabilization and increased availability of forage for the animals also needs to be brought home to the farmers.

Care needs to be taken in the choice of the species to be promoted under this sytem for which consultation with farmers through extension network will be very useful. Definite weight needs to be given to the perceived uses of the species by the farmers and not-what the technicians perceptions are.

During the implementation phase, it is expected that an area of 25,000 feddans would be brought under this system.

2.3.2 Participatory/social forestry (Gum Arabic)

Problem and Issues:

The gum gardens or Hashab gardens operate within the agricultural land use cycle of the small holder farmer where it serves both protection and production functions, thereby maximizing sustained income (Awouda, 1973). But current gum arabic stocking rates of only 10-190 trees/feddan (av. 50 trees/fed) are low and need to be raised to 200/feddan or higher. At 200 trees/fed, it is possible to raise the internal rate of return from the current 3.58 to 10.74% (Awouda, 1973).

According to Awouda (1973), the bottlenecks in increased gum arabic production and optimizing farmer's income are:

a) Favorable producer prices
b) Cash (credit) needs during the dry (harvesting) season.
c) Drinking water shortage/high costs.
d) Produce transport to market/village
e) Low gum arabic tree stocking, averaging 50 trees/feddan

These constraints were still valid for the project area as observed during the pilot survey and have been considered in this project plan.

On account of one or more of the above mentioned constraints, majority of these gum gardens have been cleared for fuelwood or charcoal or have been ill maintained over the years leading to their degradation.

At current levels of intensity and number of farmers with gum gardens in southern Kordofan, it is doubtful that these gum gardens maintain soil productivity or prevent degradation and desertification. In fact, the situation as reported in Awouda's (1973) field surveys in Kordofan and Darfur that showed only 2/3 of the farmers had gum gardens and 33% these farms showed active land degradation has deteriorated much further.

Application and Description:

As indicated in Table 2, this system of rehabilitation of gum gardens can be applied in both Zones I&II, except in areas that fall outside the zone of natural distribution of gum arabic.

It is suggested that the agroforestry interventions for rehabilitation of the gum (Hashab) gardens form the initial core of the program at all levels.

In order to achieve the project objectives of environmental rehabilitation and increased gum production, tree establishment must be carried out on a large scale. This is because the processes of desertification are widespread and occuring throughout the Gum belt, although intensified where there are concentrations of human and animal populations. This calls for the setting of priorities for interventions aiming at counteracting desertification. The present project aims at giving greatest attention to the worst affected areas first.

There are two methods of tree establishment that can be used in raising hashab plantations. One is planting of seedlings raised in nurseries and the other is direct sowing of seeds either in regularly spaced pits or broadcasting in the field. The techniques involved in establishing trees by sowing are simple and familiar to the land users who are to do the actual work in the field. It is expected that one farmer will on average sow 5-10 feddans hashab seeds on his farm together with his crops depending on the availability of labour in the family. Children 10-15 years of age who often carry out the sowing while adults do the pit digging, will be the main labour force in sowing hashab seeds. It is therefore very important for the extension service not to ignore children while campaigning for sowing.

Self-help nurseries that will be established in villages where sufficient water supplies are available will be used to raise seedlings for planting. It is expected that improved seeds of Acacia senegal will be used, both for direct seeding and for raising seedlings in the nurseries. The choice between sowing and planting will depend on the conditions of site, particularly with respect the rainfall distribution and soil characteristics.

The emphasis placed on gum gardens will be periodically evaluated with a focus on the economic returns to the producer as well as a macro level economic analysis. The results will be used to determine the extent to which the project will continue to focus on gum gardens.

2.3.3 Mixed Tree Alley Cropping

Problem and Issue:

The physical environment of the project area is fairly uniform and the changes follow latitudinal zone, ie., less moisture (rainfall at 12^{0}N latitudes compares to 11^{0}N latitude). However, edaphic and major drainage lines show a high degree of variability as expressed in their diffential exploitation by man for water, agriculture and livestock production. Those that are easy to use such as the Goz lands have been subjected to too high a pressure resulting in degradation in situ and causing sand deposition (dunes) elsewhere, largely blown by wind. On the other hand, the more productive but difficult to cultivate, clay and alluvial soils have been used less.

185

The non-degraded Goz lands as well as the alluvial soils will be the potential sites for mixed tree alley cropping. The organic matter level and water holding capacity of the Goz soils needs to be improved, while the alluvial soils will be optimally used.

Application and Description:

Alley cropping in its basic feature is a practice where the technology starts as a planted fallow much like the gum gardens during the cropping phase of the land use cycle but the line planting is very dense and distance between tree rows also as close as available moisture would allow. Crops are planted in the intervening spaces of trees that form alleys. After a period of tree establishment, the trees are cut back as often as possible during the crop growing season to avoid shading and to provide green leaf manure (GLM) to the growing crop or to be used as animal feed. The trees are allowed to grow during the long dry season, (more than 60% (Getahun) of their biomass yield is during the dry season) to grow and develop canopy. This system is kept indefinitely as long as it sustains itself and maintains high level of land productivity. This system removes the destructive element, the use of bush fire to prepare land.

The system suggested here involves the use of a mixture of tree species (choice of species depending on agroclimatic conditions of the site). The tree species, however, are preferred to be of the nitrogen-fixing kind such as leguminous species (Acacia senegal, Acacia albida, Acacia seyal, Acacia nilotica, Prosopis juliflora, Leucaena leucocephalla, Calliandra callothyrsus). These trees are planted in alleys, 4 in a row, 3 meters apart, separated from the next row of trees by a cropped area of 48 meters. The two belts of trees thus forming an alley and the cropping taken up between the alleys, hence the name Alley Cropping. The trees act as windbreaks/shelterbelts, nitrogen fixers, help water recycling, add organic matter, and when pruned provide mulch for the crop in the intervening area.

Recommended tree species for various soil types in the project area is given in Table 4. This table is indicative of potential sites for the application of the system and is by no means final. Further analysis needs to be done before finalizing the field sites for the application of the system.

Table 4 Recommended Woody Species for Hedgerow (Alley) Rotational Farming

Woody Species	Intervention Sites			
	Goz Soils	Gardud Lands	Alluvial Soils	Cracking Clay Soils
		Wadis		
Acacia auricuformis	x			x
Calliandra calothyrsus			x	x
Cassia siamea			x	x
Erythrina spp		x	x	x
Flemingia macrophylla		x		x
Leucaena spp		x		x
Prosopis chiensis		x		x
Sesbania sesban			x	x
Sesbania bispinosa			x	x

2.3.4 Horticulture and Home Gardens

Problem and Issues:

There is active interest and limited activity in fruit tree and vegetable growing, both as a source of food and to generate cash. Fruit trees popularly grown by the villagers in the project area include; Citrus spp., Mango (Mangifera indica), guava (Psidium guajava), papayas (Carica papaya), etc. Other trees popularly planted or retained in the home gardens and orchards include Neem (Azadrichta indica), Acacia albida, Tamarindus indica, Balanites aegyptiaca, Adansonia digitata, Prosopis juliflora, Parkinsonia aculeata. The home gardens and fruit orchards are well fenced and live-fencing species often seen include, Euphorbia terrucali, Lausonia inermis (henna), Ziziphus spina-christi, Acacia mellifera, etc. These live-fencing species and the large trees define the site and provide a micro-climate for the "gabraka" the home for growing many vegetables, such as tomato, onions, okra, carrots, and melons.

The economic value of growing horticultural crops (fruits and vegetables) is significant and Table 5 illustrates this. Current local (El Obeid) market and price for these horticultural products is good and it is expected to retain a high level of elasticity.

The expansion and further intensification of horticultural-based agroforestry intereventions which also includes fodder and browse (animal feed) production will, in the long run, make farmers to intensify their efforts on a small but well managed and productive unit of land instead of the current practice of using 30-50 feddan per farm family. The growing sweet potato and cassava both as food and livestock feed supplements must be encouraged by the project. The project should coordinate other donor-supported projects with similar components including WSARP, Global 2000 and the EEC.

Table 5 - Retail Price for Selected Commodities in El Obeid on May 14, 1987 (Planning Dept., El Obeid)

A. Fruits/Veg.	Unit/quantity	Price(LS)	Remark (Source)
Grape fruits	doz.	14.00	Local, from North
Mango	"	6.00	Local, from North
Orange	"	14.00	Local, from North
Banana	kg.	2.00	Same local, North
Taboli (Baobab)	2 sacks	300.00	local
Karkadeh (Hibiscus)		2.00	"
Ar 'ieb (Tamarind)	2 sacks	275.00	"
Girgeer (Erucca sativa)	-	0.25	"
Tomato	kg.	1.50	Local, North
Green Onions		0.25	" "
Okra	kg.	4.00	" "
Carrot	kg.	6.00	" "
Fodder (donkey feed)	camel load	10.00	" "

B. Agricultural Crops	2 sacks	
Millet	132.00	local
Sorghum	77.00	local
Simsim	264.00	local
Groundnut	90.00	local

C. Livestock/Products	Per Head	Per Kg.	
Camel	2,000.00	6.00	local
Cattle	1,000.00	8.00	local
Goats	200.00	10.00	local
Sheep	300.00	13.00	local
Chicken	15.00	-	local
Chicken eggs (dozen)		6.00	local
milk (liter)		2.50	local

The Recommended Interventions

The nursery center should make sure to have in stock those species for which there is farmers' interest to grow them such as fruit trees and fodder crops. The project should establish demonstration plots which will also serve as seed and planting material source. Table 6 gives the list of recommended species.

Training and demonstration as well as production and distribution of seedlings should be the principal aspect of the Central and Village Council nurseries and their respective demonstration plots. Budding and grafting techniques should be taught to selected village and extensionists and contact farmers. Pests and diseases should be closely monitored. The project should keep in mind that production and markets are closely linked and monitor supply and demand aspects.

The overall objective of this intervention is to provide additional diversity of valuable garden produce while inserting more effective environmental conservation and protection elements to the basic gardening operations (shade, organic matter, protection from wind and animals, etc.) The concept and practice of "trees in vegetable gardens" must be implanted in every and all villages and the stage for this is already in motion in the project area.

Table 6. Recommended Species for Horticulture and Home Gardens Interventions

Species	Intervention Sites			
	Garlud soils	Alluvial soils	Hill Catena	Cracking Clays
Acacia spp	X	X	X	
Acacia albida	X	X		
A. tortilis	X	X		
Adansonia digitata		X		
Cassia spectabilis	X	X		
Casmorea edulis	X	X	X	
Balanites aegyptiaca	X	X		
Carica papaya		X		
Cordocaxia edulis		X	X	
Citrus spp	X	X	X	
Azadirachta indica		X	X	
Hyphanae etbaica	X	X		
Lansonia inermis		X		
Leucaena spp.		X	X	
Manihot exulenta	X		X	
Mangifera indica		X	X	
Moringa oleifera	X	X	X	
Morus indica	X	X	X	
Prosopis spp		X	X	
Punica granatum		X	X	
Salvadora persica		X	X	
Sesbania spp		X	X	
Tamarindus indica		X	X	
Xemenia americana			X	X
Ptercelobium dulce		X	X	
Zizyphus mauritania		X	X	
Ziziphus spinachris i	X	X	X	X

2.3.5 Energy Conservation and Stoves Extension

General Statement:

A modest activity of improved stoves extension and mass awareness on wood energy conservation is considered essential and the facts from the field are stated in the subsequent sections below. This activity naturally supports both the Agroforestry and forestry efforts. In the case of the improved stoves extension, what the project is required is to facilitate stoves program of CARE and SREP in the 5 Rural Councils.

In the case of wood energy conservation, the project should raise people's awareness and what they could do individually, collectively and in partnership with GOS and the project. Such dialogues will facilitate and increase participation of the villages in the project's field and center-based activities.

Improved stoves:

The short-term benefit of improved stoves dissemination of both charcoal and wood burning stoves could be important nationally and within the project area. Firewood usage in the project area is significantly higher than that of charcoal. Firewood is still perceived as free and available. The amounts of firewood and charcoal sold in the villages are small. Wood cutting for local house construction and fencing is significantly high. Time and distance for wood collection is on the increase making the social costs high. Villagers in zone I spend more than 3 to 5 hours on wood collection and this burden is is falling more and more on women and children.

Improved charcoal "Jiko" stoves are now available at El Obeid, retailing at LS 20 each. A stove is reported to last for nine months and work at an energy saving efficiency of 29%. At such an efficiency the improved "Jiko" stove saves half the amount of charcoal used. A sack of charcoal retails at LS 10 in the project area. At current traditional charcoal production efficiency of 25%, it takes one stacked cubic meter of wood to produce 3.5 sacks of charcoal; i.e. a family's consumption for two months. In the low Rainfall Woodland Savannah which encompasses the project area, the annual increment is one cubic meter per feddan per annum. Hashab trees require some 20 years to reach their lowest gum yielding and maximum wood producing age. Thus, a family in the project area which uses 1.3 improved "Jikos" in a year, make a saving of 21 sacks, i.e. they spare a feddan woodland, recover the cost in 10 weeks and ultimately make a saving of LS 184. The overall saving in resource and actual money terms is more significant for the urban population on account of its higher charcoal consumption and the high prices paid. It is only through such effective conservation measures that current wood inbalance (fuelwood demand twice the sustainable yield) could be rectified and perhaps reversed.

The improved stoves extension will be initially centered within the 5 Rural Council Centres (RCC). The improved stoves will be demonstrated and sold at these centres. The weekly market places, the tea houses on the main roads and some social service centers will be used to demonstrate and sell these stoves.

190

Production of these stoves is based at the moment in El Obeid under a PRO Program. Should the demand for improved stoves within the project area be exceptionally high, then two of the RCCs Er Rahad and Hamadi should be allowed to develop training facilities, i.e. stoves trainee/demonstrator and stoves training workshop (workshed). Er Rahad is chosen on account of its population density, urbanization and being a trade center and a communication junction. Hamadi is an important tribal center and is accessible to the other Rural Councils in the project area.

Wood conservation

Wood for domestic uses is gradually becoming a significant problem to towns and large villages. It is estimated that a total of 12 million cubic meters (c.m.) of wood is consumed annually in Kordofan Region. Natural regeneration is being jeopardized by recurrent droughts such as that of 1983 and 1984, and intensive dry season range utilization especially by browse animals such as camels and goats, that eat up young tree/shrub seedlings and sapplings and strip down (stunt) mature trees/shrubs, thus preventing natural regeneration.

Wood cutting for local construction of houses, fencing and enclosures without wood treatment to prolong the service life of the wood against such wood destroyong agents as termites, wood borers and rot fungi, is considered a major cause of over-exploitation of woodlands and forests. Local industries such as oil mills (Er Rahad town), bakeries, brick-making and salt production together with service sector activities such as restaurants, tea houses, boarding houses, hospitals, prisons, consume considerable amounts of wood. For instance, one c.m. of wood costing LS 30 is used to fine 1000 bricks, and one camel load of wood (100 lbs.) costing LS 8 is used to produce 100 lbs of salt.

A general mass awareness campaign program and limited demonstration effort is needed to reduce consumption and demand. In as much as possible local authorities and leadership should be used to spearhead this campaign and education/extension effort. Villages, schools and urban centres should institute Arbor or Environment Day to climax the campaign. (Arbor Day is observed in El Obeid for the past 30 years and some other towns in Kordofan have started to follow suit.)

The project should prepare small tree seed packets for free issue to schools as well as formal or informal organizations as well as distributing posters and calendars, show documentary films and sponsor annual competition events as well as preparing material for Kordofan radio programs. The project should also consider sponsoring few study towns to illustrative and successful programs and projects within and outside Sudan for few and carefully selected community leaders drawn from teachers, local councils, farmers and nomadic tribal, chiefs. Women and children are more affected by woodfuel shortages and the associated environment degradation and the program must ensure to cater for those groups also.

Improved charcoal technologies

An action program is not envisaged at the beginning of the project, but as the project gets established, the experience of effective charcoal production and marketing under a highly organized entrepreneurship such as that in the Blue

Nile province should be followed as a model. The current and those planned, road improvements will facilitate this process.

5.0 FORESTRY EXTENSION

Given the present situation in the Sudan where extensive areas are being cleared of its woody vegetation, under one pretext or the other, with every passing day, there is no way that government efforts alone can match the rate of deforestation through reforestation. The task becomes particularly defficult in view of financial, technical, administrative and policy constraints. People's involvement and active participation is therefore of paramount significance in putting a halt to the processes of deforestation and desertification. The project area in southern Kordofan is no exception to the general situation of environmental degradation and fragility of the resource base. The only means of soliciting people's participation and involvement in natural resource rehabilitation efforts is through an effective extension program as proposed under this project. This program would aim at:

(a) Raising of awareness among the people about the significance of trees and forests as it effects their very existence; the role trees play in increasing and maintaining soil productivity, reversal of the process of desertification, protection from harshy climate and creation of an environment conducive to their socio-economic well-being.

(b) Provision of information on technical, economic, social, legal and institutional aspects of tree planting and woodland protection/management.

(c) Encouragement of active participation by villagers, farmers, and livestock owners in the process of planning, management and execution of rural forestry programs.

(d) Introduction of simplified forestry education which would address major issues such as deforestation, desertification, reforestation, agro-forestry, nursery development and management, fuel conservation, etc. at school, village, and Rural Council levels. This would provide the basis for management development and protection of local forest resources.

The extension program that aims at achieving the above stated objectives will most certainly be responsive to the needs and ideas of rural populations. The approach will be one of working from the village level up, using both male and female village extensions supported and village council extensionists for a group of villages and a hierarchy of staff through the Rural Council to the highest levels of project management. As stated earlier, an intensive training program is envisaged to offer training at all levels of extension staff. Training will be designed to suit the level of education and responsibility of extension staff.

The extension program will closely tie-in with the national level extension program that has been initiated in various parts of the country and is being extended to others. Further support to the extension program is expected through the World Bank's proposed forestry project, i.e., terms of establishment of natural and regional extension training centers, extension equipment, and further streamlining of the extension program.

4.0 TRAINING AND INSTITUTIONAL DEVELOPMENT

4.1 Staff Training

Agroforestry training programs are not available in the Regional and National Institutions as yet in the Sudan. Training material resource are not developed nor in place. The project on the other hand will need to hire a large number of trained agroforestry and forestry extension and training officers to manage the Rural and Village Council - based programs and provide technical services in the field.

On-the-job training can be given after the first set of field programs are developed and are in operation. The newly assigned project staff should work one or two months in the established programs before going to his/her post elsewhere in the project's other Rural Council Areas. But the project should plan on sending up to 15 Sudanese staff for intensive 5-week or shorter training to the USA and or Kenya and IITA (Ibdan, Nigeria) and at a later period, send up to 5, for degree programs. It is possible and is recommended that the universities in Sudan (Khartoum, Juba, etc.) participate in this degree program and the research part of the degree requirement be done on the project's field programs *. M.Sc. degree training in agroforestry in the US is possible at Texas A and I, University of Florida, University of Hawaii and Arizona. ICRAF is also arranging AF training (Degree) through its AFREMA Program in association with selected universities in Africa. This arrangement may be used to have some of the degree training.

4.2 Extension Training

During the early part of the project life, the project should deploy extension training specialists (consultants) to assist the El Obeid - based staff to mount short but intensive agroforestry extension training to the middle-level project extension staff as a program of training the trainers. The subject coverage should be based on the project's objectives and field programs along with extension techniques.

4.3 Institutional Development

The programs based on the 5 Rural Council areas are expected to perform as technical centers for the respective Rural Council where formal and informal practical trainings can be offered. The biotechnical data being generated will form the information base for these trainings and extension and technical services. In as much as possible, all technical information generated by the project should be processed to effectively service the training and extension efforts within the project area and be extended for others to benefit from. The training program will be planned and executed by the technical team based at El Obeid in conjunction with the 5 ACFs at each Rural Council. The training programs will be both subject (technical) and on extension techniques (development communications).

* The College of Forestry/Faculty of Agriculture have indicated their interest and willingness to participate in a student participation program, at MSC and Ph.D. level. 4 students would be awarded fellowships to work on specific research projects in the project area. The problems would be identified and approved through joint consultations between he project staff and Faculty of Agriculture.

The land and field level extension training will be for the selected men and women actively participating in the project activities as leaders and active members of the village agroforestry forestry committee on land adopters who are acting as demonstration sites or contact farmers. These extension trainings will be done by the Project staff and will be conducted in both Obeid and in one of the Rural Council Centers sites, Kasgail to combine both theory and hands-on training.

The cost of these trainings, both formal (degree) and non-formal are budgeted for and length of training period and number of trainees participant indicated.

The extension training within the project will receive high priority, as this will be the basic extension tool that will enable the project to plant the skills and knowledge that will have permanent root and will be self-generating. To make sure that the extension and training component is institutionalized at the lowest level of development unit, the village council, the project will build the needed technical facilities with village participation. Hence, traditional practices and new techniques will be hydridized to produce a new blend that will retain the best features of traditional landuses. In as much as possible, village-level activities will be based on self-help models with the project assisting to initiate and guide them during their formative stage.

5. Operation/Management and Evaluation of the Programs

5.1 Institutionalization of the Rural Councils

This project which, in part, is based on the recommendation of multi-donor team of the Forestry Sector Review led by the World Bank between 1984 to 1986, hopes to be fully complementary with plans of other donors and will in fact lay the ground work for increased and effective future donor efforts by improving the information base through the planned mapping and a forest inventory covering S. Kordofan and S. Darfur, (GOS' priority areas) and by developing and implementing replicable models for appropriate resource use.

The project choice of using the five Rural Councils (Kasgail, Hamadi, Dubeibat, Habiella and Er Rahad) as the project's delivery systems or institutions within the Regional Government is also within GOS' policy of development administration which aims at maximizing peoples' participation and decentralization of government services. The choice of these five Rural Councils as the initial project intervention sites is also appropriate because they include, and are the inter-active zones between nomads/transhumant and sedenterized/traditional agriculture as well as mechanized commerical farming whose economic and social relationship needs re-enforcement as well as their linkage with the nearby urban society and economies. The project area has recently undergone considerable pressure though not to the same extent as the areas further north. The envisaged intervention is thus timely and the multi-disciplinary efforts will be effective.

[illegible] Structure and Operational Relationships

The role of Rural Councils as instruments [illegible] and is at point [illegible] and is supported by the GoS current development policy [illegible] development programs as well as revenue collection [illegible] Rural Councils.

The field programs are stratified ranging from operational project headquarters at El Obeid, to wide range of programs at the Central Com[illegible] and program of Nursery and Demonstration in Village Councils (1000) which will serve 500 villages.

The village - level field program will largely be technical and limited material assistance to establish and operate a self-help nursery while the Rural Council Centers will have more activities housing all program components.

All field programs need to be preceded by a develoment and improvement of institutional infrastructures at all program levels. Water source and nursery, field store, perimeter fencing, land preparation, etc., need to receive early attention and the initial structures, must not be elaborate.

PLACES VISITED AND PERSONS CONTACTED BY PROJECT DESIGN TEAM

DATE A. KHARTOUM:

22/4/87 1. Sudan Survey Department

1.1 Mr. Moutasim El Tayeb, Aerial Photography

(+28.4.87) 1.2 Mr. Abd Alla Ahmed Mohammed, Tophography Section

22/4/87 2. National Remote Sensing Centre - NCR - U of K

1.1 Ismael Adam

1.2 Azhari El Fadil

22/4/87 3. Mechanized Farming Corporation (MFC)

1.1 Dr. Harbi, Acting Director General

1.2 Mr. Ali Ibrahim Khalil

(2/5/87) 1.3 Dr. Mohammed Osman M. Ibn Auf, Head, Planning Dept.

