PD-AAG-144

UNCLASSIFIED

DEPARTMENT OF STATE

AGENCY FOR INTERNATIONAL DEVELOPMENT

WASHINGTON, D. C. 20523

682 0207 0044201

MAURITANIA OASIS DEVELOPMENT PROJECT

682-0207

PROJECT PAPER

Approved May 22, 1980

ACTION MEMORANDUM FOR THE ASSISTANT ADMINISTRATOR FOR AFRICA

FROM: AFR/DR, John W. Koehring

SUBJECT: Mauritania Oasis Development Project 682-0207

Problem: Your approval is required to execute a grant of $5,991,000 from Section 121 of the Foreign Assistance Act of 1961, as amended, of the Sahel Development Program appropriation to the Government of the Islamic Republic of Mauritania (GIRM) for the Oasis Development Project, Number 682-0207. FY 1980 funding will be $1,142,000 from the Sahel Development Program.

Discussion:

A. Description of the Project:

1. Project Purpose: Oasis agriculture in Mauritania has recently gone through a difficult period. The agricultural production potential of the northernmost oasis areas of the country has been greatly reduced by the 1968-1974 drought. As a result, many inhabitants of these oases are migrating to urban areas. However, because of better water resources, environmental circumstances, and a more fluid social situation, there is greater potential in the southern part of Mauritania for the expansion and improvement of oasis agriculture. The purpose of this project is to introduce technologies in agricultural production and in water resources utilization which will assist oasis residents to become more self-sufficient in food production and to provide an information base for future expanded oasis development. Over a five year period, this project will develop and introduce various measures which oasis communities can undertake at relatively low risk and cost and which can significantly improve the productivity and vitality of the oases.

2. Conformance to A.I.D. Country Strategy: USAID/Nouakchott's strategy for Mauritania emphasizes the development of the traditional interior of the country, and specifically includes the oasis region, where other donors have not been active. The strategy focuses on stabilizing the population in the rural areas through the improvement of living conditions and increasing food production capabilities. This project is consistent with the country strategy. It is part of a three-pronged pilot project approach in agricultural development, together with USAID/Nouakchott's Integrated Rural Development Project, 682-0201, and Vegetable Production Project, 682-0204.

3. Beneficiaries of the Project: The direct beneficiaries of the project will be the 34 local personnel to be hired, some of whom will be trained by the project; the 49 other Mauritanians to receive training, either on-the-job, through project seminars, or in third country or U.S. long-term and short-term training programs; the 600-700 oasis farmers who will receive technical and commodity assistance through the project; and the 4200 oasis residents who will benefit from increased production. Since this is an activity designed to identify interventions to extend to more oases in a possible Phase II effort, ultimate beneficiaries would be an estimated 100,000 oasis inhabitants or about 8% of the country's total population. It is also envisioned that the results of this

project will prove to be beneficial to oasis residents in other Sahelian countries with similar oasis conditions.

B. Financial Summary of the Project:

1. Life-of-project funding is $5.991 million, of which $1.142 million is requested for FY 1980. Project inputs are identified as follows:

	($ Thousands) FY 1980	All Years
Technical Assistance and Personnel	325	3,776
Commodities	616	1,549
Other (Construction, Training, Evaluation)	201	666
Total AID Contributions	$1,142	$5,991

2. Host Country Contributions: GIRM contributions to the project are to be in personnel and facilities and will total $350,000. The Ministry of Rural Development will provide the training and extension coordinator, extension agents who will receive on-the-job training, and the soil agricultural station to the project. Varying amounts of time of other GIRM personnel from the Agricultural Service, the Kaedi Agricultural School, and the livestock services will also be provided.

C. Socio-economic, Technical, and Environmental Description:

1. The socio-economic acceptability of the project: This project focuses on the development of socially and technically viable technologies in agricultural production and water resources utilization. These techniques will be designed to improve small farmers' welfare and preserve or improve upon the physical environment. However, in order to be adapted, the techniques introduced by the project must be kept simple and low-cost. The six oases included in this project were selected on the basis of their broadly representative social mix, and indications that the residents will support project activities as well as benefit equitably from the project interventions.

2. Implications with respect to human rights: There are no human rights issues concerning Mauritania which could preclude authorization of this project.

3. Technical Analysis: This project has been found to be technically sound.

4. Environmental Analysis: The I.E.E. recommends a negative determination. As stated in the I.E.E., a risk/benefit analysis will be done before any pesticides are purchased for, or used in, the project; drinking water in the project oases

will be tested periodically for purity and appropriate environmental analyses will be done before any interventions developed by the project are extended to oasis farmers.

D. Major Conditions Precedent and Covenants, Waivers and Major Implementing Agencies:

(The attached Project Authorization contains all conditions precedent and covenants).

1. Waivers

A waiver from Geographic Code 000 (U.S. only) to Code 935 (Special Free World) is requested for the purchase of four-wheel-drive vehicles. Justification for this waiver appears in the project paper and is also attached to this memorandum.

2. Major Implementing Agencies:

The major implementing agencies will be the Directorate of Agriculture within the GIRM Ministry of Rural Development and a U.S. contractor to be selected through the A.I.D. competitive bidding process. In order to expedite early implementation of the project, an administrative officer will be funded through the project as a Personal Services Contractor.

E. Committee Action and Congressional Apprisement:

1. Final Project Review: The Project Paper was recommended for approval at the Project Review meeting, chaired by Jonathan R. McCabe, AFR/DR/SFWAP, on 21 January 1980; minor changes have been incorporated in the Project Paper. It was further determined that no outstanding issues remain unresolved; however, an ECPR meeting was recommended in order to inform the AA/AFR of the project. An addendum to this memorandum describes changes in the project paper in response to the ECPR meeting.

2. Congressional Apprisement: This project appears in the FY 1980 Congressional Presentation, page 111.

F. Responsible Officers:

The officer responsible for backstopping the project in AFR/DR will be Edmund Sullivan, while the USAID/Mauritania project manager will be Barnett Chessin.

Recommendation:

A. That you sign the attached Project Authorization, approve the requested waiver, and concur in a Negative Environmental Determination.

Attachment: as stated

Clearances:
for DAA/AFR:WHNorth RM
AFR/DR/SFWAP:JRMcCabe (draft)
AFR/DR:NCohen
AFR/SFWA:HGray (draft)
AFR/SFWA:CRobertson (draft)
AFR/GC:NFrame (draft)
AFR/DR/ARD:QBenbow (draft)
AFR/DR/SDP:BBoyd (draft)
AFR/DR/HRD:MSeymour (draft)
AFR/DR/ENGR:RPayette (draft)
SER/COM/ALI:PHagan/BStader (draft)
for AFR/DP:JAnderson PM
PPC:JOweis (draft)

Drafted by:USAID/Mauritania:AReed:2/4/80

ADDENDUM TO ACTION MEMORANDUM
Mauritania Oasis Development Project

The following changes have been incorporated in the Project Paper, as a result of discussions during the ECPR meeting on 1 February 1980:

A. Financial Plan:

The project budget has been modified resulting in a reduction in the total A.I.D. contribution from $7,350,000 to $5,991,000. This has been accomplished in the following manner, which does not affect the quality or quantity of A.I.D. project inputs:

1. The administrative officer for the project will remain as a Personal Services Contractor throughout the life of the project rather than being incorporated into the contract team during the second year. This will eliminate the need for institutional contractor overhead costs for the administrative officer.

2. Since the Personal Services Contractor administrative officer will also manage the local personnel hired through the project, this will eliminate contractor overhead for that category as well.

3. The contingency factor has been reduced from 15% to 5%, thus reflecting standards used in other Sahelian countries.

4. There has also been a shift in some projected expenditures from later in the project to earlier, thus incurring a lower expected inflation factor.

B. Beneficiaries:

The statement on target beneficiaries has been clarified to assure that the direct beneficiaries will be oasis farmers, men and women, who choose to participate, with the help of the project technicians, in adopting the technologies extended from Sani to their communities. Direct beneficiaries will be those who work on their own behalf and are actual oasis farmers themselves rather than people who may hire others to work for them.

C. Training and Institutional Strengthening:

A table and statement have been added to the training section of the PP to clarify the numbers of Mauritanians who will receive training through the project and to indicate that local people will be able to replace most of the U.S., short-term and long-term technicians provided through this project when the GIRM expands the oasis development activities to more oases in Southern Mauritania following this project.

D. Evaluation and Phase II:

A statement has been added to the evaluation plan indicating that there will be an in-depth evaluation during the third year of the project to ascertain whether the methods of encouraging oasis farmers to adopt new technologies are appropriate. The evaluation will be used to determine whether to continue funding for the last two years of the project. In addition, the GIRM as per a covenant in the Grant Agreement will have indicated a commitment to oasis development, through the development of a plan to carry out a second phase to extend the project interventions to other Mauritanian oases. Evidence of this commmitment will play a significant role in determining whether to continue the project beyond the third year.

Furthermore, at the time of this evaluation, the subject of institutionalization of oasis agriculture within the Ministry of Rural Development will be re-examined in depth to determine whether a formally distinct administrative structure would be preferable to the existing structure.

E. Economics:

A statement has been added to the economic feasibility analysis indicating that if date, fruit, henna, and other crop production activities are expanded, marketable surplus can be sold in local and regional markets. Thus, increased oasis production capabilities should be an incentive for farmers to remain in the oases. In addition, new techniques of production taking advantage of the dry season when the normally low level of oasis agricultural activity drives residents to seek economic activity elsewhere, should also encourage farmers to remain in the oases. Further work on marketing questions will be addressed during project implementation.

Procurement Source Waiver

1. Waiver Required: A procurement source waiver from AID Geographic Code 000 (U.S.) to Geographic Code 935 is required for motor vehicles. As discussed below, the primary basis for this waiver is that U.S. vehicles cannot be used effectively in Mauritania because of the unavailability of spare parts and the lack of experience in the use and maintenance of U.S. motor vehicles.

The total amount of the waiver will not exceed $120,000 which will be for eight 4-wheel drive vehicles at $15,000 each.

2. Justification: Mauritania faces a situation in which imports emanate almost entirely from France and other European Community countries. This past trade pattern, which has developed over many years, has resulted in the training of Mauritanians in the use and maintenance of European-made goods and in the establishment of a spare parts source in Mauritania. American manufacturers and American distribution and service firms are only recently entering this market to tentatively look into the possibility of competing with these sources. As a result, the capability to obtain special parts for U.S.-made equipment does not now exist in Mauritania, and Mauritanians are not now trained in the basics of their maintenance. In the past, audits and inspections of AID projects have been critical of the difficulties that host countries have in maintaining U.S. vehicles after the project phases out. Coupled with the severe sand and wind conditions in Mauritania, vehicles are subjected to harsh conditions not normally faced and require constant repair and access to spare parts and maintenance. Project vehicles will be used for travel on rough rural roads.

These motor vehicles are an essential part of the successful implementation of this project and are not available from eligible sources. The concept of availability means in-place facilities to repair and maintain the vehicles once delivered. They must be the type that the host country can use effectively over a normal useful life when taking into consideration spare parts and maintenance. It would be unwise for the U.S. Government to use vehicles which cannot be maintained effectively over the life of this project and which, when turned over to the GIRM, would be outside their competence to maintain under the best of circumstances.

These motor vehicles are essential to the success of this project and the GIRM does not have the necessary foreign exchange to procure them. For these reasons, it is necessary, in order to carry out the purpose of the Foreign Assistance Act (FAA) to waiver the requirements of Section 636(i) of the FAA, which requires that motor vehicles procured for the project be manufactured in the U.S. In addition, it is necessary to authorize procurement of the above described motor vehicles from Geographic Code 935 countries because the exclusion of procurement from these sources would seriously impede attainment of U.S. foreign policy objectives and the objectives of the foreign assistance program in Mauritania.

PROJECT AUTHORIZATION

Name of Country: Mauritania Name of Project: Oasis Development

Number of Project: 682-0207

1. Pursuant to Section 121 of the Foreign Assistance Act of 1961, as amended, I hereby authorize the Mauritania Oasis Development Project for the Government of the Islamic Republic of Mauritania involving planned obligations of not to exceed $5,991,000 in grant funds over a five year period from date of authorization, subject to the availability of funds in accordance with the AID OYB/allotment process, to help in financing foreign exchange and local currency costs for the project. Funds for the final two years of the project shall not be obligated until after an evaluation of the first three years of the project is completed and reviewed with the Cooperating Country and a decision is made by the Director of AFR/DR to continue the project.

2. The project consists of the development and introduction of effective and appropriate techniques for the development of Mauritanian Oases in the areas of agricultural production and water resources utilization. Activities to be included in this project are: more efficient use of water resources; improved varieties and techniques for date production; improved cultivation of grains and diversification to include vegetables; improvements to animal husbandry; "living" fences to protect cultivation from livestock; and woodlot cultivation for environmental protection and fuel. Each general category will include commodity and technical assistance and appropriate training and evaluation elements. Particular emphasis will be given to women in the oasis economy and activities to strengthen their developmental roles.

Experimental activities will be undertaken first at the Sani Oasis. If such activities prove to be applicable to oasis situations, they will be extended to farmers in other oasis locations for demonstration and replication. In addition, the project will develop an information base for future expanded oasis development.

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.