4. USAID

4.1 Dr. Hassan Mohammed Hassan, Director Regional Remote Sensing Centre - Nairobi

(12/5/87) 4.2 Mr. Abdel Rahman El Gurashi, Coordinator, Restocking of Gum Belt - El Obeid

26/4/87 5. Central Forests Administration (CFA)

5.1 Mr. Mohammed Hanafi Obeid, Acting Deputy Director, and Head Inventory, Reservation & Management Section

5.2 Dr. Hassan Monammed Hassan (4.1)

5.3 Mr. Ibrahim Gad Alla, Head Planning Section

(2/5/87) 5.4 Mr. Abbas Ballal, Deputy Director

26/4/87 7. Forestry Research Centre, (FRC), Soba (ARC)

7.1 Dr. Tagel Deen Hussein Nasroun, Director, FRC

30/4/87 8. Gum Arabic Company - GUMCO

8.1 Mr. El-Hag Mekki Awouda, Deputy Director

1/5/87 9. Mr. Ali El Tom, Consultant

2/5/87 10. Geography Dept., Faculty of Arts, U of K

10.1 Dr. Monammed Osman El Sammani, Geographer, Rural Development, Socio-economist, Regional Planner

2/5/87 11. Mr. Abul Gasim Seifed Din, Consultant

2/5/87 12. Khartoum Province, Agricultural Affairs

12.1 Dr. Farouk Ahmed Abd El Ghaffar, Director

12.2 Sid Ahmed Kheiri, Deputy Director

2/5/87 13. UNDP

13.1 Mr. J. Raquena, Program Officer

2/5/87 14. FAO's Fuelwood Project for Sudan - CFA

14.1 Mr. J. Ball, Project Manager

14.2 Mr. Ali Ahmed Saleem Project - Coordinator

197

3/5/87 15. USAID - Save the Children (working at Umm Ruwaba District)

15.1 Ms. Gameela Abd Alla Hamid

15.2 Ms. Amna Ahmed Mohammed Ali

15.3 Mr. Mohammed Ali Idris

B. EL OBEID

4/5/87 1. CARE - El Obeid

1.1 Ms. Pata, AGroforestry

(6/5/87) 1.2 Mr. Khalid Roy, Head Stoves Extension Project

1.3 Mr. El Mahi Abbakar, Assistant Stoves Ext. Project

4/5/87 2. Government Secretariat

2.1 H.E. Mohammed Ali El Mardi, Governor, Kordofan Region

2.2 Mr. Zein El Abdin El Hag, Acting Secretary General to the Regional Government

5/5/87 3. Er Rahad Restocking of Gum Belt(RGB)/Nursery

3.1 Mr. Osman Babiker, ACF

5/5/87 4. Jebel Care - Residence

Enumerators assisting Rural - Sociologist of Project Design Team

4.1 Mr. Mohammed Hussein, ACF - El Obeid (UNICEF Women's Nurseries Project)

4.2 Mr. Saad Khalafalla, ACF (RGB)

4.3 Ms. Hijra Rahama Babiker, Extensionist Regional, MOA

4.4 Gamal Abd El Samad, ACF (EEC-WN)

4.5 Hajiz El Amin Range & Pasture Administration

148

6/5/87 5. Kazgail - Sheikan R.C.

5.1 Mr. Hassan Mohammed Ali Zereiba, Administrative Officer (AO)

5.2 Ismael Abd El Tam, Head Accountant

6/5/87 6. Ed Dubeibat R.C.

6.1 Abd El Aziz Gism Alla, AO

6.2 Abu Zeid Abd El Gadir, Head Clerk

6.3 Mohammed Adam Younis, Forest Ranger

7/5/87 7. Government Secretariat

7.1 Mr. Ali Gamma Abd Alla, Secretary General, Kordofan Region Government

7.2 Mr. Abd Alla El Tom - Head Nomadic Administration

7/5/87 8. Forests Administration (FA)

8.1 Abd El hameed Ibrahim M. Madibbu, Director Regional FA

7/5/87 9. Regional Ministry of Agriculture (RMOA)

9.1. Mr. Abul Gasim Ali Abul Gasim, Director General

9.2 Mr. Ahmed Ali Obeid Alla, Director Services and Horticulture

(9/5/87)

9.3 Mr. Bakheit Mohammed Nusa, Head Field Affairs

9.4 Mr. Mohammed Ali Mansour, Director Extension

9.5 Mr. Abd El Hameed I.M. Madibbu, Director FA (8.1)

9.6 Mr. Khalid Abd Alla Shams, Director Natural Resources

(9/5/87) 9.7 Mr. Ali Omer, Head, Range & Pasture Dept.

9/5/87 10. WESARP

10.1 Dr. Osman Adam, Researcher Horticulture (veg.)

10.2 Mr. Mohammed Mukhtar, Researcher Forestry

9/5/87 11. El Obeid Crop Market

11.1 Mr. Fath El Rahman Awad El Karim, Market A.O.

10/5/87 12. Planning Admin., Regional Ministry, Finance & E. Planning

12.1 Mr. Ismael El Rahil, Director

12.2 Abdalla A. Hamdook. Deputy Director

10/5/87 13. Rural Water Corporation

13.1 El Hadi Mohammed Adam, Executive Manager, North Kordofan

10/5/87 14. Restocking Gum Belt Project (UNDP)

14.1 Mr. Mahmoud Hirad Admin., Proc. Officer

14.2 Mr. Abd Alla Mohammed El Hassan, Admin. Officer

11/5/87 15. District Council (D.C.) H.Q. - Dilling

15.1 Mr. Abd Alla Idris, Executive Officer, Dilling D.C.

11/5/87 16. MFC Habeilla

16.1 Mr. Babiker Mohammed Ibrahim, Regional Director

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX D-3

SOCIAL SOUNDNESS ANALYSIS

KHARTOUM
JULY 1987

UNCLASSIFIED

201

Social Soundness Analysis

A. Sociocultural Context

1. Introduction

Natural resource development projects in Southern Kordofan have not met the expectations of the sponsors in terms of their achievements because little attention has been given to people's views of relevant development. Consequently it is recognized that the social acceptability of rurally based projects is necessary to ensure success and sustainability.

In the development of this project a socioeconomic survey was undertaken which has been used in the design of the resource rehabilitation component. Although time prevented the tabulation and analysis of all the information, this will be done and the survey will provide baseline information to assess the impact of the project. In preparation for the survey, the following steps were undertaken:

a) collection of basic data on the population, culture and economy from existing literature on the project area.

b) a preparatory 3 day visit to the project area to determine sampling size and procedures, and to make contact with officials and communities. During this visit ennumerators were nominated among government forestry staff and they were briefed about the nature of their assignment. Potential sample villages were identified and the questionnaire layout was generally decided upon.

Based on the first visit and time available, interviews were conducted with 150 heads of household from a stratified sample of five villages. Because of the role of women in the economy a female respondent was selected from each sampled village. A female ennumerator was recruited specifically for this purpose. A few transhumants and mechanized farmers were also interviewed.

Because of time limitation, data from about 100 respondents were processed manually, checked and cross-checked with the field observation and group interview results. A report of the results is available from USAID/Khartoum. The findings serve as a basis for this social soundness analysis.

2. Demographic Landscape

The five rural councils which will be covered by the project comprised about 219,594 persons in 1983. With a natural increase of 2.8% annually the population is about 250,000 persons in 1987. The area is crossed bi-annually by a large number of nomads in their north-south movement. The 1983 population of the project area is shown in Table 1.

Table 1: Project Area Population By Rural Councils 1983

Census Code	Rural Council	Total Population	Urban Settled	Rural	Nomads
201	Ed Debeibat	29519	-	29519	-
202	El Hamadi	15861	-	15861	-
203	Habila	40573	-	36652	3921
350	Er Rahad Town	16341	16341	-	-
301	Er Rahad Rural	91210	-	85309	5901
404	Kazgail	26090	-	26090	-
TOTAL		219594	16341	193431	9822

Source: Sudan-Department of Statistics, 1983 Census Preliminary Results.

The population of the five rural councils is mostly settled (88% are settled rural and urban dwellers). The urban and nomadic population account for 7.4% and 4.6% respectively. The area covered by the five rural councils represents one of the heavily populated areas of Southern Kordofan Province: 17% of the province's total population and 20% of its total rural settled and nomadic people. Settlement has been stimulated recently by improved availability of water and by fairly good, cultivable land. In normal periods the average annual rainfall of 400-500 mms is adequate for producing a range of crops and trees. As a result, there is an increase in landuse intensity, a decrease in fallow periods, and clearance of the vegetative cover for cropland.

The pattern of settlement and hence landuse intensity varies between the five rural councils. This is indicated by the number of village councils and

villages and their sizes (Table 2).

Table 2 - Settlement and Village Distribution By Rural Councils - 1987

Rural Council	Number of Village Councils	Total No. of Villages	Average Pop. of each Village
Ed Debeibat	6	121	240
El Hamadi	8	80	198
Habila	6	43	943
Er Rahad	280	280	315
Kazgail	23	103	253
TOTAL	313	627	389

Source: Field Survey - May 1987

In the project area the family size is typical of settled rural communities in the Sudan: an average of 6-7 people. The ratio of young and old persons is high, leading to a high dependency ratio.

The education level among adult villagers is low. About 32% of the survey respondents have no schooling, while 27% have Quramic School education. Among the female population illiteracy is even higher. Some 13% of the sample had intermediate schooling and 10% a post intermediate school education. The level of education for both sexes is higher among the youth.

The population of the five rural councils has a high level of tribal complexity, yet it does not show a parallel sharp ethnic complexity as expected. The tribe rarely signifies ethnic identity, but a type of group identification and association. Ethnic isolation does not exist and most of the villages are melting pots of many tribes. However, in the case of recent migrants from Chad, tribal, ethnic and cultural boundaries tend to be sharp. The nomads represent the most isolated community: their contact with the settled population is casual and limited.

The ethnic and tribal pluralism is diluted by a common Islamic culture and the strong affiliation of almost all inhabitants with the current ruling Mahadest religious sect. This harmony in culture is manifested in cross-tribal self help committees, village councils, and other local organizations.

2. Economy and Land Use Systems

The increasing population pressure on land suitable for cultivation and grazing has led to a decline in the traditional system of crop rotation and a long fallow period. In addition land fragmentation has increased due to land pressure and the Islamic law of inheritance. As a result the fragile Goz soils upon which crops are grown have declined in soil fertility. People are now shifting to use clay pockets within the Khor Abu Habil stream and loamy soils, when available. The population is increasingly vulnerable to drought. Tree products, especially gum arabic which used to provide a reasonable income, are no longer making much of a contribution to household incomes because most were cut down during the drought of 1984 when woodfuel and wood were the prime source of income enabling families to purchase food.

The traditional farming economy contains a broad spectrum of diversification, ranging from pure crop production along a mix of emphasis between crop production, livestock and trees. The lack of a clear marketing and pricing policy by the government subjects people to highly unpredictable prices and demand. With the unpredictable situation of the physical environment, prices and policies, households rarely succeed in satisfying their basic needs. Hence, needs are changing in quantity and quality. Aspirations vary from subminimal requirements to adequate ones.

The baseline survey indicates that a significant proportion of the families are not producing enough to meet their food requirements. Families average 3 -4 sacks of grain per mokhansas (about 2.0 acres). The average size family requires 5 sacks per year and this was secured in 1986/87 by only 73% of the sample. The relatively favorable price for cash crops combined with food relief programs seems to have contributed to many farmers allocating more land and labor to cash crops, e.g. groundnuts, sesame and karkadi. Forests and areas of woody vegetation that provided supplimental food, fuelwood, fodder, etc., have been cleared for agricultural production which is often practiced on a unsustainable basis, particularly on large scale mechanized farms.

In such an unpredictable situation, many households have members, usually men, who migrate seasonally for work. Crop production, the most precarious of the economic activities, tends to be allocated to women.

Two important land use types of a purely commercial nature have recently been established in the project area which provide limited and mostly seasonal job opportunities. These are (i) the highly intensive fruit or vegetable gardening along the Khor Abu Habila stream and (ii) the highly extensive mechanized farming which is mostly concentrated in Habilla Rural Council.

Mechanized farmers represent a distinct urban-based rich people elite. They tend to have a minimum attachment to the land and regard for its future productivity. Over 75% of the people with mechanized farms in Habila are from El Obeid, Dueim, Bara, Kadugli and Dilling. Being concentrated on clays, these large farms present little competition to landuse on the Goz. The problem is that the Goz soil is overused and the clay soil is the only option for expansion to secure land for agroforestry and forestry ventures and the expanding traditional farming population.

B. Sociocultural Feasibility

1. Planning Based on Resource Inventory

The project includes funds for measuring and evaluating the forestry resource base. The information is expected to be used for planning and managing the forests as well as monitoring conditions over time. In the interpretation of the data it is essential that people and trees are viewed as integral parts of a unified system. The actual situation can only be understood and thus appropriate plans devised if cause can be distinguished from effect. That is, some of the local conditions may be a response to socioeconomic forces in general, while others may originate from within the area.

The Monitoring and Evaluation Section of the project will provided household level data to forestry department planners to complement that obtained in the resource inventory and may be called upon to help in the interpretation. The head of the section may also advise on a small number of critical human indicators that should be incorporated into the monitoring system of the resource inventory.

It should be remembered that the meaning of an indicator is often the function of the values and objectives of the interpreter. If applicable and implementable plans are to be devised, it is important that the perspective of different categories of land users is clearly understood and taken into account.

2. Perception of Trees and the Natural Resource Base

While trees and woody vegetation have always been part of the local landscape and played an important economic role, little time and labor had to go into maintaining this base. The basic belief was that the tree was a gift from God and He replaced and maintained it. This gift provided food, fodder, and fuel for the household economy and some products like gum had a cash market. Both land pressure and the serious effects of the 1984 drought have led to a greater appreciation of trees since during the drought woodfuel and

poles provided income for numerous families in a critical financial state. The current very high price for gum arabic has created a demand for seedlings. Moreover, people have begun to realize that they have a role to play in conserving the trees.

During the baseline survey respondents were asked about their reaction to the suggestion of the project focusing on the interplanting of trees with crops. There was a high level of acceptance. This type of agroforestry configuration is not new to them and they know that a pure crop stand has been ineffective in producing sustainable yields. The majority of respondents are convinced that the soil has been overused and its recovery is only possible through a system of agroforestry. The possibility of access to seedlings is welcomed since growth from the traditional method of natural regeneration is slow. Also, respondents are quite aware of the declining area of forest stands since it affects their domestic economy.

Table 3 Perception of Tree and Forest
What the Tree and Forest Mean to You?

	Response	No. of Respond.	% of Total Respondents
1.	Source for multiple domestic uses	36	37.2
2.	Source of supplementary cash from sell of woodfuel and other by-products	32	
3.	Source of cash but not so valuable as crops or livestock	7	7.2
4.	Beauty of landscape and pleasant to have around	2	2.1
5.	Source of cash from Gum Arabic with minimum effort	10	10.3
6.	Valuable for restoring soil fertility	8	8.2
7.	Control of desert expansion	9	9.3
8.	All above	18	18.6
		97	100.0

Source: Field Survey - May 1987

About 60 percent of the interviewees report having recently planted a tree. About half of them planted this year, while most the others did last year. This planting is a result of the GOS effort to focus on acacia senegal, fruit trees and shade trees. The responses show a high demand for seedlings. The project is designed to focus on meeting this demand, disaggregated by sex and farming system.

3. Economic Incentives

The initial reaction of farmers in the project area indicates that there is an unmet demand for seedlings, especially acacia senegal. This demand must be placed within the current context of the high price for gum arabic but also the other benefits such as soil fertility and fodder. (The pods from acacia senegal are used to feed goats.) In spite of the initial interest, the project needs to understand more about the gum arabic marketing system in the project area. Research in Darfur Province and other parts of the country have revealed that there are severe constraints which make production uneconomical among the poorer strata of traditional small farmers. Because of seasonal cash constraints farmers often have to rely on the costly sheil stem to meet domestic needs. Under the sheil system, private loans in terms of cash, goods or water from village merchants or intermediate traders are made to farmers, tied to payment in gum arabic or another crop. Because farmers who resort to the sheil system have no bargaining position they receive very low prices for their crop. Even if not involved in the sheil system, small producers usually sell to traders within the village and the producer prices offered vary substantially. Moreover, taxes and cesses may be levied at the producer level. Thus, many factors enter into the question of the profitability of producing gum arabic. The Monitoring and Evaluation Officer will ensure that the system operating in the project area is well understood and monitored. During the project evaluations an economic analysis will be done to help determine in which geographic areas and to what extent the project should focus on acacia senegal, expecially taking into account the economic profitability at the producer level.

Woodfuel is increasing in cost in terms of cash, time and effort. Although rural households usually rely on fuelwood as their main source of cooking fuel, most supplement this with charcoal. In the baseline village a sack of charcoal costs about LS 15-20 compared with less than LS 10 prior to 1984. Most households use at least one sack a month. In terms of walking distance to the main source of fuelwood, some 40 percent of the respondents report that it is over one km, whereas before the drought only about 13 percent had to go this far.

4. Land and Tree Tenure

During the baseline study farmers expressed concern over the availability of land for tree planting and the rights to land and trees planted. Table 4 shows the average area of land cultivated per family.

Table (4) - Average Area of Cultivable Land/Family in Marchamas (1.8 Feddan)

Area	1987 No. of respondents	%	Prior to 1984	No.R.	%
Less than 5	10	31.3		5	16.6
6-10	5	15.6		5	16.6
11-15	5	15.6		-	-
16-20	7	21.9		13	43.5
21-25	5	15.6		7	23.3
TOTAL	32	100.0		30	100.0

Source: Field Survey - May 1987

In general, land in the project area can be classified into three categories: a) privately held and controlled, such as mechanized farms, b) state land, such as gazetted forests, and c) communal authority land. In the latter, it is the local traditional leader, the sheik, who has authority to allocate land which is unclaimed and unused. Land once claimed and used by a family can be inherited.

The baseline study because it focused on landholders does not reveal any sharecroppers or landless rural village dwellers. However, discussions in the area did indicate that renting, sharecropping and landlesses prevail but the extent is unknown. Among those interviewed most had inherited their land, and a few (10%) had recently been permitted by the sheik to clear a plot. The structure of the population in terms of rights to land will be one of the main points covered in a rapid reconnaissance which will be conducted in each village initially designated by the project as one to receive intensive coverage from a Village Council Extensionist. If the land ownership structure is highly skewed so that the distribution of benefits from the agroforestry activity would be highly inequitable, the village will not be included as a participating village.

A woman may inherit a small parcel of land from her father. Upon marriage a woman is usually allocated a plot of land at her marital homestead upon which she is expected to produce food for the household but may also have a small piece dedicated to a cash crop over which she controls the earnings. In Northern Kordofan research has revealed that the men's plots are dedicated to production of crops for sale and although women and other family members labor on these fields the men control the income from them.

The actual situation of women in the project area needs to be determined in terms of land and tree rights. Do they have parcels of land which they control? If so, if they plant trees on these what rights and control do they have over the tree and its product? What rights to trees do they have on land controlled by other household members? These types of questions will be covered in the rapid reconnaissance of each proposed participant village for the agroforestry activity and investigated later in more detail.

During the baseline survey the reservations expressed about agroforestry centered primarily on land scarcity, land rights and maintenance of ownership of plots. The land and tree rights must be clearly stipulated and agreed upon within each village which participates in the agroforestry, as well as the participatory forestry management activity before project activities are implemented since if this is not done the activities have little chance of success.

5. Mechanized Farms

Mechanized farming in the project area and Sudan in general, contributes to accelerating the rate of soil erosion and represents a real danger to existing forests and woody vegetation. In Habilla Rural Council alone one million feddan are under mechanized farming and an additional one half million feddan are slated to be placed under mechanized farming within southern Kordofan. Mechanized farming presents a major blockage to developing and implementing a proper land use policy within the region. While there are regulations which mitigate against the destructive aspect, the crucial problem is the lack of willpower to enforce the existing regulations. The owners themselves are interested in short term profits and usually have no commitment to the land beyond this. When returns decline as a result of of soil degradation, they move to another area, either registered or unregistered, clear the land and begin operations there.

Mechanized farming began in the 1950s in Eastern Sudan and has spread to other good farming areas. The intent was the production of grain at low prices and utilization of the clay soils for large scale production. Land is leased by government in plots of 1000-1500 feddans to individuals or firms. The leasers are provided with access to credit, other important facilities and commodities. While the leaser obtains a long term lease he is to renew his license annually. Fees are minimal. Regulations exist which state proper crop rotation, the establishment of shelter belts and crop choice, but these have never been observed. The main factor preventing enforcement is the political and financial power of those who lease the farms. In fact a large proportion of the farms are not even registered and licensed, but these are recognized in that the holder has access to credit and other benefits through the Mechanized Farming Corporation (MFC).

Control and regulation of mechanized farms is beyond the regional government's power. Mechanized farming is centrally administered from the Mechanized Farming Corporation in Khartoum. In the project area the MFC officer in Habilla Rural Council has recently stated that the annual license cannot be renewed unless the leaser agrees to undertake the planting of a shelter belt. None have abided by this. In an effort to stimulate planting in Habilla, acacia senegal seeds were distributed to mechanized farms in the 1985/86 season for shelter belts, but in no case was planting reported. It should be noted however, that many of the farms are managed by a representative of a firm or by a hired manager who does not have the power to decide.

Thus, under the project attention must be given to ways to stop the destructive use of land in the project area. Consideration will be given to:

a) the forestry department gazetting areas which are suitable for planting forests and to protect existing stands of trees

b) USAID policy dialogue with GOS including attention to revision of laws pertaining to mechanized farming and mechanisms for enforcement of regulations

c) assistance to the local mechanized farming corporation office in the project area to enable it to monitor farms and enforce regulations, and

d) extension activities, e.g. seminars, aimed at the holders of the farms.

The resource inventory maps should be used to help the regional government and local mechanized farming corporation office to determine the extent of regulated and unregulated mechanized farming in the area.

6. Local Organization

As discussed in the section on Sociocultural Context, there are numerous villages within the project area. Although these tend to be heterogeneous in terms of tribe and ethnic affiliation, the degree of cooperation is relatively good. It is primarily the newcomers and nomads who are on the fringes of local society. The village community tends to be held together politically by the sheik who holds a hereditary position that resides within the senior extended family of the claimants to the area. The sheik is powerful since he has rights to allocate unclaimed land. He is the tribal leader of the senior group and hence political leader of the entire village. In many cases he is also the religious leader. In the baseline survey the majority of respondents considered the sheik as the best channel for approaching the community in regards to development activities and mobilization of the people. They did not rule out the use of the village council as a voluntary parliament which in most cases functions closely with the village sheik. They also stated that

there is a role to be played by the educated elites since they can better understand the language of government officials and can be effective in pressing matters upwards through administrative channels.

The village council consists of men selected by their respective village. In the case of a large ethnically diverse village, members are selected to represent the different tribes. The village council is endorse by the rural council as the representative body of a group of villages or one village. The functions of the village council are not clearly defined by any standard regulations. They range from securing rationed commodities to settling disputes, organizing self-help activities and discussing problems. It is a voluntary organization which provides a link between the rural council and its people. Its influence and power are determined by its honesty and effective performance in village matters. A village council may collect funds for self-help activities and is accountable for these. Also, it may appoint special self-help committees, such as water supply and education. The life of such a committee terminates upon completion of the specific assignment.

Because of the prevailing village level organization, it is reasonable to anticipate that the necessary level of self-help contributions and managment will be forthcoming for the agroforestry activity and the participatory forestry management activity, if they provide an adequate economic return to the villagers. The process for selecting participating villages, however, will include a rapid reconnaissance of those villages slated for involvement. The reconnaissance will include obtaining information on previous self-help efforts to determine the organizational strength in the village.

7. Participation

During the baseline survey respondents expressed a willingness to practice agroforestry and participate in this part of the project. (Participatory forestry management was not discussed with them.) The type of participation mentioned is shown in Table 5.

Table 5 - Forms of Cooperation

	No. of Respondents	%
1. Cash and manual effort	10	18.5
2. Abide by any set regulations and advises	14	25.9
3. Help in organization and extension	14	25.9
4. All above	16	29.7
	54	100.0

Source: Field Survey, May 1987

Moreover, more than three fourths stated that the people should be responsible for the activity, with technical help initially from the government. Two aspects of this are important: the anticipated benefits and the general view of the Forestry Department. If direct economic benefits are not forthcoming in the agroforestry and the participatory forestry management activities, then participation can be expected to falter and stop.

It is important to note that the local people tend to view the forestry department as interested in protecting trees vis a vis the local people. Based on previous experience, this general suspicion makes it even more essential for the project to use written formal agreements which specify the responsibilities, rights and obligations of the forestry department and the village or group that will participate. It is essential that both the agroforestry and participate forestry activities utilize written agreements. The agreement will include terms which will facilitate the financial sustainability of the activity. Many of the details on how things will be done will be left to the local entity but project personnel need to help ensure that these are reasonable and sustainable.

An added benefit will be reaped by some villages in terms of improved access to water since the nurseries must have an adequate supply. Especially during the dry season people are accustomed to buying water and hence the well could provide an added source of income. In villages where the purchase of water is tied to the sheil system in exchange for gum arabic, it is worth pilot testing the provision of water on credit from the project well.

In regards to the participation of women, the men interviewed generally agree that women could be very active and effective if they had the chance to receive extension advise and had a defined role. This reaction is due to the predominant role of women in agricultural operations. Women's participation in nurseries, community foresty and activities related to fuelwood supply is expected. However, care should be taken to avoid them doing all the work while the direct benefits, especially financial, will be mainly reaped by the men or community at large.