4.a. Source and Origin of Goods and Services

Goods and services, except for ocean shipping, financed by A.I.D. under the project shall have their source and origin in Cooperating Country or in countries included in A.I.D. Geographic Code 941 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 or the Cooperating Country.

b. Conditions Precedent to Disbursement

1. Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement, the Cooperating Country shall furnish in form and substance satisfactory to AID, evidence that it will make available the Sani agricultural station for the technology introduction trials to be carried out under the Project.

2. Prior to any disbursement, or the issuance of any commitment documents under the Project Agreement for activities in N'Takat el Quassa, El Grahan or Samoga, the Cooperating Country shall furnish in form and substance satisfactory to AID, evidence that it has obtained the agreement from each of these oasis communities that they will accept an Oasis Development Worker who will live and work in the oasis, that they will make oasis land available for project activities and that they will cooperate with project technicians.

c. Special Conditions

1. The Project Agreement shall contain a special condition (preferably added to section 2.2 of the Project Agreement) providing in substance as follows: In addition, AID's contribution to the project beyond the first three years will be subject to completion of an evaluation of the project and agreement by AID and the Cooperating Country that the project should be continued for the final two years.

d. Covenants

1. The Cooperating Country covenants to assign a Training and Extension Coordinator to the project as well as three extension agents of the Mauritanian Agriculture Service who will work primarily with the initial trials at Sani and receive on-the-job training.

2. The Cooperating Country covenants to provide regional extension personnel who will have continuing monitoring responsibilities of trial activities in oasis communities.

3. The Cooperating Country covenants that training opportunities provided under this agreement shall be available on an equitable basis to both women and men as well as to all social groups in the project area. Likewise, the Cooperating Country covenants that women and men of all social groups shall be equally considered as candidates for positions as Oasis Development Workers, or for any assistant positions.

4. The Cooperating Country and AID agree that an environmental examination of all project activities developed at Sani will be performed prior to introducing such activities into any of the oasis communities.

5. The procurement and use of pesticides under the Project shall be in accordance with AID environmental regulations in effect at the time.

6. The Cooperating Country covenants to collaborate with USAID in performing scheduled project evaluations and periodic informal reviews of the project.

7. The Cooperating Country covenants to submit to AID, at the conclusion of the first year of the project, its proposal for the further institutionalization of oasis agriculture within the Ministry of Rural Development.

8. At the time of the third year project evaluation AID and the Cooperating Country will reexamine the subject of the institutionalization of oasis agriculture within the Ministry of Rural Development to determine whether a formally distinct administrative structure for oasis agriculture would be preferable to the existing structure.

9. The Cooperating Country covenants to develop during the third year of the project a plan acceptable to AID for extending the oasis development activities developed under this project to other Mauritanian Oases.

d. Waivers

Based on the justifications set forth in Annex J of the project paper, I hereby:

1. Approve a procurement source waiver from AID Geographic Code 000 (U.S. only) to AID Geographic Code 935 (Special Free World) for the procurement of motor vechicles;

2. Certify that exclusion of procurement from free world countries other than the Cooperating Country and countries included in Code 941 would seriously impede attainment of U.S. foreign policy objectives and objectives of the foreign assistance program;

3. Find that special circumstances exist which justify the waiver of the requirement of procurement of U.S. manufactured motor vehicles under Section 636(i) of the Foreign Assistance Act of 1961, as amended.

Goler T. Butcher
Assistant Administrator
for Africa

Date

Clearances: As shown on Action Memorandum

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT PAPER FACESHEET

1. TRANSACTION CODE: A (A ADD, C CHANGE, D DELETE)

PP

2. DOCUMENT CODE: 3

3. COUNTRY/ENTITY: Mauritania

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 digits): 682-0207

6. BUREAU/OFFICE: A. SYMBOL: AFR; B. CODE: 06

7. PROJECT TITLE (Maximum 40 characters): Oasis Development

8. ESTIMATED FY OF PROJECT COMPLETION: FY 85

9. ESTIMATED DATE OF OBLIGATION: A. INITIAL FY 80; B. QUARTER 2 (Enter 1, 2, 3, or 4); C. FINAL FY 84

10. ESTIMATED COSTS ($000 OR EQUIVALENT $1 –)

A. FUNDING SOURCE	FIRST FY B. FX	FIRST FY C. L/C	FIRST FY D. TOTAL	LIFE OF PROJECT E. FX	LIFE OF PROJECT F. L/C	LIFE OF PROJECT G. TOTAL
AID APPROPRIATED TOTAL	698	444	1142	3780	2211	5991
(GRANT)	(698)	(444)	(1142)	(3780)	(2211)	(5991)
(LOAN)	( )	( )	( )	( )	( )	( )
OTHER U.S. 1.						
OTHER U.S. 2.						
HOST COUNTRY		50	50		350	350
OTHER DONOR(S)						
TOTALS	698	494	1192			6341

11. PROPOSED BUDGET APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. 1ST FY 80 F. GRANT	E. 1ST FY 80 G. LOAN	H. 2ND FY 81 I. GRANT	H. 2ND FY 81 J. LOAN	K. 3RD FY 82 L. GRANT	K. 3RD FY 82 M. LOAN
(1) SH	122	020	NA	1142		1160		1979	
(2)									
(3)									
(4)									
TOTALS									

A. APPROPRIATION	N. 4TH FY 83 O. GRANT	N. 4TH FY 83 P. LOAN	Q. 5TH FY 84 R. GRANT	Q. 5TH FY 84 S. LOAN	LIFE OF PROJECT T. GRANT	LIFE OF PROJECT U. LOAN
(1) SH	540		1170		5991	
(2)						
(3)						
(4)						
TOTALS						

12. IN-DEPTH EVALUATION SCHEDULED: MM 08 YY 82

13. DATA CHANGE INDICATOR. WERE CHANGES MADE IN THE PID FACESHEET DATA, BLOCKS 12, 13, 14, OR 15 OR IN PRP FACESHEET DATA, BLOCK 12? IF YES, ATTACH CHANGED PID FACESHEET.

2 (1 = NO, 2 = YES)

14. ORIGINATING OFFICE CLEARANCE

SIGNATURE:

TITLE: Mission Director

DATE SIGNED: MM 12 DD 19 YY 79

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM 12 DD 21 YY 79

AID 1330-4 (3-78)

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT IDENTIFICATION DOCUMENT FACESHEET

TO BE COMPLETED BY ORIGINATING OFFICE

1. TRANSACTION CODE: C (A = ADD, C = CHANGE, D = DELETE)

PID

2. DOCUMENT CODE: 1

3. COUNTRY/ENTITY: MAURITANIA

4. DOCUMENT REVISION NUMBER:

5. PROJECT NUMBER (7 DIGITS): 682-0207

6. BUREAU/OFFICE: A. SYMBOL: AFR; B. CODE: 06

7. PROJECT TITLE (MAXIMUM 40 CHARACTERS): OASIS DEVELOPMENT

8. PROPOSED NEXT DOCUMENT

A. 3 (2 = PRP, 3 = PP)

B. DATE: MM 12 YY 79

9. ESTIMATED FY OF AUTHORIZATION/OBLIGATION

a. INITIAL FY 80 b. FINAL FY 84

10. ESTIMATED COSTS ($000 OR EQUIVALENT, $1 =)

FUNDING SOURCE	LIFE OF PROJECT
A. AID APPROPRIATED	5991
B. OTHER U.S. 1.	
B. OTHER U.S. 2.	
C. HOST COUNTRY	350
D. OTHER DONOR(S)	
TOTAL	6341

11. PROPOSED BUDGET AID APPROPRIATED FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	PRIMARY TECH. CODE C. GRANT	PRIMARY TECH. CODE D. LOAN	E. FIRST FY 80 F. GRANT	E. FIRST FY 80 G. LOAN	LIFE OF PROJECT H. GRANT	LIFE OF PROJECT I. LOAN
(1) SH	122	020	NA	1142		5991	
(2)							
(3)							
(4)							
			TOTAL				

12. SECONDARY TECHNICAL CODES (maximum six codes of three positions each)

070 | 090 | 310

13. SPECIAL CONCERNS CODES (MAXIMUM SIX CODES OF FOUR POSITIONS EACH)

BSW | PART | TECH | EQTY | NUTR | ENV

14. SECONDARY PURPOSE CODE: 242

15. PROJECT GOAL (MAXIMUM 240 CHARACTERS)

To improve the economic vitality and capability of the Mauritanian oases to support their people at a better condition of living and to diminish migration from the oases to urban areas.

16. PROJECT PURPOSE (MAXIMUM 480 CHARACTERS)

to introduce appropriate new technology to help oases people to become more self-sufficient in food production and to provide an information base for future expanded oasis development.

17. PLANNING RESOURCE REQUIREMENTS (staff/funds)

18. ORIGINATING OFFICE CLEARANCE

Signature: [signature]

Title: Mission Director

Date Signed: MM 12 DD 19 YY 79

19. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION: MM 12 DD 21 YY 79

AID 1330-2 (3-76)

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J. PROCUREMENT EVALUATION
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PART I

DESCRIPTION OF PROJECT

A. SUMMARY

The drought which began in the Sahel in the late 1960s still persists after ten years. Rainfall has continued to be but a fraction of normal years in Mauritania. It was 60 percent of normal in 1978 and less than 60 percent so far in 1979 (as of November). The desert continues to edge southward throughout the Sahel; some northernmost oases in Mauritania are dying. Water tables sustaining many of these oases are being drawn down much faster than they recharge, to the point that they have dropped below the roots of date palms and other vegetation. In such areas, natural vegetation has been depleted and crop production is kept alive only by heroic methods of expensive irrigation, which further lowers the water tables. In several key areas the ground water has become saline, and irrigation may soon have to end. The oasis communities of these northern reaches of Mauritania cannot easily be sustained and many of the inhabitants are leaving. Environmental damage threatens the viability of these oases to sustain their people and the future looks increasingly bleak.

However, water resources are much better for the southern oases, and there are options and opportunities which can be tried that could make these oases more productive and could work to stabilize the environment in which they exist. Over a five year period this project will introduce various measures which oasis communities can undertake at feasibly low risk and cost which can significantly improve the productivity and vitality of their oases, improve the level of living of the people, and which may slow some of the current out-migration of oasis people toward the urban centers.

Initial activities will be undertaken at four oasis locations in the southern region of Assaba: Sani, N'Takat el Ouassa, El Grahan and Samoga. These locations have the typical oasis production mix of livestock herding, date palm and grain cultivation, and the communities appear to be receptive to self-help and innovation. They will be assisted in participating in selected demonstrations. During project implementation, other oases will be surveyed as to water and soil resources, current agricultural production, social ethnic mix, and environmental conditions. Some of these may be selected for introduction of demonstrations. These other oases will be evaluated for their potential for development assistance if the results of this initial project justify a subsequent wider-spread oasis development program.

Activities to be introduced in this project will be in these general categories: more efficient use of water resources; improved varieties and techniques for date production; improved cultivation of grains and diversification to include vegetables; improvements in animal husbandry; "living" fences to protect cultivations from livestock; and woodlot cultivation for environmental protection and fuel. Each general category will include commodity and technical assistance and appropriate training and evaluation elements. Particular emphasis will be given to women in the oasis economy and activities to

strengthen their developmental roles. In this regard, health, nutrition and women's roles in agricultural production will be taken into account in the project interventions.

Information will be needed on the effectiveness of some of the interventions before they are extended to oasis communities so that the risks taken by oasis farmers are minimized. In these cases, initial activities will be undertaken at a separate area at Sani, one of the proposed oases sites. If they prove to be applicable, they will then be extended to oasis farmers for demonstration and replication. A technical assistance team will conduct the initial activities and supervise the technology introductions at the participating oases in conjunction with Government of the Islamic Republic of Mauritania (GIRM) rural service cadre serving the region (agriculture, natural resources, hydrology, livestock etc.).

The project is designed to be simple in techniques and activities and modest in intervention costs. This should enhance the prospects for success and replication. The technical assistance will be provided with and through GIRM support services at the central and regional levels.

Project costs for the five year project are budgeted at $6,341,000 of which $5,991,000 will be the AID contribution and $350,000 for GIRM.

By the end of this project, effective and appropriate measures for the development of Mauritanian oases will have been introduced and replicated in up to six oases located in the Assaba Region. Successful activities will be those showing significant economic and social benefits relative to costs. The overall test of project success will be demonstrable improvements in the living condition of oasis people as measured in production, health, and environment. The project also will have collected information on the development potential of a substantial number of other Mauritanian oases for involvement in a subsequent wider-spread program.

B. LOGICAL FRAMEWORK

Design of this project has been in the context of the authorization contained in State 031463 which provided the guidance of AA/AFR and of the PID Review Committee. Also followed has been the Country Development Strategy Statement for Mauritania of July 1979, which provided the following strategy in project design: "...to the extent possible...to incorporate the following key elements:

- the amalgamation of modern and traditional techniques and practices;
- the use of intermediate technology;
- the use of AID technicians as project elements;
- the assumption by the AID mission of certain administrative tasks associated with projects normally assumed by host governments in more advanced countries;
- the decentralization of government administration; and
- the need to "design out" recurrent costs. (see 1981 CDSS page 53 - Project Design)

While recognizing the limitations in institutional capabilities which

justify the above strategy, design of this project also took into account the imperative to help Mauritania strengthen and modernize its institutional structure for development. In this regard, an attempt has been made to incorporat appropriate involvement and training of the government's extension and outreach services in the implementation of this project.