Because of social norms when women attend meetings with men, they do not speak out or if they do what is said is filtered through social expectations. For this reason, the project will promote special women's groups and committees so that women's views can be adequately expressed and that women have a say in project activities. Combined with this, female village extensionists will be recruited and trained to work with women.

8. Village Council Extensionists

The project point of interaction with farmers and villages will be the Village Council Extensionists. It is essential that the person have good rapport and be respected by those he/she is expected to serve. Since most of the full-time farmers in the area are women, a female would be better able to work with them. During the initial contact session with each participating village, the responsibilities of the Extensionists will be explained and reasons for preferring women in this job discussed. The criteria for selection will be explained and suitable members of the community urged to apply to the project office. The criteria should be: a member of the community to be served; at least 25 years old; experience in self help, cooperative or similar group activities (preferably as a leader); literacy; a good farmer; and acceptable to the village/community. While the project will select the person from among eligible candidates, the respective village women's group or village council should be requested to endorse the selected candidate.

Literacy will not be required for female workers since normally only younger women have had an education, but because of their age they would not be respected as an extension worker. For the illiterate female extensionists , a younger woman will be hired to assist in the reporting and monitoring tasks.

C. Beneficiaries and Benefit Incidence

A range of organizations and people will receive direct benefits from the project. The agroforestry and forest management activities will be implemented in five rural councils. Two hundred villages are expected to be actively involved in the agroforestry activity. These villages will have improved access to seedlings or seeds and to extension advise. As a result approximately 60 percent of the household (or roughly 7,00 households) are expected to receive a significant level of benefits from adopting agroforestry practices. These benefits will be in the form of improved soil fertility as a result of conservation of the soil and the addition of organic matter and nitrogen, an increase in the supply of forest products such as fodder, fuelwood and poles; an increase in cash income from the production of gum arabic and horticultural products; and an increase in the supply of food, such as fruits and vegetable, for domestic consumption. At least 50 percent of the farmers utilizing improved agroforestry practices and directly benefitting from these will be women.

In addition approximately 30 villages are expected to be involved in the management of newly designated community forests. They will receive technical advise and access to seeds or seedlings. Their participation in the management of community forests will result in access to forest products, and a decrease in soil erosion. The community as a unit may receive revenue from the sale of wood. Also small groups and individual may benefit from management of private forests. From these they will receive cash from the sale of products.

Through improved management of forests people in towns, cities and even outside the project site will indirectly benefit from availability of woodfuel and poles and from a decrease in soil erosion.

Approximately 120 people from the five rural council areas will be employed under the project. Half of these should be women. They will benefit not only from a cash income but also on the job and special training. Furthermore, GOS personnel will receive special training for the work they will undertake in the rehabilitation component. Approximately 20 of these officers will also receive short term, out of country training.

Under the resource inventory component, six people will receive short term, out of country training and an additional 20 people will participate in training workshops held in the Sudan. As a result these people will enhance their capacity in remote sensing and forest inventory techniques which should increase the demand for their services. In addition some of these people will be hired under the project to undertake specific tasks.

The anticipated users of the resource inventory are various central and regional government organizations. The Central Forest Department as the principal beneficiary will have base maps and specific forestry information from which to develop management and rehabilitation plans and to monitor forest resources. The base maps and the resource inventory data are expected to be utilized by the Relief and Rehabilitation commission to identify and rehabilitate desertified areas. The extent that these and other organizations use the information for policy formulation, planning and program/project implementation, rural farmers in southern Kordofan and southern Darfur will be the indirect beneficiaries.

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX D-4

ECONOMIC AND FINANCIAL ANALYSIS

KHARTOUM
JULY 1987

UNCLASSIFIED

216

SUMMARY OF ECONOMIC AND FINANCIAL ANALYSIS

Deforestation in the Sudan, as in other countries of Sub-Saharan Africa is a problem which now threatens the already precarious subsistance of a large proportion of rural populations. This "other energy crisis" antecedes the petroleum based energy crisis of the 70's and is far more menacing in its implications. Trees are multipurpose commodities, the progressive loss of which is undercutting the productive base upon which rural economic activities depend.

Trees are useful to human beings in two ways: direct - as producers of a wide variety of goods, commonly called "forest products"' and indirect - as custodians of favorable environmental conditions. Both are indisputably essential to the well-being, indeed to the survival, of mankind.

Although it is rather easy to measure the direct benefits of reforestation, the investments and the products being quantifiable, it is not so easy to measure the indirect benefits as these benefits are not directly quantifiable, particularly within the scope of a discrete forestry project.

These indirect benefits are referred to as "externalities" and may include one or more of the following:

1. Reduced soil erosion.
2. Reduced siltation of reservoirs and increased life of dams and hydro-electric power plants.
3. Increased navigability of streams, rivers and increased irrigation potential.
4. Reduction in the loss of biological diversity and protection of wildlife.
5. Reduction in soil compaction, increased microbial activity and enhancement of soil fertility.
6. Availability of increased animal fodder for pastoralists.
7. Elimination of population displacement that would result because of environmental degradation.
8. Reversal of the processes leading to desertification.
9. Increase in soil productivity through improvement in physical, chemical and biological properties of soil.

They are called externalities because they are not directly recoverable project outputs and, unlike the direct benefits, do not accrue to any specific individual or a group. It may be stated here that not all of these indirect benefits will occur in a given location. In the project area, however, items listed under 1, 5, 6, 7, 8 and 9 will apply.

The approach, therefore, used for the economic analysis of this project has been to use methodologies to suit various components and rely as far as possible on measurable outputs. Where such measurable outputs do not exist (Resource Inventory), the analysis of possible options has been done to arrive at the least cost option.

It may be reiterated here that, while evaluating the economic analysis of this project, one must not lose sight of the indirect benefits that accrue to the society, as has been discussed earlier.

Resource Inventory Component

In order to identify and assess forestry resources in the project area, and southern Kordofan and southern Darfur, this project will use satellite (Landsat) data to create base maps and forest resource maps on a 1:250,000 scale. These maps are essential intermediate stage output, necessary in formulating and implementing the resource rehabilitation component of the project. However, this output will benefit not only this project but also any other projects in the region covered by this exercise. Since this output has significant spill-over benefits which are difficult to quantify, the economic analysis of the resource inventory component of the project is carried out separately from that of resource rehabilitation component. Economic analysis is performed to select the least-cost design among alternative options.

Three alternative options can be employed to obtain the maps and data as called for under the project.

Each of these options is discussed below:

Option 1: Under this option, satellite imagery will be the primary tool for the mapping exercise. Data and imagery will be used for development of base maps, initial stratification for vegetation mapping, and after testing the validity of stratification through aerial photography and ground checks, it will form the basis for final analysis. This option also involves high resolution, large scale aerial photography for sub-stratification, covering 10% of the area and ground surveys for inventory. The ground surveys will be carried out over an area of 0.1% of the total project area. This is a 3-tiered methodology that has successfully been employed for mapping and vegetation inventory. The estimated expenditure for this option is likely to be $3.0 million and LS 5.0 million. This amounts to approximately 17 cents per hectare, assuming most of the imagery is available and already procured.

Option 2. This option will require a synoptic aerial photo coverage of the entire project area, approximately 25.0 million hectares. Besides, the high resolution large scale aerial photography over 10% of the area, 0.1% ground survey, as required under Option 1, shall also have to be carried out. Estimated expenditure for this option exceeds the estimate for Option 1, as included in the following Table, by about 1.5 million, costing about $0.22 per hectare. These estimates are for black and white photography as against color prints obtainable under Option 1.

Option 3. Under this option, the entire area will need to be ground surveyed. Using a sampling intensity of 2.0%, 1/50th of the areas will need to be physically traversed and measured. A party of surveyors consisting of 8-10 persons can cover 20 feddans or approximately 8 ha. each day. For 2.0% of 25 million ha. - i.e. 0.5 million ha., it will take 62,500 party days for completion. Assuming 10 parties working simultaneously and 150 work days in a year (in view of rainy season) it will take over 40 years to complete the ground survey.

It is obvious that Option 1 is the least cost option and must be adopted, not only because it is economically feasible, but also on account of its being fast, efficient and its ability to produce results that are qualitatively far superior.

Resource Rehabilitation Component

1.0 Introduction

Financial and Economic Analysis were carried out for four models under the Resource Rehabilitation component. These four models are as follows:

1. Improved Traditional Bush Fallow
2. Mixed Tree Alley Cropping
3. Participatory/Social Forestry
4. Natural Woodland Management

For each model, the net benefits of intervention are calculated on a yearly basis over a period of 30 years. The project cost is based on the USAID and GOS contributions and are spread over the first 6 years of the project. The benefit/cost ratio is computed for discount rates of 2.5%, 5%, and 8%, by dividing the present value of benefits by the present value of the project cost. In addition, the financial and economic rates of return, i.e., the rates at which the present value of benefits equals the present value of costs are calculated for each model.

2.0 Financial versus Economic Analysis

The purpose of financial analysis is to ensure that project activities can be paid for and to determine the profitability of the project from the standpoint of an individual or public for whose benefit the project is undertaken. Economic analysis is concerned with the social profitability of the project, i.e., the relationship of the costs incurred and the benefits obtained by the society as a whole.

For the purpose of calculating returns, financial analysis considers the return to the family labor, whereas in the economic analysis return to the nation as a result of cash crop export is the focus of attention. Thus, returns from sesame and groundnuts, as well as gum arabic are much higher in the economic analysis than in the financial analysis case. Accordingly, marketing and other costs associated with exporting the products are included in the economic analysis but do not appear in the financial analysis.

In the calculation of project cost, financial analysis is based on the USAID contribution component converted at the "bank rate" of LS.4.1/$, versus the opportunity exchange rate of LS.6/$ used for the economic analysis.

3.0 Estimation of Costs and Benefits

3.1 Existing Cropping System

Agroforestry, i.e. models 1,2 and 3, is intended to replace the currently practiced cropping system. The latter consists of cultivating the land for

several consecutive years without fallow and thereby contributing to the deterioration of soil productivity over the years. When the crop yield falls below an economic level for the farmer - after 7 to 10 years - the land is abandoned and a different lot is cultivated.

To estimate the return to family labor, net returns from sorghum, millet, sesame, and groundnuts are calculated on per feddan basis, assuming a declining crop yield over a 10 year period. For the purpose of yearly yield and return calculations, a 10 year cropping-10 year fallow cycle is assumed. Thus, the crop yields are at their highest levels for years 1, 11, and 21, but gradually decline at an average drop rate of between 1.8% (groundnuts) and 4.6% (millet) over a 10 year period. In addition, there is a return from fueldwood in years 10, 20 and 30 based on a relatively low growth rate of 0.1 cubic meter per feddan per year.

3.2 Improved Traditional Bush Fallow

This model is based on a 5 year cropping - 20 year fallow cycle. For a total area of 25,000 feddans, this translates to an area of 5,000 feddans being under crops and 20,000 feddans under fallow/trees at any point in time.

3.3 Mixed Tree Alley Cropping

This model is based on 80% cropping (20,000 feddans), plus 20% trees (5,000 feddans). As for the traditional bush fallow model, total return from trees and crops is compared to the return of the existing cropping system and the net benefits are calculated for the 30 year period.

3.4. Participatory/Social Forestry (Gum Arabic)

This model has two components: 1) direct seeding of Acacia senegal in an area of 15,000 feddans; and 2) tree planting in 10,000 feddans. In both cases the final tree density is assumed at 200 trees per feddan. Planting or direct seeding will be carried out by farmers on their own land with limited assistance from the project.

3.5 Natural Woodland Management

Financial analysis for this model is conducted on a per feddan basis, i.e., returns are calculated for an output of 1 feddan per year. Likewise, the present value of the project cost is converted to per feddan basis for the purpose of benefit/cost ratio and internal rate of return computations.

3.6. Gum Arabic Production and Returns

Gum Arabic is one of the important factors contributing to the profitability of the models considered in the analysis. The percentage occupied by gum arabic, however, varies from 20% in some models to 10% in others. Gum Arabic is planted in the 25,000 feddans area of the participatory/social forestry model and 5,000 feddans (one fifth) of the improved bush fallow and mixed tree alley models. Only the natural woodland management model does not include gum arabic. It is, therefore, important that sufficient light be thrown on economic and financial potential of gum arabic. In the following paragraph, gum arabic production and the pricing system in Sudan are described.

Almost all the gum arabic produced in the Sudan is exported. Sudan holds more than 80% of the world market share and its supplies in the past have strongly influenced the international gum arabic prices. Realizing the near monopoly power in the world market, GOS policy on gum arabic export has been to curtail supply to obtain monopoly profits by paying low prices to the domestic gum arabic producers and raising consumer prices in the international market. A buffer stock policy has been used to stabilize supply. However, during periods of prolonged drought such as occurred in the mid-1970s and 1983-84, the supply has been cut sharply. The consequence has been a smaller market than before because of high prices and perceived unreliability in availability forced gum arabic users to shift to gum arabic substitutes. The experience of the mid-1970s drought was that the market became smaller by about one third. However, the equilibrium price was almost double the previous price, which indicated that some users had rather in-elastic price elasticity of demand, at least in the short and medium term. Before the recent drought, in 1981-82, the international price was stable at around $1,500 /MT and Sudan's annual supply, on average, was 32,400 MT. Due to a sharp decline in Sudan's gum arabic supply to the world market caused by the drought, the 1987 price is very high ($4,950/MT) and the GOS predicts that, because of increases in demand for building up of stocks, the market at that price will clear 30,000 MT. It is difficult to judge in what way the recent drought has affected the world gum arabic demand schedule. Furthermore, there are some indications that the recent high price of gum arabic has been encouraging producers in other countries to establish gum gardens, notably Senegal, Mali, Chad and Nigeria. The World Bank predicts that at about $1,000/MT, there would be a demand for 60,000 MT of Sudan's gum arabic during 1990-2010. The GOS expects that the international price would stay around $3,500/MT, at least for a few more years. The economic analysis carried out has, however, assumed the gum arabic price of $2,000/MT.

4.0 Benefit/Cost and Rate of Return Analysis

4.1 Project Benefits and Costs

The net benefits from the four models are presented in Tables 2 through 8 (financial analysis) and 12 through 15 (economic analysis) which also present the post project cost (as the case may be) estimates. The differences of the benefits and the post project cost are the net benefits which accrue to the resource rehabilitation intervention. These benefits and costs are expressed in 1987 prices.

The disbursement of project cost of U.S. dollar and Sudanese pounds components for resource rehabilitation intervention is presented in Tables 7 and 17. USAID and GOS contributions are extracted from Tables 5 and 8 respectively of Annex F (Detailed Cost Estimates) of the Project Paper. These contributions, spread over a six-year period (FY88-FY93), constitute the project cost element of the financial and economic analysis. Total yearly contribution (in LS) is calculated by summing the two GOS and US contributions for each of the 6 years, the US contribution being converted at LS4.1/$ (bank rate) for financial analysis and LS6/$ (opportunity exchange rate) for economic analysis.

It is assumed that the total US and GOS contributions is the project cost applicable to project activities over an area of 100,000 feddans. Each of the 4 models, covering an area of 25,000 feddans, will have a cost allocation of one fourth of total contribution on a yearly basis for 6 years (see Tables 7 and 17). Total yearly contributions per 25,000 feddans as well as per feddan are calculated and considered in the computation of the Benefit/Cost ratios and financial and economic rates of return. Please note that the yearly project cost figures are not shown in Tables 2 through 5 and 12 through 15, but did enter in the analysis.

For the purpose of rate of return calculation, the present value of project cost is calculated by discounting the 6 yearly total contribution figures using 3 discount rates at 2.5%, 5% and 8%.

4.2 Benefit/Cost Analysis

To analyse the cost-benefit aspects of project future streams of project benefits and cost which will be spread overthe period of thirty years have to be discussed back to a single point in time for evaluation. For this purpose, three discount rates, 2.5%, 5% and 8% are used. Discount rate is supposed to express time preference of society. Acceptance of lower discount rates implies willingness of the society to allow project favorable for the future. From the point of view of conservation ethic which generally states that since the current generation is the temporary custodian of land that should be passed to the following generation intact, even 2.5% discount rate could be considered as too high.

The summarized results of the cost/benefit and rate of return analysis are presented in Tables 1 and 2. To illustrate, the calculated benefit/cost (B/C) ratios for the Improved Bush Fallow model in the financial analysis at discount rates of 2.5%, 5% and 8% are 10.9, 7.8 and 5.5 respectively. These B/C ratios mean, for example, that in case social time preference for this project is 5%, that is, the society discounts its future earnings at the rate of 5% annually, then one pound invested today, generate a fare stream of income for the society, the discounted value of which in today's terms is 7.8 pounds. In case society attaches weight to its future wellbeing, for example, by accepting a discount rate of 2.5% annually, then the present worth of future income of one pound invested in the project today is 10.9 pounds.

Benefit/Cost ratios are highest for the participatory/society forestry model in both financial and economic analyses cases. At 2.5% discount rate, the economic rate of return for the said model is at 30.4, i.e., one pound invested will yield more than 30 pounds of benefit to the nation (Table 2).

Mixed tree alley cropping has the lowest financial rates of return (Table 1) at 6.2, 4.2, and 2.9 (for 2.5%, 5% and 8% discount rates respectively). However, in the economic analysis, the lowest rank goes to the natural woodland management with rates of return at 6.6, 4.3 and 2.7.

4.3 Rate of Return Analysis

Internal rate of return, i.e., the rate at which the present value of benefits equals the present value of costs, is calculated for all four models for Financial (Financial rate of return) and economic (economic rate of return) analysis.

In financial analysis, the participatory/social forestry model's rate of return is the highest at 46.2% followed by the natural woodland management at 29.6%, improved bush fallow at 27.4% and mixed tree alley cropping at 21.5%.

Economic analysis, by and large, is associated with higher rates of return, i.e., 72.8% for participatory/social forestry, 34.6% for mixed tree alley cropping, 32.8% for improved bush fallow, and 17.1% for natural woodland management. The latter rate of return, which is exceptionally lower than the financial rate for the same model, is due to the assumption that in the economic analysis of the natural woodland management model, net benefits are the intervention benefits minus the benefits without intervention. In the financial analysis case, only benefits from intervention were considered.

5.0 Sensitivity Analysis

The major elements, such as gum arabic selling price and equipment, supplies and materials cost, which could significantly impact the benefit-cost ratio and rate of return of resource rehabilitation intervention models, have a direct relationship with the level of the annual returns and project costs. The latter factors are therefore considered in the sensitivity analysis.

The sensitivity analysis is carried out by choosing the scenarios in addition to the base case as follows:. 1) Project costs are increased by 25 percent; 2) Project returns are decreased by 25 percent; and 3) both 1) and 2) above. The latter is the most pessimistic and the base case the most optimistic scenarios. There was no need to consider a scenario more optimistic than the base case since for both financial and economic analysis, the latter was found to yield sufficiently attractive results in terms of rate of return and benefit/cost ratio.

Sensitivity analysis was carried out for both financial and economic analysis case on all four models. The results are shown in Tables 18 through 21 of the main report.

For the Improved Traditional Bush Fallow model under the most pessimistic scenario, the financial and economic rates of return are 19.0% and 23.5% respectively. Equivalent rates of return are 11.6% and 16.6% for the mixed tree alley cropping model; 33.0% and 47.3% for the participatory/social forestry model; and 12.5% and 11.3% for the natural woodland management model.

Similarly, benefit/cost ratio of the most pessimistic scenario is about 40% lower than the base case (most optimistic scenario). The absolute lowest benefit/cost ratio of all cases (1.5) is for the most pessimistic scenario (both cost increased by 25% and returned decreased by 25%) at the 8% discount rate. Thus, even in the most pessimistic case with high preference on current

wellbeing relative to the future (8% discount rate) investment on this project will generate at least one and a half pound for every pound invested. This sensitivity analysis provides further justification that the investment in the resource rehabilitation intervention is financially and economically sound.

6.0 Conclusion

The calculated B/C ratios and financial and economic rates of return (Tables 1 and 2) obtained under the most realistic assumptions and best available data about the factors which can affect project costs, and benefits, are large enough to be assuring that the project investment on the resource rehabilitation intervention is economically worthwhile from the individual (financial analysis) and national point of view (economic analysis).

Resource rehabilitation through participatory forestry, be it natural woodland management or any of the alternate choices of agroforestry, has both direct and indirect impact on the economic wellbeing of the farmer. The analysis carried out to determine benefits without and with intervention (see Tables 2, 3, 4 and 5 of the main report) clearly indicate a favorable Benefit/Cost ratio. Under the Improved Bush Fallow System, for example, although the farmers' net earnings drop for the initial years, these are more than compensated for during the following years, with the additional advantages of sustainability of agriculture and variety of products like fuelwood and gum arabic. On the other hand, if the land is suitable for mixed tree alley cropping, the net benefits are positive right from the beginning of the cropping cycle. In the natural woodland management, sustainable forest products, such as fuelwood, poles, timber, gum, and other products that the farmer has been obtaining from the forests will become available, without any danger of these becoming scarce or vanishing from the scene which is likely to happen if nothing is done.

The sensitivity analysis carried out for various models in the project is intended to lay at rest doubts about the validity of cost benefit analysis in case the assumptions do not prove to be accurate. Even in the worst case scenario, where the costs increase by 25% and the benefits decrease by 25%, the benefit/cost ratio still remains more than 1.0. Thus it can safely be stated that the project is economically sound.

TABLE 1
BENEFIT/COST ANALYSIS SUMMARY

RESOURCE REHABILITATION

DISCOUNT RATE

Model	2.5%	5.0%	8.0%	Internal Rate of Return
	Benefit/Cost Ratio			
1. Improved Bush Fallow *	10.9	7.8	5.5	27.4%
2. Mixed Tree Alley Cropping *	6.2	4.2	2.9	21.5%
3. Participatory/Social Forestry	19.7	14.4	10.3	46.2%
4. Natural Woodland Management	8.3	5.6	3.7	29.6%

* Net benefit of intervention as compared to existing cropping system is evaluated.

Note: Models are evaluated for an area of 25,000 feddans.

TABLE 2
ECONOMIC ANALYSIS SUMMARY

RESOURCE REHABILITATION

DISCOUNT RATE

Model	2.5%	5.0%	8.0%	Internal Rate of Return
	Benefit/Cost Ratio			
1. Improved Bush Fallow *	16.9	12.1	8.4	32.8%
2. Mixed Tree Alley Cropping *	8.4	6.0	4.2	34.6%
3. Participatory/Social Forestry	30.4	22.4	16.1	72.8%
4. Natural Woodland Management	6.6	4.3	2.7	17.1%

* Net benefit of intervention as compared to existing system is evaluated.

Note: Models are evaluated for an area of 25,000 feddans.

ECONOMIC AND FINANCIAL ANALYSIS

Deforestation in the Sudan, as in other countries of Sub-Saharan Africa is a problem which now threatens the already precarious subsistance of a large proportion of rural populations. This "other energy crisis" antecedes the petroleum based energy crisis of the 70's and is far more menacing in its implications. Trees are multipurpose commodities, the progressive loss of which is undercutting the productive base upon which rural economic activities depend.

Trees are useful to human beings in two ways: direct - as producers of a wide variety of goods, commonly called "forest products"' and indirect - as custodians of favorable environmental conditions. Both are indisputably essential to the well-being, indeed to the survival, of mankind.

Although it is rather easy to measure the direct benefits of reforestation, the investments and the products being quantifiable, it is not so easy to measure the indirect benefits as these benefits are not directly quantifiable, particularly within the scope of a discrete forestry project.

These indirect benefits are referred to as "externalities" and may include one or more of the following:

1. Reduced soil erosion.
2. Reduced siltation of reservoirs and increased life of dams and hydro-electric power plants.
3. Increased navigability of streams, rivers and increased irrigation potential.
4. Reduction in the loss of biological diversity and protection of wildlife.
5. Reduction in soil compaction, increased microbial activity and enhancement of soil fertility.
6. Availability of increased animal fodder for pastoralists.
7. Elimination of population displacement that would result because of environmental degradation.
8. Reversal of the processes leading to desertification.
9. Increase in soil productivity through improvement in physical, chemical and biological properties of soil.

They are called <u>externalities</u> because they are not directly recoverable project outputs and, unlike the direct benefits, do not accrue to any specific individual or a group. It may be stated here that not all of these indirect benefits will occur in a given location. In the project area, however, items listed under 1, 5, 6, 7, 8 and 9 will apply.

Methodologies do exist for valuing some of these indirect benefits. For example:

- Estimated loss in soil fertility from rain water run off can be correlated (using time-series data) with the amount of rainfall, run off, loss of top soil and changes in vegetative cover, in order to obtain a measure of the impact of deforestation.

- o Benefits to herders of reduced environmental degradation can be estimated from a study of grazing patterns, size of herds, forage requirements, regenerative capacity of natural forests, wind and water erosion and the rate of acceleration of forest depletion.

However, it is obvious that tools and the effort required for such analysis to be meaningfully undertaken greatly surpass the resources available for the evaluation of a single project, such as SRAAD.

The approach, therefore, used for the economic analysis of this project has been to use methodologies to suit various components and rely as far as possible on measurable outputs. Where such measurable outputs do not exist (Resource Inventory), the analysis of possible options has been done to arrive at the least cost option.

It may be reiterated here that, while evaluating the economic analysis of this project, one must not lose sight of the indirect benefits that accrue to the society, as has been discussed earlier.

Resource Inventory Component

In order to identify and assess forestry resources in the project area, and southern Kordofan and southern Darfur, this project will use satellite (Landsat) data to create base maps and forest resource maps on a 1:250,000 scale. These maps are essential intermediate stage output, necessary in formulating and implementing the resource rehabilitation component of the project. However, this output will benefit not only this project but also any other projects in the region covered by this exercise. Since this output has significant spill-over benefits which are difficult to quantify, the economic analysis of the resource inventory component of the project is carried out separately from that of resource rehabilitation component. Economic analysis is performed to select the least-cost design among alternative options. The cost effectiveness of the proposed scale of maps is also examined.

Three alternative options can be employed to obtain the maps and data as called for under the project.

Option 1. Satellite Imagery 100% of the land area with large scale, high resolution, 1:10,000 aerial photography over 10% of the land area and ground survey and enumerations over 0.1% of the land area.

Option 2. Synoptic aerial photography 1:50,000 over 100% of the land area with large scale, high resolution 1:10,000 aerial photography over 10% of the land area and ground survey and enumerations over 0.1% of the land area.

Option 3. Ground survey and enumerations over 2.0% of areas using existing maps as the basis for sampling and refinement. This option is estimated to take over 40 years to complete the work and is therefore not considered.

Each of these options is discussed below:

Option 1: Under this option, satellite imagery will be the primary tool for the mapping exercise. Data and imagery will be used for development of base maps, initial stratification for vegetation mapping, and after testing the validity of stratification through aerial photography and ground checks, it will form the basis for final analysis. This option also involves high resolution, large scale aerial photography for sub-stratification, covering 10% of the area and ground surveys for inventory. The ground surveys will be carried out over an area of 0.1% of the total project area. This is a 3-tiered methodology that has successfully been employed for mapping and vegetation inventory. The estimated expenditure for this option is likely to be $3.0 million and LS 5.0 million. This amounts to approximately 17 cents per hectare, assuming most of the imagery is available and already procured.

Option 2. This option will require a synoptic aerial photo coverage of the entire project area, approximately 25.0 million hectares. Besides, the high resolution large scale aerial photography over 10% of the area, 0.1% ground survey, as required under Option 1, shall also have to be carried out. Estimated expenditure for this option exceeds the estimate for Option 1, as indicated in the following Table, by about 1.5 million, costing about 22 cents per hectare. These estimates are for black and white photography as against color prints obtainable under Option 1.

Option 3. Under this option, the entire area will need to be ground surveyed. Using a sampling intensity of 2.0%, 1/50th of the areas will need to be physically traversed and measured. A party of surveyors consisting of 8-10 persons can cover 20 feddans or approximately 8 ha. each day. For 2.0% of 25 million ha. - i.e. 0.5 million ha., it will take 62,500 party days for completion. Assuming 10 parties working simultaneously and 150 work days in a year (in view of rainy season) it will take over 40 years to complete the ground survey.

It is obvious that Option 1 is the least cost option and must be adopted, not only because it is economically feasible, but also on account of its being fast, efficient and its ability to produce results that are qualitatively far superior.

The scale of maps, 1:250,000 is chosen because of realistic trade-off between cost and accuracy: further increase in accuracy leads to considerable increase in cost. For a general purpose map a scale of 1:500,000 could be enough. However, for the specific purpose of forestry inventory, this scale does not provide sufficient detailed information, and the scale of 1:250,000 is required.

Table: Estimates and Expenditure - Resource Inventory

(Figures in $000)

Activities	OPTION 1			OPTION 2		
	U.S.	GOS	Total	U.S.	GOS	Total
1. Long-term TA	814.61	126.56	941.17	814.61	126.56	941.17
2. Short-term TA	32.19	-	32.19	32.29	-	32.29
3. Training	36.35	43.90	80.25	36.35	43.90	80.25
4. Vehicles	130.00	-	130.00	130.00	-	130.00
5. Field and Lab. equipment	106.00	9.75	115.75	106.00	9.75	115.75
6. Imagery processing/ acquisition, including printing of image maps	1,024.30	-	1,024.30	-	-	-
7. Aerial survey 1:10,000	399.30	-	399.30)	-	548.78	-
8. Aerial survey 1:50,000	-	-	-)	-		-
9. Cartography, mapping and printing from aerial photos at LS36/KM.	-	-	-	-	2,195.12	2,195.12
10. Construction	-	268.29	268.28	-	268.29	268.29
11. Logistical	95.68	666.82	762.50	95.68	666.82	762.50
12. Contingency	263.89	111.46	375.35	121.49	385.92	507.41
TOTAL	2,902.67	1,226.83	4,129.50	1,336.41	4,245.14	5,581.56

Note: 1. Option 1 is cheaper by $1,452,060 compared to Option 2.

2. Estimates for aerial photography and preparation of maps from aerial photos based on rates given by Sudan Survey Department and verbal communications.

229

Resource Rehabilitation Component

1.0 Introduction

Financial and Economic Analysis were carried out for four models under the Resource Rehabilitation component. These four models are as follows:

1. Improved Traditional Bush Fallow
2. Mixed Tree Alley Cropping
3. Participatory/Social Forestry
4. Natural Woodland Management

For each model, the net benefits of intervention are calculated on a yearly basis over a period of 30 years. The project cost is based on the USAID and GOS contributions and are spread over the first 6 years of the project (Tables 7 and 17). The benefit/cost ratio is computed for discount rates of 2.5%, 5%, and 8%, by dividing the present value of benefits by the present value of the project cost. In addition, the financial and economic rates of return, i.e., the rates at which the present value of benefits equals the present value of costs are calculated for each model.

2.0 Financial versus Economic Analysis

The purpose of financial analysis is to ensure that project activities can be paid for and to determine the profitability of the project from the standpoint of an individual or public for whose benefit the project is undertaken. Economic analysis is concerned with the social profitability of the project, i.e., the relationship of the costs incurred and the benefits obtained by the society as a whole.

For the purpose of calculating returns, financial analysis considers the return to the family labor, whereas in the economic analysis return to the nation as a result of cash crop export is the focus of attention. Thus, returns from sesame and groundnuts, as well as gum arabic are much higher in the economic analysis than in the financial analysis case. Accordingly, marketing and other costs associated with exporting the products are included in the economic analysis but do not appear in the financial analysis.

In the calculation of project cost, financial analysis is based on the USAID contribution component converted at the "bank rate" of LS.4.1/$, versus the opportunity exchange rate of LS.6/$ used for the economic analysis.

3.0 Estimation of Costs and Benefits

3.1 Existing Cropping System

Agroforestry, i.e. models 1,2 and 3, is intended to replace the currently practiced cropping system. The latter consists of cultivating the land for several consecutive years without fallow and thereby contributing to the deterioration of soil productivity over the years. When the crop yield falls below an economic level for the farmer - after 7 to 10 years - the land is abandoned and a different lot is cultivated.

To estimate the return to family labor (Table 1), net returns from sorghum, millet, sesame, and groundnuts are calculated on per feddan basis, assuming a declining crop yield over a 10 year period. For the purpose of yearly yield and return calculations, a 10 year cropping-10 year fallow cycle is assumed. Thus, the crop yields are at their highest levels for years 1, 11, and 21, but gradually decline at an average drop rate of between 1.8% (groundnuts) and 4.6% (millet) over a 10 year period. In addition, there is a return from fueldwood in years 10, 20 and 30 based on a relatively low growth rate of 0.1 cubic meter per feddan per year.

The total return of crops and fuelwood for an area of 25,000 feddans (Table 1), calculated for a 30 year period, serves as a basis of comparison for the improved bush fallow and the mixed tree alley cropping models.

3.2 Improved Traditional Bush Fallow

This model is based on a 5 year cropping - 20 year fallow cycle. For a total area of 25,000 feddans, this translates to an area of 5,000 feddans being under crops and 20,000 feddans under fallow/trees at any point in time.

The 20 year fallow period is expected to reduce the drop rate of the crop yield and eventually (after 20 years) result in a 10% increase in the yield, a level that will be sustained thereafter. In this model, crop return per feddan is higher than the existing cropping system as a result of higher yields. However, only one fifth of the total area is under crop at any given time - compared to half the area in the case of existing system - resulting in a lower overall return for the 25,000 feddans lot (Tables 2A and 12A). This is more than compensated by the return of gum arabic and the increased return of fuelwood.

Due to the improved management practice, the fuelwood output rate in this model is more than double of the existing system, assumed at 0.22 cubic meter per feddan per year. A 20 year rotation is assumed for the fuelwood. Thus, starting in year 20, 5000 feddans of fuelwood is produced every 5 years, i.e., in years 20, 25, 30 and continuing thereafter (Tables 2 and 18).

Gum arabic is an important contributor to the total return in this model. Starting in year 6, gum arabic is produced from an area of 15,000 feddans with a density of 200 trees per feddan yielding from 250 grams (year 6) to a peak of above 530 grams in year 16. Gum arabic gross return to the farmer at LS.274.3 per kantar and the collection and materials cost at LS5.65 are considered for the purpose of economic and financial analysis (Tables 2B and 12B).

3.3 Mixed Tree Alley Cropping

This model is based on 80% cropping (20,000 feddans), plus 20% trees (5,000 feddans). As for the traditional bush fallow model, total return from trees and crops is compared to the return of the existing cropping system and the net benefits are calculated for the 30 year period (Tables 3 and 13).

A decreasing crop yield for the first five years is assumed followed by a yield increase starting in the year 6 and reaching 10% in the year 11 (Tables 3A and 13A). For gum arabic, the producing area consists of 5,000 feddans with 150 trees per feddan (remaining trees in the mixture are other multipurpose species). Output is obtained in years 6-30. The remaining trees, 150 per feddan like Acacia albida, Acacia nilotica, etc. will be planted to contribute to the production of fuelwood, poles, and timber. Tree growth rate of 2.2 cu. m. per hectar per year with a 30 year rotation is assumed. Fuelwood, poles, and timber returns are based on LS.20/cu.m., LS.97/cu.m., and LS.162/cu.m., respectively, all escalated at the rate of 5% per year above inflation, as per World Bank projections.

3.4. Participatory/Social Forestry

This model has two components: 1) direct seeding of Acacia senegal in an area of 15,000 feddans; and 2) tree planting in 10,000 feddans. In both cases the final tree density is assumed at 200 trees per feddan.

The following assumptions apply to both direct seeding and planting (Tables 4 and 14):

Output:

- Crops during years 1 (70%): 2 (60%)
- Gum arabic during years 6-30
- Woodfuel yield at the rate of 1.0 c.m./hectar/yr. output in year 30.

Operating Expenses:

- Gum arabic collection and materials:
  Tools and tapping: LS.0.05/kantar
  Transport to market: LS1.8/kantar
  Sacks: LS.1.0/kantar
  Water: LS.2.8/kantar

- Labor (@ LS.5.0/man day):

1. Direct Seeding:

	m.d./feddan	year
Site preparation:	5	1
Sowing:	2	1
Weeding, first:	3	1
Weeding, second:	2	2
Beating up:	1	2
Tapping/protection:	1.33/kantar	6-30

2. Planting:

	m.d./feddan	year
Site preparation/Pitting	6	1
Planting;	4	1
Weeding, first:	3	1
Weeding, second:	2	2
Beating up:	1	2
Tapping/protection:	1.33/kantar	6-30

232

3.5 Natural Woodland Management

Financial analysis for this model is conducted on a per feddan basis, i.e., returns are calculated for an output of 1 feddan per year. Likewise, the present value of the project cost is converted to per feddan basis for the purpose of benefit/cost ratio and internal rate of return computations (Tables 5 and 15).

Following assumptions are made:

Output:

- Wood output for 1 feddan/year, 50% woodfuel, 50% poles
- Wood yield starting at 1.0 c.m./fed/yr and reaching 2.84 c.m./yr in year 30
- Woodfuel price: LS.20/c.m; poles at LS.97/c.m.

Operating costs:

Labor: (LS5.0/manday)	year 6-30
- Firebreak maintenance	0.2 m.d./feddan
- Early burning:	0.2 m.d./feddan
- Protection:	0.5 m.d./feddan

Overhead: at 10% of labor cost.

3.6. Gum Arabic Production and Returns

Gum Arabic is one of the important factors contributing to the profitability of the models considered in the analysis. The percentage occupied by gum arabic, however, varies from 20% in some models to 10% in others with the exception of the participatory/social Forestry model. Gum Arabic is planted in the 25,000 feddans area of the participatory/social forestry model as against 5,000 feddans (one fifth) of the improved bush fallow and mixed tree alley cropping models. Only the natural woodland management model does not include gum arabic. It is, therefore, important that sufficient light be thrown on economic and financial potential of gum arabic. In the following paragraph, gum arabic production and the pricing system in Sudan are described.

Almost all the gum arabic produced in the Sudan is exported. Sudan holds more than 80% of the world market share and its supplies in the past have strongly influenced the international gum arabic prices. Realizing the near monopoly power in the world market, GOS policy on gum arabic export has been to curtail supply to obtain monopoly profits by paying low prices to the domestic gum arabic producers and raising consumer prices in the international market. A buffer stock policy has been used to stabilize supply. However, during periods of prolonged drought such as occurred in the mid-1970s and 1983-84, the supply has been cut sharply. The consequence has been a smaller market than before because of high prices and perceived unreliability in availability forced gum arabic users to shift to gum arabic substitutes. The experience of the mid-1970s drought was that the market became smaller by about one third. However, the equilibrium price was almost double the previous price, which

indicated that [illegible] users had rather in-elastic price elasticity of demand, at least in the short and medium term. Before the recent drought, in 1981-82, the international price was stable at around $1,500 /MT and Sudan's annual supply, on average, was 32,400 MT. Due to a sharp decline in Sudan's gum arabic supply to the world market caused by the drought, the 1987 price is very high ($4,950/MT) and the GOS predicts that, because of increases in demand for building up of stocks, the market at that price will clear 30,000 MT. It is difficult to judge in what way the recent drought has affected the world gum arabic demand schedule. Furthermore, there are some indications that the recent high price of gum arabic has been encouraging producers in other countries to establish gum gardens, notably Senegal, Mali, Chad and Nigeria. The World Bank predicts that at about $1,000/MT, there would be a demand for 60,000 MT of Sudan's gum arabic during 1990-2010. The GOS expects that the international price would stay around $3,500/MT, at least for a few more years. The economic analysis carried out has, however, assumed the gum arabic price of $2,000/MT.

4.0 Benefit/Cost and Rate of Return Analysis

4.1 Project Benefits and Costs

The net benefits from the four models are presented in Tables 2 through 5 (financial analysis) and 12 through 15 (economic analysis) which also present the post project cost (as the case may be) estimates. The differences of the benefits and the post project cost are the net benefits which accrue to the resource rehabilitation intervention. These benefits and costs are expressed in 1987 prices.

The disbursement of project cost of U.S. dollar and Sudanese pounds components for resource rehabilitation intervention is presented in Tables 7 and 17. USAID and GOS contributions are extracted from Tables 5 and 8 respectively of Annex F (Detailed Cost Estimates) of the Project Paper. These contributions, spread over a six-year period (FY88-FY93), constitute the project cost element of the financial and economic analysis. Total yearly contribution (in LS) is calculated by summing the two GOS and US contributions for each of the 6 years, the US contribution being converted at LS4.1/$ (bank rate) for financial analysis and LS6/$ (opportunity exchange rate) for economic analysis.

It is assumed that the total US and GOS contributions is the project cost applicable to project activities over an area of 100,000 feddans. Each of the 4 models, covering an area of 25,000 feddans, will have a cost allocation of one fourth of total contribution on a yearly basis for 6 years (see Tables 7 and 17). Total yearly contributions per 25,000 feddans as well as per feddan are calculated and considered in the computation of the Benefit/Cost ratios and financial and economic rates of return. Please note that the yearly project cost figures are not shown in Tables 2 through 5 and 12 through 15, but did enter in the analysis.

For the purpose of rate of return calculation, the present value of project cost is calculated by discounting the 6 yearly total contribution figures using 3 discount rates at 2.5%, 5% and 8%.

4.2 Benefit/Cost Analysis

To analyze the cost-benefit aspects of project future streams of project benefits and cost which will be spread over the period of thirty years have to be discounted back to a single point in time for evaluation. For this purpose, three discount rates, 2.5%, 5% and 8% are used. Discount rate is supposed to express time preference of society. Acceptance of lower discount rates implies willingness of the society to allow project favorable for the future. From the point of view of conservation ethic which generally states that since the current generation is the temporary custodian of land that should be passed to the following generation intact, even 2.5% discount rate could be considered as too high.

The results of the cost/benefit and rate of return analysis are presented in Tables 6 and 16. To illustrate, the calculated benefit/cost (B/C) ratios for the Improved Bush Fallow model in the financial analysis at discount rates of 2.5%, 5% and 8% are 10.9, 7.8 and 5.5 respectively (Table 2). These B/C ratios mean, for example, that in case social time preference for this project is 5%, that is, the society discounts its future earnings at the rate of 5% annually, then one pound invested today, generate a fare stream of income for the society, the discounted value of which in today's terms is 7.8 pounds. In case society attaches weight to its future wellbeing, for example, by accepting a discount rate of 2.5% annually, then the present worth of future income of one pound invested in the project today is 10.9 pounds.

Benefit/Cost ratios are highest for the participatory/society forestry model in both financial and economic analyses cases. At 2.5% discount rate, the economic Benefit/Cost ratio for the said model is 30.4, i.e., one pound invested will yield more than 30 pounds of benefit to the nation (Table 16).

Mixed tree alley cropping has the lowest financial Benefit/Cost ratios (Table 6) at 6.2, 4.2, and 2.9 (for 2.5%, 5% and 8% discount rates respectively). However, in the economic analysis, the lowest rank goes to the natural woodland management with Benefit/Cost ratios of 6.6, 4.3 and 2.7 (Table 16).

4.3 Rate of Return Analysis

Internal rate of return, i.e., the rate at which the present value of benefits equals the present value of costs, is calculated for all four models for financial (financial rate of return) and economic (economic rate of return) analysis.

In financial analysis, the participatory/social forestry model's rate of return is the highest at 46.2% followed by the natural woodland management at 29.6%, improved bush fallow at 27.4% and mixed tree alley cropping at 21.5% Table 6).

Economic analysis, by and large, is associated with higher rates of return, i.e., 72.8% for participatory/social forestry, 34.6% for mixed tree alley cropping, 32.8% for improved bush fallow, and 17.1% for natural woodland management (Table 16). The latter rate of return, which is exceptionally

lower than the financial rate for the same model, is due to the assumption that in the economic analysis of the natural woodland management model, net benefits are the intervention benefits minus the benefits without intervention. In the financial analysis case, only benefits from intervention were considered.

5.0 Sensitivity Analysis

The major elements, such as gum arabic selling price and equipment, supplies and materials cost, which could significantly impact the benefit-cost ratio and rate of return of resource rehabilitation intervention models, have a direct relationship with the level of the annual returns and project costs. The latter factors are therefore considered in the sensitivity analysis.

The sensitivity analysis is carried out by choosing the scenarios in addition to the base case as follows:. 1) Project costs are increased by 25 percent; 2) Project returns are decreased by 25 percent; and 3) both 1) and 2) above. The latter is the most pessimistic and the base case the most optimistic scenarios. There was no need to consider a scenario more optimistic than the base case since for both financial and economic analysis, the latter was found to yield sufficiently attractive results in terms of rate of return and benefit/cost ratio.

Sensitivity analysis was carried out for both financial and economic analysis case on all four models. The results are shown in Tables 18 through 21.

For the Improved Traditional Bush Fallow model under the most pessimistic scenario, the financial and economic rates of return are 19.0% and 23.5% respectively. Equivalent rates of return are 11.6% and 16.6% for the mixed tree alley cropping model; 33.0% and 47.3% for the participatory/social forestry model; and 12.5% and 11.3% for the natural woodland management model.

Similarly, benefit/cost ratio of the most pessimistic scenario is about 40% lower than the base case (most optimistic scenario). The absolute lowest benefit/cost ratio of all cases (1.5) is for the most pessimistic scenario (both cost increased by 25% and returned decreased by 25%) at the 8% discount rate. Thus, even in the most pessimistic case with high preference on current wellbeing relative to the future (8% discount rate) investment on this project will generate at least one and a half pound for every pound invested. This sensitivity analysis provides further justification that the investment in the resource rehabilitation intervention is financially and economically sound.

6.0 Conclusion

The calculated B/C ratios and financial and economic rates of return (Tables 6 and 16) obtained under the most realistic assumptions and best available data about the factors which can affect project costs, and benefits, are large enough to be assuring that the project investment on the resource rehabilitation intervention is economically worthwhile from the individual (financial analysis) and national point of view (economic analysis).

Resource rehabilitation through participatory forestry, be it natural woodland management or any of the alternate choices of agroforestry, has both direct and indirect impact on the economic wellbeing of the farmer. The analysis carried out to determine benefits without and with intervention (see Tables 2, 3, 4 and 5 of the main report) clearly indicate a favorable Benefit/cost ratio. Under the Improved Bush Fallow System, for example, although the farmers' net earnings drop for the initial years, these are more than compensated for during the following years, with the additional advantages of sustainability of agriculture and variety of products like fuelwood and gum arabic. On the other hand, if the land is suitable for mixed tree alley cropping, the net benefits are positive right from the beginning of the cropping cycle. In the natural woodland management, sustainable forest products, such as fuelwood, poles, timber, gum, and other products that the farmer has been obtaining from the forests will become available, without any danger of these becoming scarce or vanishing from the scene which is likely to happen if nothing is done.

The sensitivity analysis carried out for various models in the project is intended to lay at rest doubts about the validity of cost benefit analysis in case the assumptions do not prove to be accurate. Even in the worst case scenario, where the costs increase by 25% and the benefits decrease by 25%, the benefit/cost ratio still remains more than 1.0. Thus it can safely be stated that the project is economically sound.

TABLE 1
ESTIMATED RETURNS OF EXISTING CROPPING SYSTEM, 25000 FEDDANS
(12,500 FEDDANS CROPPED AT ANY TIME)

YEAR	RETURN TO FAMILY LABOR PER FEDDAN SORGHUM	MILLET	SESAME	GROUNDNUTS	TOTAL CROPS	FUEL WOOD	TOTAL RETURN
	(L.S.)					(000 L.S.)	
1	41	16	83	176	928	0	928
2	40	16	82	174	916	0	916
3	40	16	78	169	891	0	891
4	39	16	76	166	874	0	874
5	38	16	73	163	854	0	854
6	37	16	71	159	834	0	834
7	36	16	69	157	820	0	820
8	35	16	68	153	802	0	802
9	34	16	66	151	788	0	788
10	33	16	63	147	765	388	1153
11	41	16	83	176	928	0	928
12	40	16	82	174	916	0	916
13	40	16	78	169	891	0	891
14	39	16	76	166	874	0	874
15	38	16	73	163	854	0	854
16	37	16	71	159	834	0	834
17	36	16	69	157	820	0	820
18	35	16	68	153	802	0	802
19	34	16	66	151	788	0	788
20	33	16	63	147	765	632	1397
21	41	16	83	176	928	0	928
22	40	16	82	174	916	0	916
23	40	16	78	169	891	0	891
24	39	16	76	166	874	0	874
25	38	16	73	163	854	0	854
26	37	16	71	159	834	0	834
27	36	16	69	157	820	0	820
28	35	16	68	153	802	0	802
29	34	16	66	151	788	0	788
30	33	16	63	147	765	1029	1794

1. *Total crops return is based on 23% sorghum; 32% millet; 21% sesame; 24% groundnuts.*
2. For fuelwood, an output of 0.1 cu. m./feddan/yr., at ls 20/cu. m. base 1987 price, escalated at annual rate of 5% (over inflation rate) as per World Bank projection.