With regard to the geographical area of concentration, this project is concerned with development of the oases of the Assaba Region, a part of the traditional interior identified in the CDSS for priority attention by AID.

1. Goal -- This project is designed to improve the economic vitality and capability of the Mauritanian oases to support their people at a better condition of living, and to diminish migration from the oases to urban areas.

2. Purpose -- to introduce appropriate new technology to help oasis people become more self-sufficient in food production and to provide an information base for future expanded oasis development.

3. Activities

a. Sites and Interventions

This project will be conducted in oases of the Assaba Region in the central southern tier of Mauritania. Most of these oases are still "living" and water resources can, with more efficient use, support increased production and larger populations. Although the Assaba Region has felt the effects of the drought, which has greatly reduced grain harvests, more efficient use of water and improved cultivation techniques can help restore environmental health and productive capacity of the oases. By centering this initial project in a region with a limited radius (about 70 km maximum), administration of the technical trials and extension assistance will be more feasible and efficient. There are ample numbers of oases within this area (around 70 in the Assaba) from which candidate communities will be selected to participate in demonstrations and replications of successful ventures. Improved roads (Nouakchott-Kiffa-Nema and Kiffa-Kankossa) are making access to these Assaba oases easier and are opening them to social changes. This is weakening the traditional hold of the wealthier herders (Bidan Moors) over the poorer herder-farmers (Haratin and Zenaga Moors - see Social Analysis Annex C-5) and giving the latter group a stronger influence over their own productive efforts. (See Annex B for further discussion of the Assaba as a region for particular development attention and for profiles of selected oasis sites).

Four sites have been selected for initial trial activities because of the relative availability of water, the representative nature of current production and animal husbandry, the potential for acceptance of the innovations to be tried, and the nature of the social mix. Traditionally the oases and their production have been owned by wealthy Bidan Moors while poorer Haratin and non-Moors have had little opportunity to benefit from oases. However, changing social circumstances, particularly in the Assaba Region, are loosening this traditional structure. The oases chosen for involvement in this project have a broader social base of beneficiaries. Further surveys of water resources will be conducted at each oasis area selected as an initial

activity. The purpose of this will be to evaluate the potential expansion limits to agricultural production at each oasis (initial studies during project design verified sufficient water availability for trials but did not measure maximum limits of potential cultivation areas). The four initial oasis sites are Sani, N'Takat el Ouassa, El Grahan and Samoga.

Among other Assaba oases which might later participate in the project activities are Billaouar and Bougaara, 60 kms east of Kiffa, the regional capital. These oases will soon become more accessible, with completion of a new road from Kiffa to Nema now under construction. This will open the oases to transport and modern marketing and will ease traditional social constraints to innovation and community action.

During the third year of the project, an evaluation of the results to date will indicate prognosis for a broader program. To measure the potential scope of such a program, hydrogeologic and other surveys of up to 40 oases will be conducted to identify future potential participating oases.

This 5-year project will introduce appropriate new technologies which can significantly improve the efficiency of oasis cultivation of agricultural crops, increase the oasis farmers' productive output, improve their nutrition and protect their environment. Innovations will include such activities as these:

Agricultural Production

-New or improved varieties of date palms, including disease-resistant varieties.
-Improved pest management techniques including chemical and biological controls.
-More efficient and simple pollination techniques.
-Use of micro-climate under palms for other cultivations.
-Introduction of other fruit tree crops, including citrus.
-Nursery propagation of tree and living fence stocks.
-Improved varieties of sorghum, millet and other grains.
-Improved varieties and cultivation techniques for henna.
-Improved varieties and cultivation of field and root crops.
-Introduction of diverse vegetables in oasis cultivations (emphasis on those which can be introduced in diets to address nutritional deficiencies).
-Cultivation of forage for animals.
-Living fencing to protect cultivations from animals.
-Windbreak plantation to protect cultivations and habitations.
-Controlled pasturing of herds to protect environment.

Water Resources and Utilization

-Options in well construction (traditional, improved-traditional, modern cement-lined, simple hydraulically-driven pipe well).
-Options in water drawing techniques (hand drawn, use of pulleys, weighted lever "shadouf", animal traction, horizontal wheel "Noria", and varieties of hand pumps).
-Water delivery options (by hand, by animals, gravity flow).
-Irrigation options (channels unlined, cement-lined, plastic lined; pipes, hoses; trickle irrigation).
-Simple filtration systems for pure drinking water.

The above general listing is illustrative only. There will be other activities identified and added during the project implementation. (See below, Part II-A for elaboration).

b. Coordination between GIRM and USAID

At the inception of the project GIRM and USAID will hold discussions with the proposed oases to reach agreements regarding participation in the project. The Project Grant Agreement will contain a condition precedent requiring that the GIRM execute an agreement with participating oasis communities providing that the communities will (a) accept an Oasis Development Worker who will live and work in the community; (b) make land available for project activities; and (c) cooperate with project technicians. There will also be a condition precedent requiring that the GIRM make the Sani research station available to the project. The Grant Agreement will also contain covenants providing in substance as follows: (a) training opportunities provided through the project should be made available to women and to all social groups in the project area, and that such individuals should also be considered as candidates for Oasis Development Worker, or assistant, on an equitable basis; and (b) before any project interventions will be extended to participating oasis farmers, appropriate environmental analyses will be done, and (c) the GIRM will indicate its commitment to expanding the oasis development activities to other Mauritanian oases through the development of a plan to do so by the time of the evaluation during the third year. The GIRM will also provide for organizational arrangements to involve the GIRM regional extension personnel with continuing monitoring responsibilities in the extension of these trials; for assignment to the project of a Training and Extension Coordinator as well as three agents of the Mauritanian Agricultural Service who will work primarily with the initial introductions at Sani and receive on-the-job training; and agreement to collaborate and participate with USAID in scheduled project evaluations and periodic informal reviews. These conditions have been discussed with the GIRM and have been agreed to in principle.

Other conditions precedent and covenants to this project were the subject of considerable discussion during its review, and a series of conditions precedent and covenants are reflected in the Project Authorization.

The Project Agreement will also contain the USAID commitments to provide a technical assistance package which will include specified long and short-term specialists; construction of certain essential but modest facilities; commodity assistance in tools, seeds, fertilizers, variety plant stocks, wire and fencing, project vehicles, pumps and irrigation supplies and other required items as listed in Annex H; salaries and/or support costs for designated full-time Mauritanian project personnel; support to the agricultural agentsworking and training on the project; transportation support to GIRM extension personnel when they are assisting in installing extension demonstrations in the oases; training costs; and other operating costs associated with implementing the project.