TABLE 2
BENEFIT/COST ANALYSIS OF IMPROVED TRADITIONAL BUSH FALLOW, 25000 FEDDANS
(5 YEAR CROPPING + 20 YEAR FALLOW)
(000 LS)

YEAR	EXISTING CROPPING SYSTEM RETURN	IMPROVED BUSH FALLOW RETURN CROPS	FUELWOOD	GUM ARAB.	TOTAL	NET BENEFITS
1	928	371	0	0	371	-557
2	916	367	0	0	367	-550
3	891	356	0	0	356	-534
4	874	349	0	0	349	-524
5	854	342	0	0	342	-512
6	834	371	0	4448	4819	3985
7	820	370	0	5515	5885	5066
8	802	367	0	6583	6949	6147
9	788	362	0	7650	8012	7224
10	1153	356	0	7650	8007	6854
11	928	371	0	7294	7666	6738
12	916	371	0	7650	8021	7105
13	891	369	0	8006	8375	7484
14	874	364	0	8362	8726	7853
15	854	363	0	8362	8725	7871
16	834	371	0	7532	7903	7069
17	820	371	0	7769	8140	7320
18	802	369	0	8006	8375	7573
19	788	364	0	8243	8608	7820
20	1397	363	1112	8125	9600	8203
21	928	419	0	7532	7950	7022
22	916	419	0	7769	8187	7271
23	891	419	0	8006	8425	7534
24	874	419	0	8243	8662	7788
25	854	419	1419	8125	9962	9108
26	834	419	0	7532	7950	7116
27	820	419	0	7769	8187	7368
28	802	419	0	8006	8425	7623
29	788	419	0	8243	8662	7874
30	1794	419	1811	8125	10354	8560

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	113725	75035	47596
PRESENT VALUE OF PROJECT COST (000 LS):	10398	9563	8687
BENEFIT/COST RATIO:	10.9	7.8	5.5
INTERNAL RATE OF RETURN: 27.4%			

1. For existing cropping system returns, see Table 1.
2. For improved bush fallow returns, see Tables 2A and 2B.

TABLE 2A
ESTIMATED RETURNS OF IMPROVED TRADITIONAL BUSH FALLOW, 25000 FEDDANS
(5 YEAR CROPPING + 20 YEAR FALLOW)
CROPS AND FUELWOOD

YEAR	RETURN TO FAMILY LABOR PER FEDDAN (LS) SORGHUM	MILLET	SESAME	GROUNDNUT	TOTAL CROPS	FUEL WOOD	TOTAL RETURN
			(L.S.)			(000 L.S.)	
1	41	16	83	176	371	0	371
2	40	16	82	174	367	0	367
3	40	16	78	169	356	0	356
4	39	16	76	166	349	0	349
5	38	16	73	163	342	0	342
6	41	16	83	176	371	0	371
7	41	16	83	175	370	0	370
8	40	16	82	174	367	0	367
9	40	16	80	172	362	0	362
10	40	16	78	169	356	0	356
11	41	16	83	176	371	0	371
12	41	16	83	176	371	0	371
13	41	16	82	175	369	0	369
14	40	16	80	174	364	0	364
15	40	16	79	174	363	0	363
16	41	16	83	175	371	0	371
17	41	16	83	176	371	0	371
18	41	16	82	175	369	0	369
19	40	16	80	174	364	0	364
20	40	16	79	174	363	1112	1475
21	46	19	93	198	419	0	419
22	46	19	93	198	419	0	419
23	46	19	93	198	419	0	419
24	46	19	93	198	419	0	419
25	46	19	93	198	419	1419	1838
26	46	19	93	198	419	0	419
27	46	19	93	198	419	0	419
28	46	19	93	198	419	0	419
29	46	19	93	198	419	0	419
30	46	19	93	198	419	1811	2230

1. Only 1/5 of total area (5000 feddans) is cropped at any time. It is assumed that yield drop rate is equal to the one in the traditional case for years 1-5; is 50% for years 6-10; 30% for years 11-15; 25% for years 16-20. Starting in year 21, the crop yield is assumed to increase by 10% as a result of 20 years fallow period and to sustain this higher rate for the subsequent years.

2. For fuelwood, an output of 0.22 cu. m./feddan/yr., at ls 20/cu. m. base 1987 price, escalated at annual rate of 5% (over inflation rate) as per World Bank projection.

TABLE 2B
ESTIMATED RETURNS OF IMPROVED TRADITIONAL BUSH FALLOW, 25000 FEDDANS
(5,000 CROPPING + 20,000 FALLOW)
GUM ARABIC
(000 LS)

YEAR	YIELD GR/TREE	OUTPUT KANTARS	GROSS RETURN	COLLECT. & MATER. COST	GUM ARABIC RETURN
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	250	16556	4541	94	4448
7	310	20530	5631	116	5515
8	370	24503	6721	138	6583
9	430	28477	7811	161	7650
10	430	28477	7811	161	7650
11	490	27152	7448	153	7294
12	490	28477	7811	161	7650
13	490	29801	8175	168	8006
14	490	31126	8538	176	8362
15	490	31126	8538	176	8362
16	530	28035	7690	158	7532
17	510	28918	7932	163	7769
18	490	29801	8175	168	8006
19	470	30684	8417	173	8243
20	450	30243	8296	171	8125
21	430	28035	7690	158	7532
22	410	28918	7932	163	7769
23	390	29801	8175	168	8006
24	370	30684	8417	173	8243
25	350	30243	8296	171	8125
26	330	28035	7690	158	7532
27	310	28918	7932	163	7769
28	290	29801	8175	168	8006
29	270	30684	8417	173	8243
30	250	30243	8296	171	8125

1. Gum arabic gross return at ls 274.3 per kantar to the farmer.
2. A density of 200 trees/feddan is assumed.
3. Gum arabic collection & materials cost are per kantar basis ls 0.05 for tool, ls 2.8 for water, ls 1.8 for transport to market and ls 1.0 for sack.

TABLE 3

BENEFIT/COST ANALYSIS OF MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20,000 CROPS + 5,000 TREES)
(000 LS)

YEAR	EXISTING CROPPING SYSTEM RETURN	CROPS	MIXED TREE ALLEY CROPPING RETURN GUM ARAB.	FUELWOOD	POLES	TIMBER	TOTAL	NET BENEFITS
1	929	1484	0	0	0	0	1484	555
2	916	1466	0	0	0	0	1466	550
3	891	1425	0	0	0	0	1425	534
4	874	1398	0	0	0	0	1398	524
5	854	1366	0	0	0	0	1366	512
6	834	1484	1112	0	0	0	2596	1763
7	820	1517	1379	0	0	0	2895	2075
8	802	1555	1646	0	0	0	3201	2399
9	788	1587	1913	0	0	0	3500	2712
10	1153	1626	1913	0	0	0	3539	2386
11	928	1674	2179	0	0	0	3854	2926
12	916	1674	2179	0	0	0	3854	2937
13	891	1674	2179	0	0	0	3854	2963
14	874	1674	2179	0	0	0	3854	2980
15	854	1674	2179	0	0	0	3854	3000
16	834	1674	2357	0	0	0	4032	3198
17	820	1674	2268	0	0	0	3943	3123
18	802	1674	2179	0	0	0	3854	3052
19	788	1674	2090	0	0	0	3765	2977
20	1397	1674	2002	0	0	0	3676	2279
21	928	1674	1913	0	0	0	3587	2659
22	916	1674	1824	0	0	0	3498	2582
23	891	1674	1735	0	0	0	3409	2518
24	874	1674	1646	0	0	0	3320	2446
25	854	1674	1557	0	0	0	3231	2377
26	834	1674	1468	0	0	0	3142	2308
27	820	1674	1379	0	0	0	3053	2233
28	802	1674	1290	0	0	0	2964	2162
29	788	1674	1201	0	0	0	2875	2087
30	1794	1674	1112	5705	13835	23105	45431	43636

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	64332	40468	24983
PRESENT VALUE OF PROJECT COST (000 LS):	10398	9563	8687
BENEFIT/COST RATIO:	6.2	4.2	2.9
INTERNAL RATE OF RETURN: 21.5%			

1. For crops, 20,000 feddans with the yield increasing by 10% in the year 11.
2. For gum arabic, 5000 feddans at 150 trees/feddan with output at years 6-30.
3. Tree growth rate of 2.2 cu m per hectar/year. 50% fuelwood, 25% poles, 25% timber.
4. 30 year rotation for trees with fuelwood return at ls 20/cu m;poles at ls 97/cu m, timber at ls 162/cu m, 1987 price, all escalated at the rate of 5% per year.

TABLE 5A
MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20,000 FEDDANS OF CROPS)

YEAR	RETURN TO FAMILY LABOR PER FEDDAN (LS) SORGHUM	MILLET	SESAME	GROUNDNUT	TOTAL CROPS
	(L.S.)				1000 L.S..
1	41	16	83	176	1484
2	40	16	82	174	1466
3	40	16	78	169	1425
4	39	16	76	166	1398
5	38	16	73	163	1366
6	41	16	83	176	1484
7	42	16	85	180	1517
8	43	17	87	184	1555
9	44	17	89	188	1587
10	45	18	91	192	1626
11	46	19	93	198	1674
12	46	19	93	198	1674
13	46	19	93	198	1674
14	46	19	93	198	1674
15	46	19	93	198	1674
16	46	19	93	198	1674
17	46	19	93	198	1674
18	46	19	93	198	1674
19	46	19	93	198	1674
20	46	19	93	198	1674
21	46	19	93	198	1674
22	46	19	93	198	1674
23	46	19	93	198	1674
24	46	19	93	198	1674
25	46	19	93	198	1674
26	46	19	93	198	1674
27	46	19	93	198	1674
28	46	19	93	198	1674
29	46	19	93	198	1674
30	46	19	93	198	1674

1. Crop yield increase of 10% after year 10.

TABLE 3B
MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20000 CROPS + 5000 TREES)
GUM ARABIC RETURN
(000 LS)

YEAR	YIELD GR/TREE	OUTPUT KANTARS	GROSS RETURN	COLLECT. & MATER. COST	GUM ARABIC RETURN
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	250	4139	1135	23	1112
7	310	5132	1408	29	1379
8	370	6126	1680	35	1646
9	430	7119	1953	40	1913
10	430	7119	1953	40	1913
11	490	8113	2225	46	2179
12	490	8113	2225	46	2179
13	490	8113	2225	46	2179
14	490	8113	2225	46	2179
15	490	8113	2225	46	2179
16	530	8775	2407	50	2357
17	510	8444	2316	48	2268
18	490	8113	2225	46	2179
19	470	7781	2134	44	2090
20	450	7450	2044	42	2002
21	430	7119	1953	40	1913
22	410	6788	1862	38	1824
23	390	6457	1771	36	1735
24	370	6126	1680	35	1646
25	350	5795	1589	33	1557
26	330	5464	1499	31	1468
27	310	5132	1408	29	1379
28	290	4801	1317	27	1290
29	270	4470	1226	25	1201
30	250	4139	1135	23	1112

1. Gum arabic gross return at ls 274.3 per kantar to the farmer.
2. A density of 150 trees/feddan is assumed.
3. Gum arabic collection & materials cost are per kantar basis ls 0.05 for tool, ls 2.8 for water, ls 1.8 for transport to market and ls 1.0 for sack.

TABLE 4

BENEFIT/COST ANALYSIS OF PARTICIPATORY/SOCIAL FORESTRY MODEL
15,000 FEDDANS OF DIRECT SEEDING+ 10,000 FEDDANS OF PLANTING
(000 LS)

YEAR	CROPS RETURN	GUM ARABIC	FUEL WOOD	GROSS RETURN	LABOR COST	NET BENEFITS
1	1299	0	0	1299	1409	-192
2	1100	0	0	1100	375	725
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	7413	0	7413	183	7230
7	0	9192	0	9192	228	8965
8	0	10971	0	10971	272	10700
9	0	12750	0	12750	316	12435
10	0	12750	0	12750	316	12435
11	0	14530	0	14530	360	14170
12	0	14530	0	14530	360	14170
13	0	14530	0	14530	360	14170
14	0	14530	0	14530	360	14170
15	0	14530	0	14530	360	14170
16	0	15716	0	15716	389	15327
17	0	15123	0	15123	374	14748
18	0	14530	0	14530	360	14170
19	0	13937	0	13937	345	13592
20	0	13344	0	13344	330	13013
21	0	12750	0	12750	316	12435
22	0	12157	0	12157	301	11857
23	0	11564	0	11564	286	11278
24	0	10971	0	10971	272	10700
25	0	10378	0	10378	257	10121
26	0	9785	0	9785	242	9543
27	0	9192	0	9192	228	8965
28	0	8599	0	8599	213	8386
29	0	8006	0	8006	198	7808
30	0	7413	25932	33345	183	33161

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	205299	137797	89483
PRESENT VALUE OF PROJECT COST (000 LS):	10399	9563	8688
BENEFIT/COST RATIO:	19.7	14.4	10.3
INTERNAL RATE OF RETURN: 46.2%			

1. Crops return: 70% first yr, 60% second yr, 25000 feddans.
2. Gum arabic: 200 trees per feddan, 25000 feddans, yr 6-30, 274.3 ls/kantar.
3. Woodfuel: 2.2 cu m/hectar/yr, 25000 feddans, output at yr 30.
4. Labor: 13 man days/fed. for planting(10,000 f.) and 10 man days/fed. for direct seeding (15,000 f.) in year 1; 3 man days for each part in yr 2 labor for tapping/protection @ 1.33 man days/kantar for yeras 6-30.

245

TABLE 5
BENEFIT/COST ANALYSIS OF NATURAL WOODLAND MANAGEMENT MODEL
(LS/FEDDAN)

YEAR	LABOR COST	YIELD CM/FED/YR	FUEL WOOD RETURN	POLES RETURN	GROSS RETURN	NET RETURN
1	0	1.00	10	49	59	59
2	0	1.02	11	52	63	63
3	0	1.04	11	56	67	67
4	0	1.06	12	60	72	72
5	0	1.08	13	64	77	77
6	124	1.10	14	68	82	-42
7	124	1.50	20	97	118	-6
8	124	1.90	27	130	156	33
9	124	2.00	30	143	173	49
10	124	2.04	32	153	185	61
11	124	2.08	34	164	198	74
12	124	2.12	36	176	212	88
13	124	2.16	39	188	227	103
14	124	2.20	41	201	243	119
15	124	2.24	44	215	259	136
16	124	2.28	47	230	277	154
17	124	2.32	51	246	296	173
18	124	2.36	54	262	316	193
19	124	2.40	58	280	338	214
20	124	2.44	62	299	361	237
21	124	2.48	66	319	385	261
22	124	2.52	70	341	411	287
23	124	2.56	75	363	438	314
24	124	2.60	80	387	467	343
25	124	2.64	85	413	498	374
26	124	2.68	91	440	531	407
27	124	2.72	97	469	566	442
28	124	2.76	103	500	603	479
29	124	2.80	110	532	642	518
30	124	2.84	117	567	684	560

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (LS):	3473	2140	1280
PRESENT VALUE OF PROJECT COST (LS):	416	383	347
BENEFIT/COST RATIO:	8.3	5.6	3.7
INTERNAL RATE OF RETURN: 29.6%			

1. Labor cost at 0.9 man day/fed. for 25 feddans in yrs 6-30 plus 10% overhead.
2. Output at 1 feddan/year, 50% woodfuel, 50% poles.
3. Wood yield starting at 1.0 cu m/fed./yr and reaching 2.84 cu m/yr in yr 30.
4. Woodfuel price: 20 ls/cu m ; poles at 97 ls/cu m (1987 base).
5. Present value of project cost is converted to per feddan basis.

TABLE 5
BENEFIT/COST ANALYSIS SUMMARY

RESOURCE REHABILITATION

M O D E L	DISCOUNT RATE 2.5%	5.0%	8.0%	INTERNAL RATE OF RETURN
	BENEFIT/COST RATIO			
1. IMPROVED BUSH FALLOW *	10.9	7.3	5.5	27.4%
2. MIXED TREE ALLEY CROPPING *	6.2	4.2	2.9	21.3%
3. PARTICIPATORY/SOCIAL FORESTRY	19.7	14.4	10.3	46.2%
4. NATURAL WOODLAND MANAGEMENT	8.3	5.6	3.7	29.6%

* Net benefit of intervention as compared to existing cropping system is evaluated.

Note: models are evaluated for an area of 25,000 feddans.

TABLE 7
CAPITAL INVESTMENT BREAKDOWN
RESOURCE REHABILITATION
FINANCIAL ANALYSIS

YEAR	1	2	3	4	5	6
USAID CONTRIBUTION ($)	490331	914459	937986	1118866	738874	408701
GOS CONTRIBUTION (LS)	2477613	3330377	4804310	4235369	4530091	5456658
TOTAL CONTRIBUTION (000 LS)	6130	7080	8650	8840	7559	7132
CONTRIBUTION/25000 FED.(000LS)	1533	1770	2163	2210	1890	1783
COTRIBUTION/FEDDAN (LS)	61	71	87	88	76	71
					DISCOUNT RATE	
				2.5%	5.0%	8.0%
PRESENT VALUE OF TOTAL CONTRIBUTION/25000 FEDDANS (000 LS)				10398	9563	8687
PRESENT VALUE OF TOTAL CONTRIBUTION/PER FEDDAN (LS)				416	383	347

1. USAID contribution is converted at the bank rate of 4.1 LS/$.

248

TABLE II
ESTIMATED RETURNS OF EXISTING CROPPING SYSTEM, 25000 FEDDANS
(12,500 FEDDANS CROPPED AT ANY TIME)
ECONOMIC ANALYSIS

YEAR	RETURN TO NATION PER FEDDAN (L.S.) SORGHUM	MILLET	SESAME	GROUNDNUTS	TOTAL CROPS	FUEL WOOD (000 L.S.)	TOTAL RETURN
1	41	16	239	356	1877	0	1877
2	40	16	233	350	1841	0	1841
3	40	16	222	342	1788	0	1788
4	39	16	215	336	1749	0	1749
5	38	16	207	331	1710	0	1710
6	37	16	201	323	1667	0	1667
7	36	16	194	318	1631	0	1631
8	35	16	191	311	1599	0	1599
9	34	16	184	306	1563	0	1563
10	33	16	176	300	1521	388	1909
11	41	16	239	356	1877	0	1877
12	40	16	233	350	1841	0	1841
13	40	16	222	342	1788	0	1788
14	39	16	215	336	1749	0	1749
15	38	16	207	331	1710	0	1710
16	37	16	201	323	1667	0	1667
17	36	16	194	318	1631	0	1631
18	35	16	191	311	1599	0	1599
19	34	16	184	306	1563	0	1563
20	33	16	176	300	1521	632	2153
21	41	16	239	356	1877	0	1877
22	40	16	233	350	1841	0	1841
23	40	16	222	342	1788	0	1788
24	39	16	215	336	1749	0	1749
25	38	16	207	331	1710	0	1710
26	37	16	201	323	1667	0	1667
27	36	16	194	318	1631	0	1631
28	35	16	191	311	1599	0	1599
29	34	16	184	306	1563	0	1563
30	33	16	176	300	1521	1029	2550

1. Total crops return is based on 23% sorghum; 32% millet; 21% sesame; 24% groundnuts.
2. For return to nation, see Tables in the Appendix. It is based on sesame export price of $750/MT, and groundnuts at $600/MT, at the exchange rate of ls 6/$.
3. For fuelwood, an output of 0.1 cu. m./feddan/yr., at ls 20/cu. m. base 1987 price, escalated at annual rate of 5% (over inflation rate) as per World Bank projection.

TABLE 12
ECONOMIC ANALYSIS OF IMPROVED TRADITIONAL BUSH FALLOW, [illegible] HEDANS
15 YEAR CROPPING - 30 YEAR FALLOW
1995 LS:

YEAR	EXISTING CROPPING SYSTEM RETURN	IMPROVED BUSH FALLOW RETURN: CROPS	FUELWOOD	GUM ARAB.	TOTAL	NET BENEFITS
1	1877	751	0	0	751	-1126
2	1841	736	0	0	736	-1104
3	1788	715	0	0	715	-1073
4	1749	699	0	0	699	-1049
5	1710	684	0	0	684	-1026
6	1667	751	0	8400	9151	7484
7	1631	744	0	10416	11160	9529
8	1599	736	0	12432	13168	11569
9	1563	725	0	14448	15173	13610
10	1909	715	0	14448	15163	13254
11	1877	751	0	13776	14527	12649
12	1841	746	0	14448	15134	13293
13	1798	742	0	15120	15862	14074
14	1749	736	0	15792	16528	14779
15	1710	728	0	15792	16520	14811
16	1667	751	0	14224	14975	13308
17	1631	747	0	14672	15419	13798
18	1599	743	0	15120	15863	14264
19	1563	739	0	15568	16306	14743
20	2153	736	1112	15344	17192	15039
21	1877	833	0	14224	15057	13180
22	1841	833	0	14672	15505	13665
23	1788	833	0	15120	15953	14165
24	1749	833	0	15568	16401	14653
25	1710	833	1419	15344	17596	15887
26	1667	833	0	14224	15057	13390
27	1631	833	0	14672	15505	13874
28	1599	833	0	15120	15953	14354
29	1563	833	0	15568	16401	14838
30	2550	833	1811	15344	17988	15438

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	212703	140424	89103
PRESENT VALUE OF PROJECT COST (000 LS):	12594	11598	10554
BENEFIT/COST RATIO:	16.9	12.1	8.4
ECONOMIC RATE OF RETURN: 32.8%			

1. For existing cropping system returns, see Table 11.
2. For improved bush fallow returns, see Tables 12A and 12B.

TABLE 13A

ECONOMIC RETURNS OF IMPROVED TRADITIONAL [illegible] 5000 FEDDANS
[illegible] YEAR CROPPING + 20 YEAR FALLOW
[illegible] AND [illegible]

YEAR	RETURN TO NATION PER FEDDAN (LS) SORGHUM	MILLET	SESAME	GROUNDNUT	TOTAL CROPS	FUEL WOOD	TOTAL RETURN
	(L.S.)					(LS.)	
1	41	16	239	356	751	0	751
2	40	16	233	350	736	0	736
3	40	16	222	342	715	0	715
4	39	16	215	336	699	0	699
5	38	16	207	331	684	0	684
6	41	16	239	356	751	0	751
7	41	16	236	353	744	0	744
8	40	16	233	350	736	0	736
9	40	16	227	346	725	0	725
10	40	16	222	342	715	0	715
11	41	16	239	356	751	0	751
12	41	16	237	354	746	0	746
13	41	16	235	352	743	0	743
14	40	16	233	350	736	0	736
15	40	16	229	347	725	0	725
16	41	16	239	356	751	0	751
17	41	16	238	354	747	0	747
18	41	16	236	352	743	0	743
19	40	16	234	351	739	0	739
20	40	16	233	350	736	1112	1848
21	46	19	263	395	833	0	833
22	46	19	263	395	833	0	833
23	46	19	263	395	833	0	833
24	46	19	263	395	833	0	833
25	46	19	263	395	833	1419	2252
26	46	19	263	395	833	0	833
27	46	19	263	395	833	0	833
28	46	19	263	395	833	0	833
29	46	19	263	395	833	0	833
30	46	19	263	395	833	1811	2645

1. Only 1/5 of total area (5000 feddans) is cropped at any time. It is assumed that yield drop rate is equal to the one in the traditional case for years 1-5; is 50% for years 6-10; 30% for years 11-15; 25% for years 16-20. Starting in year 21, the crop yield is assumed to increase by 10% as a result of 20 years fallow period and to sustain this higher rate for the subsequent years.
2. For return to nation, see Tables in the Appendix. It is based on sesame export price of $750/MT, and groundnuts at $600/MT, at the exchange rate of ls 6/$.
3. For fuelwood, an output of 0.1 cu. m./feddan/yr., at ls 20/cu. m. base 1987 price, escalated at annual rate of 5% (over inflation rate) as per World Bank projection.

TABLE 12B
ECONOMIC RETURNS OF IMPROVED TRADITIONAL BUSH FALLOW, 25000 FEDD
(5,000 CROPPING + 20,000 FALLOW)
GUM ARABIC
(600 LS)

YEAR	YIELD GR/TREE	OUTPUT KANTARS	GROSS RETURN	MARKETING COLLECT. & MATER. COST	GUM ARABIC RETURN
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	250	16556	9023	623	8400
7	310	20530	11189	773	10416
8	370	24503	13354	923	12432
9	430	28477	15520	1072	14448
10	430	28477	15520	1072	14448
11	490	27152	14798	1022	13776
12	490	28477	15520	1072	14448
13	490	29801	16242	1122	15120
14	490	31126	16964	1172	15792
15	490	31126	16964	1172	15792
16	530	28035	15279	1056	14224
17	510	28918	15760	1089	14672
18	490	29801	16242	1122	15120
19	470	30684	16723	1155	15568
20	450	30243	16482	1139	15344
21	430	28035	15279	1056	14224
22	410	28918	15760	1089	14672
23	390	29801	16242	1122	15120
24	370	30684	16723	1155	15568
25	350	30243	16482	1139	15344
26	330	28035	15279	1056	14224
27	310	28918	15760	1089	14672
28	290	29801	16242	1122	15120
29	270	30684	16723	1155	15568
30	250	30243	16482	1139	15344

1. Gum arabic gross economic return at Ls 545/kantar ($2000/MT).
2. A density of 200 trees/feddan is assumed.
3. Gum arabic collection & materials cost are per kantar basis Ls 0.05 for tool, Ls 2.8 for water, Ls 1.8 for transport to market and Ls 1.0 for sack.
4. Marketing costs at Ls 32/kantar do not include taxes, profits of merchants and Gum Arabic Company. The costs obtained by 1986 marketing survey is increased by 35% (source: 1986 Marketing Survey by Dept. of Economics- Min. of Agriculture)

252

Table 15

ECONOMIC ANALYSIS OF MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20,000 CROPS + 5,000 GUM..
(000 LS)

YEAR	EXISTING CROPPING SYSTEM RETURN	MIXED CROPS	TREE ALLEY CROPPING RETURN GUM ARAB.	FUELWOOD	POLES	TIMBER	TOTAL	NET BENEFITS
1	1877	3004	0	0	0	0	3004	1127
2	1841	2945	0	0	0	0	2945	1104
3	1788	2860	0	0	0	0	2860	1072
4	1749	2798	0	0	0	0	2798	1049
5	1710	2735	0	0	0	0	2735	1026
6	1667	3004	2100	0	0	0	5104	3437
7	1631	3068	2604	0	0	0	5672	4041
8	1599	3138	3108	0	0	0	6246	4647
9	1563	3202	3612	0	0	0	6814	5251
10	1909	3272	3612	0	0	0	6884	4976
11	1877	3334	4116	0	0	0	7450	5572
12	1841	3334	4116	0	0	0	7450	5609
13	1788	3334	4116	0	0	0	7450	5662
14	1749	3334	4116	0	0	0	7450	5701
15	1710	3334	4116	0	0	0	7450	5740
16	1667	3334	4452	0	0	0	7786	6119
17	1631	3334	4284	0	0	0	7618	5987
18	1599	3334	4116	0	0	0	7450	5851
19	1563	3334	3948	0	0	0	7282	5719
20	2153	3334	3780	0	0	0	7114	4961
21	1877	3334	3612	0	0	0	6946	5068
22	1841	3334	3444	0	0	0	6778	4937
23	1788	3334	3276	0	0	0	6610	4822
24	1749	3334	3108	0	0	0	6442	4693
25	1710	3334	2940	0	0	0	6274	4564
26	1667	3334	2772	0	0	0	6106	4439
27	1631	3334	2604	0	0	0	5938	4307
28	1599	3334	2436	0	0	0	5770	4171
29	1563	3334	2268	0	0	0	5602	4039
30	2550	3334	2100	5705	13835	23105	48078	45528

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	106197	69554	44707
PRESENT VALUE OF PROJECT COST (000 LS):	12594	11598	10554
BENEFIT/COST RATIO:	8.4	6.0	4.2
ECONOMIC RATE OF RETURN: 34.6%			

1. For crops, 20,000 feddans with the yield increasing by 10% in the year 11.
2. For gum arabic, 5000 feddans at 150 trees/feddan with output at years 6-30.
3. Tree growth rate of 2.2 cu m per hectar/year. 50% fuelwood, 25% poles, 25% timber.
4. 30 year rotation for trees with fuelwood return at ls 20/cu m;poles at ls 97/cu m, timber at ls 162/cu m. 1987 price, all escalated at the rate of 5% per year.

TABLE 15A
MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20,000 FEDDANS OF CROPS)
ECONOMIC RETURNS

YEAR	RETURN TO NATION PER FEDDAN (LS) SORGHUM	MILLET	SESAME	GROUNDNUT	TOTAL CROPS 1000 L.
			(L.S.)		
1	41	16	239	356	3004
2	40	16	233	350	2945
3	40	16	222	342	2860
4	39	16	215	336	2798
5	38	16	207	331	2735
6	41	16	239	356	3004
7	42	16	244	364	3068
8	43	17	249	372	3138
9	44	17	254	380	3202
10	45	18	259	388	3272
11	46	19	263	395	3334
12	46	19	263	395	3334
13	46	19	263	395	3334
14	46	19	263	395	3334
15	46	19	263	395	3334
16	46	19	263	395	3334
17	46	19	263	395	3334
18	46	19	263	395	3334
19	46	19	263	395	3334
20	46	19	263	395	3334
21	46	19	263	395	3334
22	46	19	263	395	3334
23	46	19	263	395	3334
24	46	19	263	395	3334
25	46	19	263	395	3334
26	46	19	263	395	3334
27	46	19	263	395	3334
28	46	19	263	395	3334
29	46	19	263	395	3334
30	46	19	263	395	3334

1. Gradual crop yield increase starting at year 6 and reaching 10%
2. For return to nation, see Tables in the Appendix. It is based on sesame export price of $750/MT, and groundnuts at $600/MT. at the exchange rate of ls 6/$.

TABLE 130
MIXED TREE ALLEY CROPPING, 25000 FEDDANS
(20000 CROPS + 5000 TREES)
GUM ARABIC ECONOMIC RETURN
(000 LS)

YEAR	YIELD GR/TREE	OUTPUT KANTARS	GROSS RETURN	MARKETING COLLECT. & MATER. COST	GUM ARABIC RETURN
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	250	4139	2256	156	2100
7	310	5132	2797	193	2604
8	370	6126	3339	231	3108
9	430	7119	3880	268	3612
10	430	7119	3880	268	3612
11	490	8113	4421	305	4116
12	490	8113	4421	305	4116
13	490	8113	4421	305	4116
14	490	8113	4421	305	4116
15	490	8113	4421	305	4116
16	530	8775	4782	330	4452
17	510	8444	4602	318	4284
18	490	8113	4421	305	4116
19	470	7781	4241	293	3948
20	450	7450	4060	281	3780
21	430	7119	3880	268	3612
22	410	6788	3700	256	3444
23	390	6457	3519	243	3276
24	370	6126	3339	231	3108
25	350	5795	3158	218	2940
26	330	5464	2978	206	2772
27	310	5132	2797	193	2604
28	290	4801	2617	181	2436
29	270	4470	2436	168	2268
30	250	4139	2256	156	2100

1. Gum arabic gross return to nation at ls 545/kantar ($2000/MT).
2. A density of 150 trees/feddan is assumed.
3. Gum arabic collection & materials cost are per kantar basis ls 0.05 for tool, ls 2.8 for water, ls 1.8 for transport to market and ls 1.0 for sack.
4. Marketing costs at ls 32/kantar do not include taxes, profits of merchants and Gum Arabic Company. The costs obtained by 1986 marketing survey is increased by 35% (source: 1986 Marketing Survey by Dept. of Economics- Min. of Agriculture)

TABLE 14

ECONOMIC ANALYSIS OF PARTICIPATORY/SOCIAL FORESTRY MODEL
15,000 FEDDANS OF DIRECT SEEDING+ 10,000 FEDDANS OF PLANTING
(000 LS)

YEAR	CROPS RETURN	GUM RETURN	FUEL WOOD	GROSS RETURN	LABOR COST	NET BENEFITS
1	2629	0	0	2629	1360	1229
2	2209	0	0	2209	375	1834
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	14000	0	14000	183	13816
7	0	17360	0	17360	228	17132
8	0	20720	0	20720	272	20448
9	0	24080	0	24080	316	23764
10	0	24080	0	24080	316	23764
11	0	27439	0	27439	360	27080
12	0	27439	0	27439	360	27080
13	0	27439	0	27439	360	27080
14	0	27439	0	27439	360	27080
15	0	27439	0	27439	360	27080
16	0	29679	0	29679	389	29290
17	0	28559	0	28559	374	28185
18	0	27439	0	27439	360	27080
19	0	26319	0	26319	345	25973
20	0	25200	0	25200	330	24869
21	0	24080	0	24080	316	23764
22	0	22960	0	22960	301	22659
23	0	21840	0	21840	286	21553
24	0	20720	0	20720	272	20448
25	0	19600	0	19600	257	19343
26	0	18480	0	18480	242	18237
27	0	17360	0	17360	228	17132
28	0	16240	0	16240	213	16027
29	0	15120	0	15120	198	14922
30	0	14000	25932	39931	183	39748

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	382892	259635	170363
PRESENT VALUE OF PROJECT COST (000 LS):	12594	11598	10554
BENEFIT/COST RATIO:	30.4	22.4	16.1
ECONOMIC RATE OF RETURN: 72.8%			

1. Crops return: 70% first yr, 60% second yr, 25000 feddans.
2. Gum arabic: 200 trees per feddan, 25000 feddans, yr 6-30, 545 ls/kantar. collection & materials @ ls 5.65 and marketing @ ls 32 per kantar.
3. Woodfuel: 1.0 cu m/hectar/yr, 25000 feddans, output at yr 30.
4. Labor: 13 man days/fed. for planting(10,000 f.) and 10 man days/fed. for direct seeding (15,000 f.) in year 1; 3 man days for each part in yr 2 labor for tapping/protection @ 1.33 man days/kantar for yeras 6-30.

TABLE 5:
ECONOMIC ANALYSIS OF NATURAL WOODLAND MANAGEMENT, 2500 [illegible]
(000 LS)

YEAR	BENEFITS WITHOUT INTERVENTION	BENEFITS WITH INTERVENTION	NET BENEFITS WITH INTERVENTION
1	500	1463	963
2	523	1566	1043
3	546	1677	1131
4	569	1795	1225
5	523	1920	1397
6	480	-1041	-1521
7	441	-154	-595
8	405	816	411
9	372	1228	856
10	195	1535	1340
11	103	1861	1759
12	54	2209	2155
13	28	2579	2551
14	0	2973	2973
15	0	3393	3393
16	0	3838	3838
17	0	4313	4313
18	0	4817	4817
19	0	5353	5353
20	0	5924	5924
21	0	6530	6530
22	0	7174	7174
23	0	7858	7858
24	0	8586	8586
25	0	9358	9358
26	0	10179	10179
27	0	11051	11051
28	0	11976	11976
29	0	12959	12959
30	0	14003	14003

	DISCOUNT RATE 2.5%	5.0%	8.0%
PRESENT VALUE OF NET BENEFITS (000 LS):	82638	49792	28740
PRESENT VALUE OF PROJECT COST (000 LS):	12594	11598	10554
BENEFIT/COST RATIO:	6.6	4.3	2.7
INTERNAL RATE OF RETURN: 17.1%			

1. For benefits without intervention, see table 1, Appendix.
2. For benefits with intervention, see table 5.

257

TABLE 15
ECONOMIC ANALYSIS SUMMARY

RESOURCE REHABILITATION

M O D E L	DISCOUNT RATE 2.5%	5.0%	8.0%	ECONOMIC RATE OF RETURN
	BENEFIT/COST RATIO			
1. IMPROVED BUSH FALLOW *	16.9	12.1	8.4	32.3%
2. MIXED TREE ALLEY CROPPING *	8.4	6.0	4.2	24.6%
3. PARTICIPATORY/SOCIAL FORESTRY	30.4	22.4	16.1	72.3%
4. NATURAL WOODLAND MANAGEMENT *	6.6	4.3	2.7	[illegible]

* Net benefit of intervention as compared to existing system is evaluated.

Note: models are evaluated for an area of 25,000 feddans.

TABLE 17
CAPITAL INVESTMENT BREAKDOWN FOR ECONOMIC ANALYSIS
RESOURCE REHABILITATION

Year	1	2	3	4	5	6
USAID Contribution ($)	890931	914459	937986	1110866	738871	408701
GOS Contribution (LS)	2477613	3330377	4804310	4285269	4530091	5456658
Total Contribution (000 LS)	7823	8817	10432	10950	8965	7909
Contribution/25000 (Fed. (000 LS)	1956	2204	2608	2738	2241	1977
Contribution/Feddan (LS)	78	88	104	110	90	79
				Discount Rate		
				2.5%	5.0%	8.0%
Present Value of Total Contribution/2500 feddans (000 LS)				12594	11598	10554
Present Value of Total Contribution/per feddan (LS)				504	464	424

1. USAID contribution is converted at the exchange rate of 6 LS/$

TABLE 13

SENSITIVITY ANALYSIS OF IMPROVED TRADITIONAL BUSH FALLOW MODEL

	BENEFIT/COST RATIO @ DISCOUNT RATE 2.5%	5.0%	8.0%	RATE OF RETURN
		FINANCIAL ANALYSIS		
1- BASE CASE	10.9	7.8	5.5	27.4%
2- PROJECT COST +25%	8.8	6.3	4.4	24.4%
3- RETURNS -25%	7.7	5.5	3.8	21.5%
4- BOTH 2 AND 3	6.2	4.4	3.1	19.0%
		ECONOMIC ANALYSIS		
1- BASE CASE	16.9	12.1	8.4	32.3%
2- PROJECT COST +25%	13.5	9.7	6.8	29.9%
3- RETURNS -25%	11.9	8.5	5.9	25.9%
4- BOTH 2 AND 3	9.5	6.8	4.7	23.5%

TABLE 19

SENSITIVITY ANALYSES OF MIXED FREE VALLEY CROPPING MODEL

	BENEFIT/COST RATIO @ DISCOUNT RATE 2.5%	5.0%	8.0%	RATE OF RETURN
		FINANCIAL ANALYSIS		
1- BASE CASE	6.2	4.2	2.9	21.5%
2- PROJECT COST +25%	4.9	3.4	2.3	17.6%
3- RETURNS -25%	4.2	2.8	1.9	13.9%
4- BOTH 2 AND 3	3.3	2.2	1.5	11.6%
		ECONOMIC ANALYSIS		
1- BASE CASE	8.4	6.0	4.2	34.6%
2- PROJECT COST +25%	6.7	4.8	3.4	27.3%
3- RETURNS -25%	5.6	3.9	2.7	19.9%
4- BOTH 2 AND 3	4.5	3.1	2.2	16.6%

TABLE 20

SENSITIVITY ANALYSIS OF PARTICIPATORY/SOCIAL FORESTRY MODEL

	BENEFIT/COST RATIO @ DISCOUNT RATE 2.5%	5.0%	8.0%	RATE OF RETURN
		FINANCIAL ANALYSIS		
1- BASE CASE	19.7	14.4	10.3	46.2%
2- PROJECT COST +25%	15.8	11.5	8.2	40.7%
3- RETURNS -25%	14.6	10.7	7.6	37.4%
4- BOTH 2 AND 3	11.7	8.5	6.1	33.0%
		ECONOMIC ANALYSIS		
1- BASE CASE	30.4	22.4	16.1	72.8%
2- PROJECT COST +25%	24.3	17.9	12.9	60.6%
3- RETURNS -25%	22.7	16.7	12.0	54.8%
4- BOTH 2 AND 3	18.1	13.3	9.6	47.3%

TABLE 21

SENSITIVITY ANALYSIS OF NATURAL WOODLAND MANAGEMENT MODEL

	BENEFIT/COST RATIO @ DISCOUNT RATE 2.5%	5.0%	8.0%	RATE OF RETURN
		FINANCIAL ANALYSIS		
1- BASE CASE	8.3	5.6	3.7	29.6%
2- PROJECT COST +25%	6.7	4.5	2.9	21.5%
3- RETURNS -25%	5.1	3.3	2.2	15.1%
4- BOTH 2 AND 3	4.0	2.6	1.7	12.5%
		ECONOMIC ANALYSIS		
1- BASE CASE	6.6	4.3	2.7	17.1%
2- PROJECT COST +25%	5.2	3.4	2.2	14.6%
3- RETURNS -25%	4.8	3.1	2.0	13.2%
4- BOTH 2 AND 3	3.9	2.5	1.6	11.3%

APPENDIX A

TABLE A

ESTIMATES OF FINANCIAL BENEFITS WITHOUT FORESTRY MANAGEMENT INTERVENTION
(For a 40,000 Feddan area)

Year	Remaining Forestry Area	Disappeared Forestry Area	Fuelwood Output From Remaining Area	Likely Price of Fuelwood	Financial Benefit per Feddan
	(feddans)	(Feddans)	(1000 cub. m)	(LS/cub. m)	(LS)
1987	40,000	0	40.00	20.00	20
1988	39,791	209	39.79	21.00	20.9
1989	39,583	417	39.58	22.05	21.8
1990	39,376	624	39.38	23.15	22.8
1991	34,434	5,566	34.43	24.31	20.9
1992	30,113	9,887	30.11	25.52	19.2
1993	26,3[illegible]	13,666	26.33	26.80	17.6
1994	23,029	16,971	23.03	28.14	16.2
1995	20,139	19,861	20.14	29.55	14.9
1996	10,069	29,931	10.07	31.03	7.8
1997	5,035	34,965	5.03	32.58	4.1
1998	2,517	37,483	2.52	34.21	2.1
1999	1,259	38,741	1.26	35.92	1.1
2000	0	40,000	0	37.71	0

Notes:

1. Remaining forest area estimates are based on the World Bank estimates on remaining area of forestry and woodland in Kordofan with few conservative measure adopted (World Bank, Sudan Forestry Sector Review, Report No. 5911-SU, Nov. 1985, p.43).

2. Fuelwood output from remaining area is estimated by assuming 1 cubic meter per feddan based on the World Bank estimate that the current rate of cutting in savannah area is twice of the allowable cut.

3. Prices are at 1987 prices at tree site. Estimates are based on the World Bank's projection that the price of fuelwood will increase at annual average rate of 5% over the period of 1987-2008.

APPENDIX [illegible]

TABLE B

SORGHUM: ESTIMATED COSTS AND RETURNS OF RAINFED TRADITIONAL CULTIVATION IN KORDOFAN, BASE YEAR AND THE EFFECT OF 10 PERCENT YIELD INCREASE DUE TO AGRO-FORESTRY PRACTICE, PER FEDDAN

		Base Year	10% Yield Increase from Base Year
Yield (kg)		154	[illegible]
Price received (LS/sack)	30		
Value of output (LS)		11.80	[illegible]
Hired labor (mandays)		1.19	1.31
Wage of hired labor (LS/manday)	4		
Cost of hired labor (LS)		4.76	5.24
Equipment cost (LS)		.49	.49
Cost of materials (LS)		5.26	5.15
Seeds (LS)		.56	.55
Sacks (LS)		5.22	5.13
Fungicides (LS)		.07	.07
Transport to market (LS)		1.56	1.72
Total cost (LS)		10.76	11.20
Returns to family labor (LS)		11.04	15.85
Use of family labor (mandays)		10.08	10.70

Sources: for base year, the 1985/86 farm survey of rainfed traditional area by Dept. of Agric. Econ., Ministry of Agriculture; 1985 Agricultural Situation and Outlook.

The findings of the survey are adjust as follows:

1. The yield of the survey is 154 kg/feddan. While the 1979/80 - 1983/84 average yield of traditional sector in Kordofan is 182 kg/feddan. There is a declining trend in yield in traditional sorghum cultivation in Kordofan estimated as annual rate of -2.3% (source: A.L. Ijaim, M.M. Elhanan, S.S. Sidhu, "Trends and Changes in Sorghum Production in the Sudan, 1961/62 - 1982/83." PS-RR-1-1986, Ministry of Agriculture). Accordingly, the 1977/78 - 1983/88 by using this trend estimate. Since two figures of yields of the survey and extrapolated estimate are similar, no adjustment is made for cost figures of the survey findings, except wage rate, which is LS 3.33/manday by the survey.
2. To estimate the costs for the case of 15% yield increase adjustments are made for those of sacks and transport to market by using proportional increase with yield. For harvesting, about 25% of the total mandays are used. It is assumed that the increase in labor requirement due to increase in yield is met by hired labor and family labor equally.
3. One sack weighs 91.5 kg.

APPENDIX C

TABLE C
MILLET: ESTIMATED COSTS AND RETURNS OF RAINFED TRADITIONAL CULTIVATION IN KORDOFAN, BASE YEAR AND THE CASE OF 10 PERCENT YIELD INCREASE DUE TO AGRO-FORESTRY PRACTICE, PER FEDDAN

		Base Year	10% Yield Increase from Base Year
Yield (kg)		77	85
Price received (LS/sack)	40		
Value of output (LS)		33.72	37.22
Hired labor (mandays)		3.40	3.45
Wage of hired labor (LS/manday)	4		
Cost of hired labor (LS)		13.60	13.80
Equipment cost (LS)		.40	.40
Cost of materials (LS)		2.54	2.55
Seeds (LS)		.78	.62
Sacks (LS)		1.68	1.85
Fungicides (LS)		.08	.08
Transport to market (LS)		1.10	1.21
Total cost (LS)		17.64	17.96
Returns to family labor (LS)		16.08	19.26
Use of family labor (mandays)		10.90	10.95

Notes: For data sources and estimation procedures, see notes of Table B. The annual growth rate of yield used to estimate for the base year yield is -4.6% (Source: Hayat A. Baabound, M.M. Elhanan, S.S. Sidhu, "Trends and Changes in Millet Production in the Sudan, 1961/62 - 1982/83." PS-RR-3-1986, Ministry of Agriculture. One sack of millet weighs 91.35 kg.

APPENDIX D

TABLE D

SESAME: ESTIMATED COSTS AND RETURNS OF RAINFED TRADITIONAL CULTIVATION IN KORDOFAN, BASE YEAR AND THE CASE OF 10 PERCENT YIELD INCREASE DUE TO AGRO-FORESTRY PRACTICE, PER FEDDAN

		Base Year	10% Yield Increase from Base Year
Yield (kg)		65	71
Price received (LS/sack)	70		
Value of output (LS)		101.27	110.62
Hired labor (mandays)		2.53	2.61
Wage of hired labor (LS/manday)	4		
Cost of hired labor (LS)		10.12	10.44
Equipment cost (LS)		.79	.79
Cost of materials (LS)		5.52	5.08
Seeds (LS)		3.07	2.45
Sacks (LS)		2.05	2.23
Fungicides (LS)		.40	.40
Transport to market (LS)		1.29	1.41
Total Cost (LS)		17.72	17.72
Returns to family labor (LS)		83.55	92.90
Use of family labor (mandays)		12.66	12.74
Gross returns to nation (LS)		292.50	319.50
Producer cost (LS)		17.72	17.72
Marketing cost (LS)		35.49	38.77
Net returns to nation (LS)		239.29	263.01

Notes: For data sources and estimation procedures, see notes of Table B. The annual growth rate of yield to estimate the base year yield from the average of 1979/80 - 1983/84 is -3.5% (Source: Hayat H.Baabound, M.M. Elhanan, S.S. Sidhu, "Trends and Changes in Sesame Production in the Sudan, 1961/62 - 1982/83." PS-RR-4-1986, Ministry of Agriculture. One sack of sesame weighs 44.93 kgs. Gross returns to nation are evaluated at $750/MT at exchange rate of LS 6/$.

APPENDIX E

TABLE E
GROUNDNUTS: ESTIMATED COSTS AND RETURNS OF RAINFED TRADITIONAL CULTIVATION IN KORDOFAN, BASE YEAR AND THE CASE OF 10 PERCENT YIELD INCREASE DUE TO AGRO-FORESTRY PRACTICE, PER FEDDAN

		Base Year	10% Yield Increase From Base Year
Yield (kg)		214	235
Price received (LS/sack)	50		
Value of output (LS)		238.16	261.52
Hired labor (mandays)		9.12	9.24
Wage of hired labor (LS/manday)	4		
Cost of hired labor (LS)		36.48	36.96
Equipment cost (LS)		.97	.97
Cost of materials (LS)		21.70	22.09
Seeds (LS)		5.78	4.62
Sacks (LS)		15.82	17.37
Fungicides (LS)		.10	.10
Transport to market (LS)		3.39	3.72
Total cost (LS)		62.54	63.74
Returns to family labor (LS)		175.62	197.78
Use of family labor (mandays)		11.75	11.86
Gross returns to nation (LS)		539.28	592.20
Producer cost (LS)		62.54	63.74
Marketing cost (LS)		121.34	133.24
Net returns to nation (LS)		355.40	395.21

Notes: For data sources and estimation procedures, see notes of Table B. The annual growth rate of yield used to estimate the base year yield from the 1979/80 - 1983/84 average is -1.8% (Source: Hayat A. Salah, M.M. Elhanan, S.S. Sidhu, "Trends and Changes in Groundnuts Production in the Sudan, 1961/62 - 1982/83." PS-RR-2-1986, Ministry of Agriculture. One sack of groundnuts weighs 44.93 kgs. Gross returns to nation are evaluated at $600/MT at exchange rate of LS 6/$.