The technical assistance team programmed for the project will consist of the following:

1. Team Leader/Agronomist
2. Short term consultant specialists: Horticulture, Date palms, Irrigation, Intermediate technology (pumps), Animal traction, Diet/nutrition specialist (Mauritanian), Agricultural economist
3. Oasis Development Workers (one for each oasis)
4. Team Administrative Officer
5. Rural Works Mechanic/Technician (Mauritanian)
6. Various supporting laborers, drivers, clerks, assistants.

The above team will be supplemented by the GIRM Training and Extension Coordinator and by three agricultural extension agents (moniteurs) who will be the counterparts for the technical specialists.

During the implementation, initial trials of technologies will take place at the Sani station to insure that they are appropriate to the environmental and climatic conditions of the oases and to the technical capabilities of the oasis people. Once verified, the Training and Extension Coordinator (TEC) will coordinate the introduction of the technology innovations in demonstrations at the oases working with the GIRM extension service personnel in identifying

appropriate farmer participants and assisted by the Oasis Development Worker in helping the participants to initiate their demonstrations. Depending on the nature of the demonstration, assistance to the farmer participants may include traditional tools, seeds, fencing, traditional well improvement or construction, irrigation hose or supplies for lining channels, nursery stock for transplants, selective fertilizers and insecticides, assistance in constructing water-lifting devices and other items the particular activities require. The assistance necessary will be determined by the Training and Extension Coordinator, who will secure or arrange for provision of the requirements from the project headquarters at Sani.

The demonstrations at the oases will be evaluated as to the relative ease or difficulty in getting them introduced and operating, the labor and other inputs required of the participants, and the interest on the part of other oasis farmers which they generate. These factors will be important in verifying the replicability of the technology for a broader second phase program. A further test will be instances of adoption by other oases farmers of innovations they have observed in the oasis demonstrations. Technical assistance will be offered to these other farmers as well for such introductions, although on a more limited commodity assistance scale.

The technical assistance team will operate under USAID administrative and technical guidance through a Project Manager. Since the team will include its own Administrative Officer, administrative support requirements imposed on USAID will be limited generally to certain project implementation processes for procurement, contracting and training. However, there will be need for appropriate USAID participation in various substantive project implementation elements and USAID staff specialists in agronomy, sociology, education, environment, nutrition, and health will be called on from time to time to supplement the TA Team. Also, important linkages will exist between the Oasis Development Project and other USAID projects, such as Vegetable Production, Renewable Resources, and Rural Assessment Manpower Survey (RAMS). The Project Manager will be responsible to insure that such linkages and coordination will take place, in collaboration with managers of the other USAID projects. A system to insure this coordination is being adopted by USAID.

The project team will work in collaboration with GIRM regional officials in the Assaba Region, including the Governor, the Prefets, and the regional representatives of technical services of the GIRM (especially agriculture, hydrology, rural works, health, environmental protection, and animal husbandry). In Nouakchott, the responsible GIRM official concerned with this project is the Director of the Agricultural Service who reports directly to the Minister of Rural Development. Inasmuch as field personnel of the various central ministries report administratively to the Governor of the region, coordination between these GIRM officials will take place at the Governor's level for activities of this project, the same as for other government and assistance programs in the region.

The GIRM and USAID will conduct negotiations with the oasis communities to secure formal understandings and commitments relative to their participation in the project. Initially, they will be asked to agree to these conditions: to

accept an Oasis Development Worker who will live in their oasis as the project representative to serve as liaison and advisor to the members of the community; to authorize this worker to build a project building of simple traditional construction to serve as his shelter and as a storehouse for project commodities; to provide a plot of land to be used for a nursery of tree and living fencing stocks; to agree, in principle, that some oasis cultivators will make available for project technology introductions parts of their individual plots, the timing and size of plots to be negotiated with extension personnel during the project; to secure agreement of these oasis cultivators that they will care for, water and harvest these crop introductions, subject to their being permitted to own/consume/sell their harvest as they wish; to secure agreement that they will follow the advice of the resident Oasis Development Worker and other project technicians in the cultivation and care of these trials and will assist the O.D. Worker to collect production and other information.

The incentives for the oasis community to participate in the project will be the expectation that their production will be improved by the new technology. The communities will also benefit from geophysical surveys which will pinpoint best water sources for exploitation in the oasis area; a simple hydraulically driven pipe well, such as the "Tysen" pump, and hand pump to be installed for pure drinking water for the community and irrigation water for the nursery; a demonstration modern well and simple filtering system, also to provide pure drinking water; and a substantial quantity of wire fencing (for up to 30 quarter-hectare plots in each oasis) to be issued to those farmers willing to plant living fences around their cultivated perimeters. (As the living fences are large enough to take over, in three years, the wire fencing can be moved by those farmers to further extend their protected cultivations.)

Discussions by the design team with oasis farmers and with GIRM officials in the region indicated that these incentives and prospects for increased production should ensure acceptance by the communities to participate, and cooperation of the farmers in the technology introductions.

c. Project Inputs

(1) By AID;

Technical assistance team and support funding, construction of modest Sani facilities (storage/office and simple overnight accommodations, perhaps based on the modified low-cost buildings built by the ADAUA-SOCOGIM Project in Rosso) commodities for Sani trials and extension introductions at oases, geophysical and other studies, travel and transportation and rents, training costs, and other operating requirements (see Part III and Annex H for details).

(2) By GIRM and Oases Communities:

Approximately fifty person years over the five years of the project, including varying amounts of the time of the Director of the Agricultural Service, the regional governor, the regional representatives for agriculture, hydrology, rural works, health, natural resources and animal husbandry, extension services personnel in these categories, faculty of the Ecole Nationale de Formation et de Vulgarisation Agricole at Kaedi, GIRM support services to these personnel, and the time of oasis farmers participating in project introductions and demonstrations. The value of this contribution is calculated at approximately

$30,000 per year at 1979 prices. The GIRM will provide the land and facilities of the Sani research station which will preclude the need for the project to lease a similar facility at an estimated cost of $15,000 per year. The value of the total contribution of Mauritania over the five years (assuming a 15 percent annual inflation) will be approximately $350,000.

d. Project Outputs (Illustrative)

(1)	Initial introductions at Sani	Number
	Wells (traditional and modern)	5 constructed
	Water lifting devices	6 trials
	Water delivery systems	12 trials
	Cultivation of palms	18 varieties
	Cultivation of food grains	20 trials
	Cultivation of legumes	15 trials
	Cultivation of root crops	30 trials
	Cultivation of vegetables	50 trials
	Cultivation of horticulture	20 trials
(2)	Introductions in six Oases	No. of Demonstrations
	Wells (traditional and modern)	40
	Water lifting	25
	Water delivery	48
	Cultivations - palms	1380 shoots
	Cultivations - grains	80
	Other cultivations	100
	Nurseries	6
	Living fences	4000 meters
(3)	Training	
	Agricultural Agents	12 moniteurs
	Farmer participants	600 (date palm tech. assis
	Farmer participants	250 (other demonstrations)
(4)	Study reports	
	Geophysical	6 oases
	Hydrogeologic	40 oases
	Dietary/nutritional	6 oases
	Marketing	6 oases

4. Critical Assumptions

An assumption critical to successful development of the oases is that the destruction of vegetation immediately surrounding them, caused by drought conditions and by over-grazing by animals, can be arrested. Part of the problem stems from the natural preference of oasis herders (and nomadic herders who pause at the oases to water their animals) to graze their animals close to the water supply. The implication of the destruction of the vegetation caused by this practice is not clear to the herders partly because it is gradual. It has become an especially grave problem in the vicinities of larger population centers where desertification and dune movement have created wastelands of the environs. In some areas, the dunes have invaded the date palm and other cultivation areas. This problem is being addressed by the USAID in the Renewable Resource Management Project (No. 682-0205) which will study needs and develop

techniques for dune stabilization and range management. The Oases Development Project contains other interventions in woodlot and windbreak planting, living fences to control grazing areas, and trials in cultivation of fodder legumes for animals and in improved varieties of grasses (see Parts II-A-5 and 7).

A second assumption is that sufficient numbers of appropriate technology innovations in cultivations and in efficient water use techniques can be identified and introduced, which will have a significant impact on oasis production and the economic well-being of the oasis people. Successful introduction of new technologies will require that techniques be found which are appropriately simple, moderate in labor requirements, and inexpensive in material inputs and are demonstrably effective in increasing production. Activity categories programmed for this project are designed to meet these tests, but they will be evaluated during project implementation. Technical personnel to be provided will be capable of trying and evaluating a sufficiently wide range and number of productive innovations and the extension element will have the technical and support resources necessary to introduce the proven innovations into the oases.

Motivation for oasis farmers to accept and utilize the new technology is critical as well. While the above tests can facilitate motivation, they will be insufficient unless the farmers perceive little risk in adopting the techniques. For example, promotion of diverse vegetable production by oasis communities will not be easy. Oasis Moors are not accustomed to producing or consuming many vegetables, except in the Adrar region where the French army provided a cash market in the 1940s and 1950s, and for which the mining enterprise in Zouerate and the port activities at Nouadhibou furnish a continuing cash market demand. Continued vegetable and other production in the Adrar is now threatened by lowering water tables which is increasing irrigation costs and causing salinity of the available water. Until effective solutions can be found to replenish the over-used ground water basin and rehabilitate groundwater quality, oases in this part of Mauritania would not be appropriate for expanded agricultural production ventures. Therefore, this project is trying its development techniques and demonstrations in the more southern oases in the Assaba Region where water resources will permit expanded cultivation.

Current market demand for vegetables is insufficient in these oasis regions to be an inducement to oasis farmers to raise vegetables for sale. Market demand may grow in Kiffa and other regional market centers as new roads are completed. However, most of the cash market demand will continue to serve non-Mauritanian construction people and merchants, and the relatively small urbanized population which has become accustomed to buying and eating vegetables. The larger population which buys food in the regional markets prefers to spend money on the meat, grains and milk which form the basis of their diets. Study will continue of market trends in these regional centers (USAID projects for Vegetable Production and Rural Assessment and Manpower Employment Survey contain activities to study these markets). However, it is uncertain that forseeable increases in market demand in the immediate future will be sufficient to induce oasis farmers to raise vegetables for sale. For these reasons, the emphasis in this project will be to induce vegetable production in the oases primarily for auto-consumption. Efforts will be made to discover the types

of vegetables most acceptable to oasis farmers, requiring minimum labor and other inputs, and effective ways to prepare such vegetables to complement their traditional "couscous" and other dishes. Palatability will be a primary consideration as well as nutritional value. Efforts will be directed to convincing oases women of the relation between nutrition and the health of their families, especially the very high death rate of their children.

Oasis cultivators cannot currently grow sufficient millet and sorghum to meet their consumption requirements and must buy or barter to fill their needs. Therefore, if their vegetable production results in reduction of their cultivation of grains, they will see it as uneconomic and risky. Vegetable production ventures will have to involve minimum labor inputs and utilize cultivable land not currently in grain production. However, the project will encourage intercropping with legumes. Equal emphasis will need to be given to introducing high yielding grain varieties and improved techniques in grain production to assuage farmers' concerns about feeding their families.

PART II

PROJECT ANALYSIS

A. TECHNICAL

1. General

This section discusses the specific technologies which will be tried at Sani and extended to the oases. The appropriateness of the proposed innovations and the methods of their introduction are addressed according to specific categories. Technical analyses, in substantially greater detail, are contained in Annex C.

The innovations to be selected for extension must show appropriately modest requirements for technical skills, labor and other contributions which the oasis farmers will have to make in order to adopt the new techniques. Also, the production benefits will have to demonstrably exceed the farmer contribution requirements by a margin sufficient to motivate them to adopt the techniques. These are the considerations controlling the design of the project interventions.

Each of the interventions will involve not only trials and extension demonstrations, but also substantial training. For the most part, this will be on-the-job field training of agricultural agents, farmers participating in demonstrations, and other farmers who adopt the new techniques and receive technical assistance in the process. The project also provides limited third country field visitations for oasis farmers to observe more advanced production of date palms and range management in North Africa.

2. Water Interventions

Field trials and demonstrations of use and conservation of water will be developed and implemented to test methods and technologies, to show applicable practices, and to promote the replication of the most suitable of those practices. The trials will take place at the Sani testing site in conjunction with the agricultural trials they will be serving. Demonstrations will be at Sani and other project oases, the acceptance and replication of the demonstrated practices being also a test of their suitability. Trials and demonstrations will be kept simple and progress appropriately in accordance with local conditions. However, a catalogue approach will be followed; ample provisions will be made so that project implementors may select what best fits the implementation situation. Also, they can test and evaluate, from the technical and economic viewpoints, a broad spectrum of approaches and techniques.

a. Water wells and shadoufs

Wells presently used for irrigation and livestock and domestic water supply are traditional, shallow dug wells, lined with logs or stones, which do not last long. Water is lifted by hand, using a goat-skin bucket attached to a rope, or by using the lever and fulcrum "shadouf" (or achilal). The yields of these wells are limited.

In order to improve the efficiency of wells, trials will be made to increase their diameter and depth. For instance, larger diameter wells can accommodate two shadoufs. An increased depth of the well will allow for higher water yields.