APPENDIX F

TABLE F
ESTIMATES OF SORGHUM YIELDS AND RETURNS TO FAMILY LABOR
IN CASE NO-INTERVENTION, PER FEDDAN,
1987/88-2011/12

Year	Yield	Gross Revenue	Cost	Return Family Labor
1987	158	52	11	41
1988	154	51	10	40
1989	151	50	10	40
1990	147	48	9	39
1991	144	47	9	38
1992	141	46	9	37
1993	137	45	9	36
1994	134	44	9	35
1995	131	43	9	34
1996	128	42	9	33
1997	125	41	8	33
1998	122	40	8	32
1999	119	39	8	31
2000	117	38	3	30
2001	114	37	8	29
2002	111	36	8	28
2003	109	36	8	28
2004	106	35	8	27
2005	103	34	8	26
2006	101	33	8	25
2007	99	32	8	24
2008	97	32	8	24
2009	95	31	8	23
2010	92	30	7	23
2011	90	30	7	23
2012	98	29	7	22
2013	86	28	7	21
2014	84	27	7	20
2015	82	27	7	20
2016	80	25	7	19

1. For the estimates of the base year 1987 (1987/88), see Table B.

2. Yearly yields are estimated by assuming annual rate of growth - 2/3%. See notes of Table B.

3. The costs for hired labor, sack and transport to market in the cost components are adjusted by the level of yield.

APPENDIX G

TABLE G - ESTIMATES OF MILLET YIELDS
AND RETURNS TO FAMILY LABOR IN CASE OF NO-INTERVENTION,
PER FEDDAN, 1987/88 - 2011/12

Year	Yield	Gross Revenue	Cost	Return Family Labor
1987	77	34	18	16
1988	73	32	16	16
1989	70	31	15	16
1990	67	29	13	16
1991	64	28	12	16
1992	61	27	11	16
1993	58	25	9	16
1994	55	24	8	16
1995	53	23	7	16
1996	50	22	6	16
1997	48	21	5	16
1998	46	20	4	16
1999	44	19	3	16
2000	42	18	2	16
2001	40	17	2	15
2002	38	17	2	15
2003	36	16	2	14
2004	34	15	1	14
2005	33	14	1	13
2006	31	13	1	12
2007	30	13	1	12
2008	29	13	1	12
2009	27	12	1	11
2010	26	11	1	10
2011	25	11	1	10
2012	24	10	1	9
2013	23	10	1	9
2014	22	10	1	9
2015	20	9	1	8
2016				

1. Yearly yields are estimated by assuming annual growth rate - 4.6%. See notes of Table C.

APPENDIX II

TABLE II - ESTIMATES OF SESAME YIELDS
AND RETURNS TO FAMILY LABOR IN CASE OF NO-INTERVENTION,
PER FEDDAN, 1987/88 - 2011/12

Year	Yield	Gross Revenue	Cost	Return Family Labor	Return to Nation
1987	65	101	18	83	239
1988	63	98	16	82	233
1989	60	93	15	78	222
1990	58	90	14	76	215
1991	56	87	14	73	207
1992	54	84	13	71	201
1993	52	81	12	69	194
1994	51	79	11	68	191
1995	49	76	10	66	184
1996	47	73	10	63	176
1997	45	70	9	61	169
1998	44	68	8	60	166
1999	42	65	7	58	159
2000	41	64	7	57	155
2001	39	61	6	55	148
2002	38	59	6	53	144
2003	37	50	6	52	140
2004	35	54	6	48	132
2005	34	53	6	47	128
2006	33	51	6	45	124
2007	32	50	6	44	121
2008	31	48	6	42	117
2009	30	47	6	41	113
2010	29	45	6	39	109
2011	28	44	6	38	105
2012	27	42	5	37	102
2013	26	40	5	35	98
2014	25	39	5	34	94
2015	24	37	5	32	90
2016	23	36	5	31	86

1. Yearly yields are estimated by assuming annual growth rate - 3.5%. See notes of Table D.

APPENDIX I

TABLE I - ESTIMATES OF GROUNDNUT YIELDS
AND RETURNS TO FAMILY LABOR IN CASE OF NO-INTERVENTION,
PER FEDDAN, 1987/88 - 2011/12

Year	Yield	Gross Revenue	Cost	Return Family Labor	Return to Nation
1987	214	238	62	176	356
1988	210	234	60	174	350
1989	206	229	60	169	342
1990	203	226	60	166	336
1991	199	221	58	163	331
1992	195	217	50	159	323
1993	192	214	57	157	318
1994	188	209	56	153	311
1995	185	206	55	151	306
1996	182	202	55	147	300
1997	178	198	54	144	294
1998	175	195	53	142	289
1999	172	191	53	138	283
2000	169	188	52	136	278
2001	166	185	52	133	272
2002	163	181	51	130	267
2003	160	178	50	128	262
2004	157	175	50	125	257
2005	154	171	49	122	252
2006	151	168	48	120	247
2007	149	166	48	118	243
2008	146	162	47	115	238
2009	143	159	47	112	232
2010	141	157	46	111	229
2011	138	154	45	109	225
2012	135	151	45	106	219
2013	133	148	44	104	216
2015	131	146	43	103	213
2016	128	143	42	101	208

1. Yearly yields are estimated by assuming annual rate of growth - 1.8%. See notes of Table E.

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION

ANNEX E

IMPLEMENTATION SCHEDULE

KHARTOUM
JULY 1987

UNCLASSIFIED

273

1. Introduction

The implementation of the Sudan Reforestation and Anti-Desertification Project is planned over a six year period. This period can be differentiated into two phases: Pre-Implementation and Implementation. Schedules for phases are provided below. Implementation progress will be monitored by the Project Committee consisting of: Chief USAID/Sudan Agricultural Division, Controller, Project Development Officer and the Forestry Advisor.

2. Pre-Implementation Phase

This phase begins with the authorization of the project by the USAID Mission Director and extends until the time when the last long-term assistance personnel for the Rehabilitation Component arrive. The principal responsibility for undertaking the action required during this period is the Project Manager. He will be required to undertake the following immediately following the obligation of the Project:

- Issue Project Implementation Letter No. 1 to the GOS; including details on CPs, transactions, accounts and accounting, steering committee, etc.

- Prepare a PIO/T to issue requests for expression of interest.

- Prepare a PIO/T to negotiate contract with RCSSMRS.

- Prepare a PIO/T to issue a RFTP for the Rehabilitation Contract.

- Prepare a PIO/T to negotiate a contract with the selected Contractor.

- Monitor the progress of the GOS to meet Condition Precedents and notify GOS upon their being met. Note the 90 day timeframe.

Working with the Contracting Officer, the Project Manager will also be required to set up an Evaluation Committee to review contractors' proposals for the Rehabilitation Component.

In conjunction with the USAID/Sudan Controller the project manager will assist in the review of the findings of the Financial Review proposed for the RCSSMRS. Likewise the Project Manager will ensure that the GOS sets up the required special accounts, and adequately funds these accounts and the USAID Project Trust Fund.

The Project Manager will also work with the USAID/Sudan Executive Office to arrange logistical support (housing, transport, etc.) for the contractor personnel.

The Project Manager will cooperate with the GOS Central Forestry Administration staff to ensure that basic project equipment and facilities (houses) are in place prior to the arrival of the contractor personnel.

OVERALL

IMPLEMENTATION SCHEDULE
FOR THE
SRAAD PROJECT

ACTIVITY	TIMING	RESPONSIBLE PARTY
USAID Project Paper Review	July 13, 1987	Project Committee
Project Authorization	August 1987	USAID Director
Project Grant Agreement signed	August 1987	USAID/GOS
Distribute REI	August 1987	Contracting Officer
Issue PIO/T for RCSSMCS	August 1987	Project Manager
Issue PIO/T for Rehab Contractor	August 1987	Project Manager
Receive Expressions of Interest	September 1987	Contracting Officer
Advertise Rehab Component RFTP	October 1987	Contracting Officer
Undertake Financial Review of RCSSMRS	September 1987	Controller
Negotiate Contract with RCSSMRS	January 1988	Contracting Officer
Review Responses to Rehab RFTP	January 1988	Evaluation Committee
Negotiate Rehab Component Contract	February 1988	Contracting Officer
First RCSSMRS Staff Arrive	May 1988	Contractor
Prepare Work for Inventory	June 1988	Contractor
First Steering Committee	August 1988	USAID/GOS
First Rehab Contractor Staff Arrive	June 1988	Contractor
Prepare Work for Rehab	July 1988	Contractor
Second Steering Committee	February 1989	USAID/GOS
Internal Project Review	May 1989	USAID/GOS
Second Annual Workplans	June 1989	Contractor
Third Steering Committee	August 1989	USAID/GOS
Fourth Steering Committee	February 1990	USAID/GOS
First External Evaluation	May 1990	USAID/GOS
Third Annual Workplans	June 1990	Contractor
Fifth Steering Committee	August 1990	USAID/GOS
Sixth Steering Committee	February 1991	USAID/GOS
Fourth Annual Workplans	June 1991	Contractor
Seventh Steering Committee	August 1991	USAID/GOS
Eighth Steering Committee	February 1992	USAID/GOS
Fifth Annual Workplans	June 1992	Contractor
Ninth Steering Committee	August 1992	USAID/GOS
Tenth Steering Committee	February 1993	USAID/GOS
Final Evaluation	May 1993	USAID/GOS
Eleventh Steering Committee	August 1993	USAID/GOS

275

Implementation Schedule
Resource Inventory Component

Activity	Timing	Responsible Party
Signing of PROAG	8/87	USAID/GOS
Issue PIO/T for contractor	8/87	USAID/GOS
Negotiate Contract with Contractor	1/88	Contracting Office
Mobilization of contractor staff	2-3/88	Contractor
Initiation of procurement of M and E	2-4/88	Contractor
CTA and other Contractor Staff at Post	5/88	Contractor
Posting of Sudanese staff Co-Project Director and Field Project Officers	6/88-7/88	GOS
Prepare First Work Plan	6/88	Contractor
First Steering Committee meeting	8/88	USAID/GOS
Acquisition of building/office space	8/88	GOS/Contractor
Establishment of Inventory Unit within IRM of Forest Department	9/88	Contractor
Acquisition of M and E completed	9/88	Contractor
Start training in Nairobi and Khartoum on image interpretation	9/88	Contractor
Start training in Field Inventory, Khartoum	9/88	Contractor
Development of Inventory Plan	9/88	Contractor
Development of Field Manual	10/88	Contractor
Start Construction of Inventory Unit Building	10/88	Contractor
Conduct initial image interpretation, with confirmation tests through aerial photography and ground truthing	10-11/88	Contractor
Develop initial sampling strategy and inventory design	11/88	Contractor
Field crew start sample enumerations, development of volume and biomass equations	11/88	Contractor
Start on software	11/88	Contractor
Start image interpretation and mapping of 5 Rural Councils in Kordofan	11/88	Contractor
Finalize sampling strategy and inventory design	12/88	Contractor
Identify Sampling Units (PSU's) for aerial photography	1/89	Contractor
Complete software development and test	2/89	Contractor
Order aerial photography of PSU's	1/89-2/89	Contractor
2nd Steering Committee Meeting	2/89	USAID/GOS
Establish procedures for inventory quality control and test	2/89	Contractor
Internal Project Review	2/89	USAID/GOS
Identify sub-strata and field sampling sites in each PSU	3/89	Contractor
Initiate ground surveying and enumeration in each sub-strata beginning in Kazgail	3/89	Contractor
Complete image interpretation and mapping of 5 Rural Council areas	6/89	Contractor

276

Activity	Timing	Responsible Party
Complete ground surveying and enumeration in Kazgail and start on sub strata samples in Hamadi, followed by Dubeibat, Hamadi and Er Rahad	6/89	Contractor
3rd Steering Committee Meeting	8/89	USAID/GOS
4th Steering Committee Meeting	8/89	USAID/GOS
Start interpretation and anlysis of data	8/89	Contractor
Complete ground survey/enumeration of 5 RC area	12/89	Contractor
Complete volume and biomass data for analysis for 5 Rural Council areas	12/89	Contractor
Enter data into GIS	12/89	Contractor
First evaluation of Resource Inventory	1/90	USAID/GOS
Start image interpretation and mapping of remaining area of Southern Kordofan	1/90	Contractor
Identify Sampling Units (PSU's)	1/90	Contractor
Order aerial photography of PSU's	2/90	Contractor
Identify sub-strata and field sampling sites in each PSU	2/90	Contractor
Complete image interpretation and mapping of remaining areas of Southern Kordofan	2/90	Contractor
5th Steering Committee Meeting	2/90	USAID/GOS
Initiate ground surveying and enumerations Kordofan	3/90	Contractor
Complete ground surveyingand enumerations Kordofan	10/90	Contractor
Initiate ground surveying and enumeration	10/90	Contractor
Start interpretation and analysis of data	10/90	Contractor
Complete volume and biomass data analysis for rest of southern Kordofan	11/90	Contractor
Enter data into GIS	11/90	Contractor
Complete printing of image of S. Kordofan and S. Darfur	11/90	Contractor
Printing of ancilliary forest maps of S. Kordofan completed	11/90	Contractor
2nd Evaluation	1/91	USAID/GOS
6th Steering Committee meeting	2/91	USAID/GOS
Complete building and install all necessary equipment	4/91	Contractor
Establish growth and yield plots in Southern Kordofan	5/91	Contractor
Printing of Forest/Vegetation maps of S. Kordofan completed	5/91	Contractor
Initiate image interpretation and mapping of Southern Darfur	6/91	Contractor
Identify PSU's	6/91	Contractor
Order aerial photography of PSU's	6/91	Contractor
Identify sub-strata and field sampling sites in each PSU	7/91	Contractor

Annex [illegible]
Page [illegible] of [illegible] pages

Activity	Timing	Responsible Party
Complete image interpretation and mapping of Southern Darfur	[illegible]	Contractor
3tia Steering Committee Meeting	[illegible]	USAID/GOS
Complete ground surveying and enumeration in Southern Darfur	4/92	Contractor
Start interpretation and analysis of data	4/92	Contractor
Complete volume and biomass data analysis for Southern Darfur	5/92	Contractor
Enter data into GIS	5/92	Contractor
Establish growth and yield plots in Southern Darfur	5/92	Contractor
Printing of Forest/Vegetation Map for S. Darfur completed	5/92	Contractor
Printing of Ancillary Forest Maps 1:100,000 scale completed for S. Darfur	5/92	Contractor
Final evaluation	6/92	USAID/GOS

Implementation Schedule
Resource Rehabilitation Component

Activity	Timing	Responsible Party
Signing of PROAG	8/87	USAID/GOS
Distribute REI	8/87	USAID
Issue PIO/T for Contract	8/87	USAID
Receive Expressions of Interest	9/87	USAID
Advertize for RFTP	10/87	USAID
Meet initial CPs and CPs for TA	11/87	GOS
Review responses to RFTP	1/88	USAID
Negotiate to sign contract	2/88	USAID/Contractor
Procurement of M & E initiated	3/88	Contractor
TA Team at post	5/88	Contractor
Seconded GOS staff at post	6/88	GOS
Prepare Annual Work Plan	7/88	Contractor
Prepare design for Nursery/Extension Demonstration Center	7/88	Contractor
First Meeting of Steering Committee	8/88	USAID/GOS
First Steering Sub-Committee (Rehab) Meeting	8/88	USAID/GOS
Establishment of Seed Production Stands Started	9/88	Contractor
Training of Extension Staff Started	9/88	Contractor
Socio-Economic Survey (Needs Assessment) Started	9/88	Contractor
Nursery/Extension Demonstration (N/E.D.) Centers identified and surveyed	9/88	Contractor
Construction of first N/E.D. Center started	10/88	Contractor
Construction of Resource Rehab. HQ, El Obeid started	10/88	Contractor
Construction of self-help village nurseries in Kazgail RC	10-11/88	Contractor
Socio-economic survey completed and target villages identified	12/88	Contractor
Training of Extension Staff Completed	12/88	Contractor
2nd Project Steering Sub-Committee Meeting	1/89	USAID/GOS
Construction of First N/E.D. Center completed	1/89	Contractor
Extension activities initiated in Kazgail RC	1/89	Contractor
Construction of N/E.D. Centers started in other RC	2/89	Contractor
2nd Steering Committee Meeting	2/89	USAID/GOS
First results of resource inventory become available	5/89	Contractor (R.I.)
T.A. Team Specialists arrive and begin development of Operational Plan	6/89	USAID/Contractor
First annual review	6/89	USAID/GOS
2nd Annual Work Plan prepared	7/89	Contractor

229

Activity	Timing	Responsible Party
3rd Steering Sub-Committee (RR) Meeting	7/89	USAID/GOS
Construction of remaining N/E.D. Centers completed	7/89	Contractor
Project activities (extension, woodland management, agroforestry, gum gardens started in other RCs)	7/89	Contractor
First nursery starts production	7/89	Contractor
Establishment of seed production stands completed	7/89	Contractor
Reseeding/planting of gum garden started	7/89	Contractor
Agroforestry initiated in Kazgail RC	7/89	Contractor
Development of natural woodland management plan initiated	7/89	Contractor
3rd Steering Committee Meeting	8/89	USAID/GOS
Construction of RR (El Obeid) completed	9/89	Contractor
Extension training for remaining staff	9-12/89	Contractor
10% Agroforestry and gum gardens completed	10/89	Contractor
Operational plan completed	9-10/89	Contractor
Farmland identified for agroforestry	11/89	Contractor
Woodland earmarked and demarcated for community forestry	11-12/89	Contractor
4th SteeringSub-Committee (RR) meeting	1/90	USAID/GOS
Extension initiated in remaining RCs	1/90	Contractor
20% of targetted community forests established Kazgail	2/90	Contractor
20% of targetted agroforestry completed in in Kazgail	2/90	Contractor
30% of targetted gum garden planted in in Kazgail	2/90	Contractor
Development of management plans for natural woodland completed	3/90	Contractor
First evaluation	2-3/90	USAID/GOS
3rd Annual Work Plan prepared	6/90	Contractor
5th Steering Sub-Committee (RR) meeting	7/90	USAID/GOS
Nurseries in remaining RC start production	7-8/90	Contractor
4th Steering Committee Meeting	8/90	USAID/GOS
20% of targetted community forests established	10/90	Contractor
20% of targetted agroforestry on farm land	10/90	Contractor
20% of targetted gum garden planted	10/90	Contractor
20% of natural woodlands brought under management	10/90	Contractor
6th Steering Sub-Committee (RR) Meeting	[illegible]/91	USAID/GOS
5th Steering Committee Meeting	[illegible]/91	USAID/GOS
4th Annual Work Plan prepared	[illegible]/91	Contractor
Resource Inventory data analysis completed and available	7/91	Contractor (R.I.)

Activity	Timing	Responsible Party
7th Steering Sub-Committee (RR) Meeting	7/91	USAID/GOS
6th Steering Committee Meeting	8/91	USAID/GOS
40% of targetted community forestry, natural woodland management, gum gardens and agro-forestry completed	10/91	Contractor
8th Steering Sub-Committee (RR) Meeting	1/92	USAID/GOS
7th Steering Committee Meeting	2/92	USAID/GOS
Mid-Term Evaluation	2-3/92	USAID/GOS
5th Annual Work Plan prepared	6/92	Contractor
9th Steering Sub-Committee Meetin	7/92	USAID/GOS
8th Steering Committee Meeting	8/92	USAID/GOS
75% of targetted community forestry, natural woodland management, gum gardens and agroforestry completed	9/92	Contractor
10th Steering Sub-Committee Meeting	1/93	USAID/GOS
9th Steering Committee Meeting	2/93	USAID/GOS
100% of targetted community forestry, natural woodland management, gum gardens and agroforestry completed	8/93	Contractor
Final Evaluation	9-10/93	USAID/GOS

Notes:

1. Please ensure the following reviews and evaluations are scheduled concurrently for both Project components:

   First Annual Review (Internal Review)
   First Evaluation
   Second Evaluation

2. Include External Evaluation for Resource Inventory Component at the end of year 4 to coincide with Mid-Term Evaluation for Resource Rehabilitation Component.

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION PROJECT

ANNEX F

DETAILED COST ESTIMATES

KHARTOUM
JULY 1987

UNCLASSIFIED

BUDGET TABLES

Table 1	Summary Project Costs
Table 2	Sources and Uses of Funds
Table 3	Summary USAID Contributions
Table 4	USAID Contributions to Resource Inventory
Table 5	USAID Contributions to Resource Rehabilitation
Table 6	Summary GOS Contributions
Table 7	GOS Contributions to Resource Inventory
Table 8	GOS Contributions to Resource Rehabilitation
Table 9	Technical Assistance Plan
Table 10	Training Plan
Table 11	Vehicle Procurement Plan
Table 12	Construction Plan
Table 13	Procurement List

July 14, 1987

[illegible]

[illegible]	[illegible]	[illegible]	[illegible]
1. [illegible]	[illegible]	[illegible]	[illegible]
2. [illegible] Rehabilitation Component	[illegible]	[illegible]	[illegible]
3. Other Project Support	[illegible]	[illegible]	[illegible]
Total Project Costs	$8,000,000	$7,500,000	$15,500,000

* Note. The foreign exchange rate used in developing this budget is $US 1 = 4.1 Sudanese pounds.

July 14, 1987

TABLE 2
SOURCES AND USES OF FUNDS
(US Dollars)

Description	USAID Contribution	GOS* Contribution	Total Project Costs
1. Technical Assistance	$4,392,667	$962,256	$5,354,923
2. Training	$121,304	$383,945	$505,249
3. Commodities	$2,211,926	$425,830	$2,637,756
4. Construction	$0	$1,135,230	$1,135,230
5. Logistical Support	$459,993	$3,794,426	$4,254,419
6. Evaluation and Audit	$86,825	$128,144	$214,969
6. Contingency	$727,285	$670,169	$1,397,454
Total Project Costs	$8,000,000	$7,500,000	$15,500,000

* Note. The foreign exchange rate used in developing this budget is $US 1 = 4.1 Sudanese pounds.

Description	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.Technical Assistance	$0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.Trainees	[illegible]	[illegible]	[illegible]	[illegible]	$19,205	[illegible]	[illegible]	[illegible]
3.Commodities	$359,789	$889,565	$164,227	$553,827	$161,051	[illegible]	[illegible]	[illegible]
4.Logistical support	$14,300	$37,950	$55,055	$72,540	$94,174	$88,533	[illegible]	$409,[illegible]
5.Evaluations and Audits	$0	$28,875	$27,567	$0	$70,388	$0	$0	[illegible]
Subtotal	$[illegible],189	$1,822,850	$1,371,615	$1,773,347	$943,219	$611,[illegible]	$36[illegible]	[illegible]
6.Contingency	$78,933	$182,285	$177,162	$177,334	$94,322	$61,[illegible]	$[illegible]	$[illegible]
7.Total	$439,121	$2,[illegible]	[illegible]	$1,950,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

285

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.Technical Assistance	$0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a.Computers	$0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
b.Photocopiers	$0	$21,000	$22,050	$0	[illegible]	$0	[illegible]	[illegible]
2.Training	$9,400	$16,590	$19,764	$0	$0	$0	$0	[illegible]
a.Study Tours	$9,400	$16,590	$19,764	$0	$0	$0	[illegible]	[illegible]
3.Commodities	$165,789	$629,147	$1,220	$415,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a.Base Maps	$200,000	$520,000	$0	$0	$0	$0	[illegible]	[illegible]
b.Satelite Imagery	$15,000	$16,500	$0	$131,100	$0	$0	$0	[illegible]
c.Aerial Photos	$0	$0	$0	$255,[illegible]	$0	$0	[illegible]	[illegible]
d.Lab Equipment	$3,789	$0	$0	$0	$0	[illegible]	[illegible]	[illegible]
e.Field Equipment	$0	$47,147	$0	$0	$11,711	$0	[illegible]	[illegible]
f.Office Equipment	$0	$5,[illegible]	$1,[illegible]	$1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
g.Vehicles	[illegible]	$0	[illegible]	[illegible]	[illegible]	[illegible]	$0	[illegible]
h.Computers	$12,000	$0	$0	$[illegible]	$0	[illegible]	[illegible]	[illegible]
4.Logistical Support	$14,000	$17,500	$19,[illegible]	$21,296	$22,[illegible]	$0	$0	[illegible]
a.Vehicle Spares	$14,000	$17,600	$19,360	$21,296	$22,425	$0	$0	[illegible]
SubTotal	$389,189	$927,737	$717,594	$715,729	$36,603	$1,611	$0	$2,[illegible]
5.Contingency	$38,933	$92,734	$71,759	$71,573	$3,660	$161	$0	$[illegible]
6.Total	$428,121	$1,020,071	$789,342	$787,302	$40,263	$1,772	$0	$2,625,871

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1.Personnel Services	$0	[illegible]	[illegible]	$[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
a.Civilian	[illegible]	[illegible]	[illegible]	[illegible]	$53[illegible]	[illegible]	[illegible]	[illegible]
b.Shortfall	$0	$[illegible]	$16,528	$17,364	$51,[illegible]	[illegible]	[illegible]	[illegible]
2.Training	$0	$9,879	$17,420	$10,290	$[illegible]	[illegible]	[illegible]	[illegible]
a.Study Tours	$0	$9,879	$17,420	$10,290	$[illegible]	[illegible]	[illegible]	[illegible]
3.Commodities	$0	$259,413	$163,[illegible]	$137,226	$[illegible]	$[illegible]	[illegible]	[illegible]
a.Material Equipment	$0	$76,[illegible]	$51,[illegible]	$57,366	$1,144	[illegible]	[illegible]	[illegible]
b.Vehicles	$0	$182,500	$109,909	$79,860	$146,4[illegible]	[illegible]	[illegible]	[illegible]
4.Logistical Support	$0	$20,250	$35,695	$51,244	$[illegible]	$[illegible]	$[illegible]	[illegible]
a.Vehicle Spares	$0	$20,250	$35,695	$51,244	$[illegible]	$[illegible]	$[illegible]	$[illegible]
Subtotal	$0	$[illegible]	$[illegible]	$1,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5.Contingent	$0	$36,[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6.Total	$0	$953,701	$1,129,116	$1,163,374	$[illegible]	$[illegible]	$[illegible]	[illegible]

[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										
[illegible]										

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]								
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
2.Training	[illegible]	143,000	[illegible]	[illegible]				[illegible]
a.In-Country training	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]
b.Air Tickets	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]
3.Commodities	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]
a.See Table II	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]
4.Construction	0	0	0	0	0	[illegible]	[illegible]	[illegible]
5.Logistical support	219,000	475,321	576,375	697,256	822,754	[illegible]	[illegible]	[illegible]
a.Housing Rental	10,000	12,500	15,625	19,531	[illegible]			[illegible]
b.In-country Travel	10,000	12,500	15,625	19,531	[illegible]	[illegible]	[illegible]	[illegible]
c.Vehicle Operations	63,000	90,000	112,500	140,625	175,781	[illegible]	[illegible]	[illegible]
d.Aircraft Charter	136,000	162,500	203,125	253,906	317,383	[illegible]	[illegible]	[illegible]
e.Casual Labor	[illegible]	136,821	234,375	244,141	305,176	[illegible]	[illegible]	[illegible]
f.Office Operations	5,000	12,500	15,625	19,531	24,414	[illegible]		[illegible]
SubTotal	262,000	958,321	877,375	954,391	1,007,535	[illegible]		[illegible]
6.Contingency	36,200	85,382	87,738	95,489	100,754	[illegible]	[illegible]	[illegible]
7.Total	398,200	944,703	965,113	1,050,380	1,108,289	[illegible]	[illegible]	[illegible]

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
c.Training Grants	0	42,000	[illegible]	[illegible]	[illegible]	[illegible]		[illegible]
d.Study Tour Tickets	0	24,000	48,[illegible]	48,[illegible]	[illegible]	48,[illegible]		[illegible]
3.Commodities	0	317,325	298,265	367,776	[illegible]	[illegible]	[illegible]	[illegible]
a.See Table 17	0	317,325	298,265	367,776	[illegible]	248,524	[illegible]	[illegible]
4.Construction	0	1,031,500	1,241,250	1,519,377	290,405	205,891	215,77[illegible]	[illegible]
a.Staff Quarters	0	77,000	169,400	186,340	0	0		[illegible]
b.Other Housing	0	44,000	96,800	106,480	0			[illegible]
c.Nursery Centers	0	330,000	726,000	798,600	0			[illegible]
d.Village Nurseries	0	33,000	72,600	119,790	131,769	144,946	159,44[illegible]	[illegible]
e.Hand-Dug Wells	0	82,500	145,200	399,300	149,319		0	776,[illegible]
f.Offices	0	440,000	0	0	0	0	0	[illegible]
g.Seed Prod Stands	0	25,[illegible]	31,250	39,063	48,828	[illegible]	[illegible]	[illegible]
5.Logistical support	40,000	540,750	1,1[illegible]	1,950,791	2,314,157	2,546,157	[illegible]	[illegible]
a.Housing Rental	0	125,250	250,313	454,688	757,324	1,079,491	1,748,111	[illegible]
b.In-country Travel	0	30,000	37,500	46,875	58,594	73,242	91,553	[illegible]
c.Vehicle operations	0	108,750	225,000	375,000	579,613	823,975	1,029,968	[illegible]
d.Office Operations	0	12,500	15,625	19,531	24,414	30,519	38,147	[illegible]
e.Monitoring	40,000	100,000	125,000	156,250	195,313	122,070	152,588	[illegible]
f.Casual Labor	0	112,500	356,250	560,547	708,008	917,371	653,301	[illegible]
g Donkeys	0	17,250	29,063	70,313	53,734	0	0	169,[illegible]
h.Donkey Maintenance	0	34,500	101,250	267,188	439,453	0	0	842,[illegible]
SubTotal	40,000	2,390,875	3,396,515	4,735,244	4,142,754	4,212,453	4,499,455	23,416,296
6.Contingency	4,000	239,088	339,652	473,524	414,275	421,245	449,846	2,341,630
7.Total	44,000	2,629,963	3,736,167	5,208,769	4,557,029	4,633,698	4,949,301	25,757,925

240

[illegible]							
a. [illegible]	[illegible]						
b. [illegible]							
c. Forest Mensuration Expert	1	[illegible]					
d. Information Specl	1	1	[illegible]	[illegible]			
e. Workshop Facilitator	1	1	[illegible]	[illegible]			
Sub-Total	[illegible]	[illegible]	[illegible]				
2. Resource Rehabilitation							
a. Proj Manager/AF (LT)	1	[illegible]	[illegible]				
b. Extension/Trng Specl (LT)	1	[illegible]	[illegible]				
c. Monitoring/Evaluation (LT)	1	[illegible]	[illegible]	[illegible]	[illegible]		
d. Soil Agronomist	[illegible]	[illegible]					
e. Agroforestry Research	1	[illegible]					
f. Rural Sociologist	[illegible]						
g. Seed Tree Improv Specl	[illegible]						
h. Tree Forest Ast	[illegible]						
i. Extension Specl	[illegible]						
Sub-Total	[illegible]	[illegible]	[illegible]	[illegible]			
Total	46	53	50	23	[illegible]	[illegible]	[illegible]

1. [illegible]								
[illegible]	[illegible]	[illegible]	[illegible]					
2. [illegible]								
a.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(20 people x [illegible])								
c.Local Instructors	10							
3.Resource Reorganization								
a.[illegible] Term Training	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
(10 people x [illegible])								
b.Workshops			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
(20 people x [illegible])								
c.Training/Research	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]								
[illegible] people x [illegible]								
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]			
Total	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

[illegible]								
a. [illegible] Wheel [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
b. [illegible] Wagon	[illegible]	[illegible]	[illegible]		[illegible]			
c. [illegible] Ton [illegible]			[illegible]					
[illegible] Resource Rehabilitation								
a. [illegible] Wheel Drive	[illegible]	[illegible]	[illegible]	[illegible]				
b. [illegible] Wagon	[illegible]	[illegible]			[illegible]			
c. Tractors	[illegible]	[illegible]	[illegible]	[illegible]				
d. Motor [illegible]	[illegible]	[illegible]	[illegible]					
e. [illegible] Ton [illegible]	[illegible]	[illegible]	[illegible]					
[illegible] Capital Costs								
a. [illegible] Wheel Tractor	$[illegible]	$[illegible]	$[illegible]	$[illegible]	[illegible]			
b. [illegible] Wagon	$[illegible]	$[illegible]	$[illegible]	[illegible]	[illegible]			
c. [illegible]	$[illegible]	$[illegible]	$[illegible]	[illegible]	$[illegible]	[illegible]		
d. Motor [illegible]	$0	$[illegible]	$[illegible]	$[illegible]	$[illegible]	$[illegible]	[illegible]	[illegible]
e. 7 Ton Dump [illegible]	$[illegible]	$30,000	$0	$0	$[illegible]	[illegible]	[illegible]	[illegible]
Sub-Total	$1[illegible]0,000	$1[illegible]0,000	$90,000	$60,000	$1[illegible]	$4[illegible]	[illegible]	[illegible]
-Resource [illegible]	$1[illegible]	$[illegible]	$0	$[illegible]	$[illegible]	[illegible]		[illegible]
-Resource Pen	$0	$175,[illegible]	$9[illegible]	$60,000	$[illegible]	$4[illegible]	[illegible]	[illegible]

292

TABLE 11a

PROCUREMENT PLAN FOR MAINTAINING VEHICLE OPERATION

1.Resource Inventory Fleet								
a.Four Wheel Drive	4	5	5	5	5	5		5
b.Station Wagon	2	2	2	2	2	2		2
c.7 Ton Lorry	1	1	1	1	1	1		1
2.Resource Rehabilitation Fleet								
a.Four Wheel Drive	0	4	9	9	10	12	12	52
b.Station Wagon	0	2	2	2	4	4	4	18
c.Tractors	0	1	2	2	2	2	2	11
d.Motorcycles	0	5	15	25	25	30	30	130
e.7 Ton Lorry	0	1	1	1	2	2	2	9
4.Running Costs								
a.Vehicle								
-Foreign Exchange	$14,000	$30,000	$34,000	$39,000	$48,000	$55,000	$55,000	$275,000
-Local Currency	$63,000	$135,000	$153,000	$171,000	$216,000	$162,000	$162,000	$1,062,000
b.Tractor								
-Foreign Exchange	$0	$2,000	$4,000	$4,000	$4,000	$4,000	$4,000	$22,000
-Local Currency	$0	$9,000	$18,000	$18,000	$18,000	$18,000	$18,000	$99,000
c.Motorcycle								
-Foreign Exchange	$0	$2,500	$7,500	$12,500	$12,500	$15,000	$15,000	$65,000
-Local Currency	0	15,000	45,000	75,000	75,000	90,000	90,000	$390,000
Sub-Total FX	$14,000	$34,500	$45,500	$54,500	$64,500	$55,000	$55,000	$422,000
Sub-Total LC	63,000	159,000	216,000	264,000	309,000	270,000	270,000	1,551,000
-Resource Inventory								
-Foreign E	$14,000	$16,000	$16,000	$16,000	$16,000	$0	$0	$78,000
-Local Cur	63,000	72,000	72,000	72,000	72,000	0	0	$351,000
-Resource Rehabilitation								
-Foreign E	$0	$18,500	$29,500	$38,500	$48,500	$55,000	$55,000	$245,000
-Local Cur	$0	$87,000	144,000	192,000	237,000	270,000	270,000	1,200,000
Total Costs for Vehicles								
-Foreign E	$144,000	$224,500	$135,500	$114,500	$164,500	$100,000	$55,000	$933,000
-Local Cur	63,000	159,000	216,000	264,000	309,000	270,000	270,000	1,551,000
Donkeys	0	23	31	60	36	0	0	150
1.Capital Costs	0	13,800	18,600	36,000	21,600			90,000
2.Maintenance Costs	0	27,600	64,800	136,800	180,000	0	0	409,200

****

July 14, 1987

TABLE 12
INSTITUTION PLAN

Description	FY 87	FY 88	FY 89	FY 90	FY 91	FY 92	FY 93	Total
1.Staff Quarters	0	1	2	2	0	0	0	5
a.Kazgail		1						1
b.Hamadi			1					1
c.Duobeat			1					1
d.Habila				1				1
e.Er Rahad				1				1
2.Other Housing	0	4	8	8	0	0	0	20
a.Kazgail		4						4
b.Hamadi			4					4
c.Duobeat			4					4
d.Habila				4				4
e.Er Rahad				4				4
3.Nursery Centers	0	1	2	2	0	0	0	5
a.Kazgail		1						1
b.Hamadi			1					1
c.Duhebat			1					1
d.Habila				1				1
e.Er Rahad				1				1
4.Hand-Dug Wells	0	5	8	20	5	0	1	39
5.(A)Village Nurseries	0	10	20	30	30	10	0	100
5.(B)Village Nurseries	0	10	20	30	30	20	20	150
6.El Obeid Offices	0	1	0	0	0	0	0	1
7.Resource Inventory Office	0	1						1

295

July 14, 1987

PRICE ASSUMPTIONS

Description	Price Unit	FY 87	FY 88	FY 89	FY 90	FY91	FY 92	FY 93
1.Technical Assistance								
a.Long-Term Contract	$20,000							
b.Long-Term Contract	$20,000							
c.Short-Term Contract	$15,000							
d.Short-Term Contract	$15,000							
e. Long Term/Trust	9,000							
f. Short Term/Trust	9,000							
g. Donkey	600							
f.Donkey Maintenance	1,200							
2.Training								
a.Training Grants	20,000							
b.Study Tours (PW)	$800							
c.Travel Costs	$3,000							
d.In-Country (PW/LS)	1,000							
3.Commodities								
a.(See Procurement Plan)								
b.Vehicles								
-Four Wheel Drive	$15,000							
-Station Wagon	$20,000							
-7 Ton Lorry	$30,000							
-Tractor	$30,000							
-Motor Cycle	$3,000							
-Motorcycle Ops (LC)	3,000							
4.Construction								
a.Office	400,000							
b.Staff Houses	70,000							
c.Other Housing	10,000							
d.Nursery Construction	300,000							
e.Hand Dug Wells	15,000							
f.Village Nursery	3,000							
5.Logistical Support								
a.Vehicle Operations (FX)	2,000							
b.Vehicle Operations (LS)	9,000							
c.MotorCycle Spares (FX)	500							
6.Contingency	10.00%	0.10	0.10	0.10	0.10	0.10	0.10	0.10
7.Inflation								
a.Technical Assistance	1.05	1.00	1.05	1.10	1.16	1.22	1.28	1.34
b.Training	1.05	1.00	1.05	1.10	1.16	1.22	1.28	1.34
c.Commodities	1.10	1.00	1.10	1.21	1.33	1.46	1.61	1.77
d.Construction	1.10	1.00	1.10	1.21	1.33	1.46	1.61	1.77
e.Logistical Support	1.25	1.00	1.25	1.56	1.95	2.44	3.05	3.81
f.Local Costs	1.25	1.00	1.25	1.56	1.95	2.44	3.05	3.81

UNCLASSIFIED

SUDAN

REFORESTATION AND ANTI-DESERTIFICATION

ANNEX G

SCOPES OF WORK

KHARTOUM
JULY 1987

UNCLASSIFIED

Job Description

Chief of Party and Senior Agroforester (Rehabilitation Component of the Sudan Reforestation and Anti-desertification) Project.

Work Location:	El Obeid, Kordofan Region, Sudan
Length of Assignment:	5 years
Responsibility:	Technical and Administrative Head of the Project and Subject Specialist for Agroforestry
Counterpart Staff:	Counterpart Project Manager, Conservator of Forests

Scope of Work and Responsibilities:

This officer will be responsible for the overall technical leadership during the life of the Project and, in close collaboration with his/her GOS Counterpart, be responsible to initiate and manage the Project. He/she will be technically responsible to the GOS and administratively answerable to USAID as the resident manager of the Contractor.

Assisted by his senior staff at El Obeid, the co-project manager and the consultants for various technical specialities, and in close coordination with the Resource Inventory team, he/she will be responsible for carrying out surveys proposed in the project and development of the operational plan, to serve as the main document for implementation. He/she will be required to keep track of the progress of resource inventory data. This data is a necessary pre-requisite for the development of operational plan which will address landuse and land degradation problem in the area. The plan will take into account the data regarding resource situation and needs assessment carried out through the socio-economic survey. This operational plan will be developed under his technical direction.

Assisted by his senior staff at El Obeid and the 5 ACF's at the Rural Councils, will develop detailed annual implementation plans for the field programs as detailed in the project paper, including but not limited to the nursery/extension centers, natural woodland management, agroforestry, as well as the training and extension activities at all levels. He/she shall ensure physical facilities and infrastructures are in place and that all local and international procurment are well planned and executed.

He/she shall be responsible to prepare quarterly progress reports and other technical documentations as generated by the Project or/and needed by the Project training and extension activities. He/she shall serve as the chairman of the Project Implementation Committee and participate in various steering committees.

It will be incumbent on the Officer, to ensure that effective coordination and collaboration takes place between the project and the relevant GOS Regional Departments and donors active in the area with similar activities and programs. He/she will be required to travel extensively in the project area to ensure effective implementation of project activities.

Qualifications:

Ph.D. in agroforestry/social forestry or farming systems with a minimum of five years in project management and technical experience in tropical environments, especially arid/semi-arid areas. He/she with undergraduate degree in Forest Management, should be well versed with use of resource inventory data, its analysis and interpretation for use in forest management and landuse planning. He/she should have had first hand experience in working with NGOs or PVOs as well as with governmental institutions. Working knowledge of Arabic a plus but not a prerequisite.

Job Description

Monitoring and Evaluation Officer

Work Location: El Obeid, Kordofan Region, Sudan

Length of Assignments: 3 years +

Responsibility: Responsible to the Project Leader Rehabilitation Component of the Sudan Reforestation and Anti-desertification Project.

Counterpart Staff: Associate Monitoring and Evaluation Officer (to be selected and hired by the Project or seconded by GOS)

Scope of Work and Responsibilities:

This officer will be responsible for the coordination of project related research, monitoring and evaluation activities to be developed and carried out in the Resource Rehabilitation component. Furthermore, the officer will develop a staffing plan for the office to be submitted to the Project Leader for approval and action. An Associate Officer will be hired and receive on the job training to assume responsibilities for the Monitoring and Evaluation Section in the last years of the Project.

The Officer will be required to work in close cooperation with other the Project Staff in designing questionnaires and monitoring tools and in decision making regarding the direction of the activities. For instance, the Monitoring and Evaluation Officer will assist in determining the villages which will receive direct Project assistance.

In monitoring and evaluating project progress the officer will undertake the following tasks:

a. developing questionnaires and monitoring forms, testing and revising these forms, training the people responsible for collecting the data, making arrangments to ensure adequate supervision, and data processing and analyses;
b. collecting data and reports from other sources which relate to the Project area;
c. ensuring that the data analyses include disaggregation of information by sex of the respondent;
d. ensuring the publication and distribution of surveys and special studies carried out;
e. identifying topics or problems areas which should be studied;
f. writing scopes of work and making arrangements for special studies that will be done by consultants;
g. developing a system for storage and retrieval of Project data and reports ;
h. devising a method for assessing the training activities and their effect, and

i. submitting annual budgets and work plans.
j. coordinate with the Resource Inventory team in collection, analysis and utilization of resource data as it becomes available.

It will be incumbent on the Officer to ensure that the data are collected and processed in a timely fashion to facilitate project decisions.

Qualifications:

Ph.D. in anthropology or related social science discipline, with a minimum of three years experience in conducting or supervising household level research in a developing country. Preference will be given to candidates who have an agricultural/natural resources background and have carried out agroforestry/Social forestry or farming systems research. Candidates should have demonstrated ability to work in collaboration with other technical professionals. If the successful candidate does not speak Arabic, he/she must be willing to learn at least rudimentary Arabic. The specialist must be willing to travel and reside often in the Project Area. Candidates will be required to submit evidence of their analytical capability.

Job Description

Extension/Training officer (Expert)

Work Location: EL Obeid, Kordofan province, Sudan.

Length of Assignment: 3 years

Responsibility: Responsible to the Project Leader Rehabilitation Component of the Sudan Reforestation and Anti-desertification) Project

Counterpart Staff: Project Extension Coordinator, seconded by GOS or hired by the project

Scope of Work and Responsibilites:

This officer will be responsible for the training and extension activities to be designed, developed and carried out. He/she will also be responsible that trained staff and resource materials are in place especially at the regional (El Obeid) and the Rural (Council) Centers. He/she shall make sure that counterpart staff is well trained and given the necessary on the job experience.

The officer will be required to work in close collaboration with the Project Extension Coordinator, Project Monitoring and Evaluation Officer and the Associate Monitoring and Evaluation Officer as well as the Project Leader Agroforestry/Chief of Party. He/she will also work closely with Agriculture Extension Division, Kordofan, WSARP and PVO's active in Agroforestry extension in the Region.

The officer's direct responsibilities will include:

a. Collect and assemble training and extension resource material relevant to the Project.
b. Plan, design and excute training workshops for field extension staff members of the project.
c. Assist the ACF's at the 5 Rural Council Centers to mount extension training courses.
d. Assist in and plan field days, Arbor Day.
e. Prepare and produce extension/training resource material (Audo Visuals, Posters, Film strips, Displays, etc).
f. Assist in project evaluation and monitoring (internal and external).

The officer will discharge these responsibilities in close contact with Project Extension Coordinator (counterpart) and impart necessary skills to him so that he can assume full responsibility for this component of project after 3 years.

Qualifications:

At least M.Sc., but preferably a Ph.D. in Agroforestry/Social Forestry or agricultural extension with a minimum of five years of relevant experience preferably in arid/semi-arid area of LDC's. An M.Sc. or Ph.D. in Horticulture or Home Economics with four to eight years of practical experience may be considered. Candidate should have demonstrated ability to work in collaboration with other technical professionals. Working knowledge of Arabic preferred but not essential.

Job Description

Chief Technical Advisor (CTA) - Resource Inventory Component of Sudan Reforestation and Anti-desertification Project

Work Location: Khartoum, Sudan

Length of Assignment: 3 years, maybe extended to 4 years

Responsibility: Technical and Administrative Head of the Project (Inventory) and Subject Specialist in Vegetation/ Physiographic Mapping and Forest Inventory

Counterpart Staff: Counterpart Project Director, Seconded by GOS, and Senior Conservator of Forests

Scope of Work and Responsibilities:

This officer will be responsible for the overall technical and administrative leadership of the Resource Inventory Component of the project to be implemented in southern Kordofan and southern Darfur, in close collaboration with his/her GOS counterpart.

Assisted by 2 senior level Foresters, and field inventory teams, and other technicians, he/she will draw and develop phased implementation plan for carrying out vegetation/physiographic mapping and forest resource inventory. The First phase will cover the 5 Rural Councils in southern Kordofan (where the Resource Rehabilitation component will be implemented) and the 2nd phase will cover rest of the project area.

The CTA will be responsible for ensuring that physical facilities and infrastructures are in place and that all local and international procurement are well planned and executed.

The CTA will be responsible for monitoring training activities for the Sudanese staff, both in-country and abroad.

The CTA will ensure that the information and data is generated by the project in a timely manner and made available to the Leader of the Resource Rehabilitation Component.

He/she will advise the Inventory, Reservation and Management Unit of the Forest Department on the establishment of an Inventory Unit for handling, processing and statistical analysis of information. He/she will assist with the development of inventory data handling and statistical procedures. He/she will also advise the Inventory Unit on computer data-handling issues and provide data-management training.

He/she will ensure that effective coordination and collaboration takes place between the project and related GOS agencies involved in various project activities, such as National Remote Sensing Center, Sudan Survey Department,

Forest Department, Agriculture Department (Division of Statistics), Soil Survey Administration, etc. He/she will be responsible to prepare quarterly progress reports and other technical documentation as generated by the project.

He/she will be required to travel extensively in the project area to ensure effective and timely implementation of project activities.

Qualifications:

Ph.D. in Resource Inventory/Mapping with at least 5 years experience in the use of remote sensing (satellite imagery) in vegetation/physiographic mapping and forest inventory, at least 2 of which should be in arid/semi-arid regions.

He/she should have had first hand experience with ground surveying forest enumerations, sampling and statistical analysis.

The candidate should have demonstrated ability to work in collaboration with other technical professionals.