Modern, large-diameter, dug wells with concrete lining and 2 to 5 meters of penetration into the aquifer will be more efficient than traditional wells. They are relatively expensive, costing about $600 per meter, but it may be possible to construct a local "semi-modern" version at a much lower cost. Such wells will be used at trial and demonstration sites. Also, well-cum-pump, hydraulically "drilled" tube wells of small diameter (Tysen well developed in Chad by AID/Peace Corps), will be used to provide a reliable and sufficient potable water supply at each oasis and at trial site, and nurseries. Trials will be made as to the number and spacing of wells, while insuring that the rate of water consumption is not higher than the rate of aquifer recharge. The approach of using one "high"-yield central well per hectare will be tested as opposed to using several traditional wells.

b. Water lifting

Water lifting means will be studied in order to optimize well efficiency. In addition to use of the shadouf, the use of manual and/or animal-powered pumps will be tried and evaluated.

Hand pumps allow for yields much easier and higher than with the shadouf, but they are expensive and require maintenance which is costly and very difficult to sustain as proven by years of experience in Africa. However, some types recently developed with African conditions in mind will be tried, including the "Vergnet" foot-pump. Motor-pumps will not be used, except for water

exhaustion during construction of modernized versions of wells.

Animal power to draw water from wells is not currently widespread in West Africa, except for deep wells. However, trials and demonstrations of water-lifting by animals will be conducted. Higher water yields than with the shadouf will be possible and less manpower needed. The horizontal Persian wheel (called "noria" in North Africa) has been successful elsewhere and will be tested in this project.

c. Water use and irrigation

Currently, water lifted from wells is distributed to plants using earthen ditches running from earthen reservoirs next to wells, or through hand-portage of water. This is labor-consuming and also involves important water losses by seepage from the ditches. Usually, one well serves about one quarter to one eighth of an hectare (30 to 50 date palms). Surface water is also used through small earthen dikes for recession agriculture of sorghum and millet. Since these crops are of special economic and nutritional importance, attention will be given to promoting and assisting in small dike construction.

Improvements are needed in efficiency of water conveyance and irrigation. Trials and demonstrations will focus on various methods and techniques of water portage from central wells and reservoirs to satellite basins. Distribution of water and irrigation will be rendered more efficient by using lined ditches (plastic, cement, clay) and other water distribution systems (plastic pipes, hoses, simple drip-irrigation). However, as all of these are relatively expensive and/or complicated, technical and economic feasibility will have to be tested on high-return crops. Results of these tests will also be useful over the long-run and country-wide, even if the above "sophisticated" approaches and techniques are of limited applicability/replicability in the immediate term and in poor oases. Also, improvements will be studied as to surface water use (small dams, diversion channels, recession agriculture). Implementation of such improvements will be achieved through assistance to local populations in oases. Water conservation will be improved through watering in the right quantities, at the right time and frequency, taking into account crop water-requirements.

d. Water-related diseases

The use of wells such as the Tysen well reserved for domestic water supply will be tested and demonstrated. Also, trials and demonstrations will be made of simple sand filters for domestic water supply. This will contribute to reducing diseases borne and transmitted by water as well as those due to the insufficient supply of water.

e. Other

Other tests and studies will be considered such as evaluation of water availability and quality, and of water requirements. Forty oases will be studied during the third year of the project. Water availability and quality will be assessed by the GIRM Hydrological Service which will perform

geophysical surveys under contract in the project oases in order to locate the best areas for groundwater occurrence and wells. Water well construction, especially modern dug wells and Tysen-type wells, will be best achieved by contracting with the Hydrological Service which has expertise in, and equipment for, well construction as well as for hydrogeologic and hydrologic studies. The groundwater hydrogeologist during Phase I of the project paper design and the irrigation specialist during Phase II both attested to the capability of the GIRM Hydrological Service to carry out these activities.

Water requirements and irrigation will be studied also taking advantage of the expertise of the Rural Engineering Department and other GIRM entities, as well as project TDY personnel.

f. Training

Training in well construction, water lifting, irrigation, surface water control and water-related diseases will be achieved on the sites through trials and demonstrations. The most capable farmers and technicians will visit other localities in Mauritania where such devices as persian wheels are in use in order to become familiar with techniques and methods related to water, pumps and irrigation.

3. Date Palms

Date palm growing in Assaba Region is only about fifty years old. Cultural methods of oases agriculture are more primitive than in the Adrar Region, the northernmost Mauritanian date palm area. The inhabitants of Assaba oases were and still are primarily pastoral people. Their main cash income derives from cattle, sheep and goats.

The problems of date culture in Assaba are the poor productivity of palms and the low grade of dates that are produced. The poor productivity is due to some extent because planting of shoots was originally done without much selection and some early planting was also done with seeds, an inferior method. However, the main problem is the loss of production due to considerable damage done by two insects; the date scale *Parlatoria blanchardi* and date mite *Olygonichus afrasiaticus*.

French technicians working in Mauritania began developing an effective biological control method using the Iranian species of the ladybug *Chilochorus bipustalus* which is a good predator of the date scale. Work on development of that method decreased after the French (IRFA) technicians left. However, it is expected that recent new financing by FAC will regenerate it in March 1980. The facilities for reproduction of the ladybug exist in Mauritania and the introduced ladybug has been well established, at least in some of the parts of Adrar and Tagant Regions. It appears, however, that no systematic introduction of the ladybug was done in the Assaba area because infestation by

the date scale was not then as severe as it was in the more northern areas. Assistance in the introduction of the ladybug to the Assaba will be a part of this project.

The date mite, which destroys much of the date crop here, is not effectively controlled in Assaba. Attempts to introduce sulfur dusting have failed in the Assaba (as well as in some other areas) because the present methods of doing this are very laborious and the application is not usually done at the correct time, which is when the web of the mites first appears on the developing fruit. Introduction of a simple device for application of sulfur dust, which has functioned well elsewhere, should facilitate considerably the dusting procedure and will make it much easier to do this during the correct period. (See Annex C-2).

Assistance in the improvement of pollination techniques on which a satisfactory production of dates depends will be offered through use of a simple pollination device and a method of preparation of pollen developed in California. This will save the arduous climbing of the palm trees and will assure more efficient pollination than that currently used in Mauritania.

Introduction of date plam shoots from three different sources will be done for three different purposes. (See details in Annex C-2). One will be the type of date palms producing high starch dates from which "farine de dates" (date flour) is made. This will help improve nutrition for the oases people to supplement the grain crops which sometimes fail or are in short supply. There are no such date palms now in the Assaba. The second variety will be date palms that produce semiripe dates, high in vitamins and which are very attractive fresh fruits of superior flavor. Such semi-ripe dates of selected quality are valued everywhere in the traditional date growing and consuming areas of North Africa and the Near East. In Mauritania 25 percent or more of the date drops are consumed in semi-ripe state as an "annual cure" at the time of "Guetna" (July/August), at which time the Mauritanians converge on the date groves for this purpose. However, the quality of the Mauritanian semi-ripe dates cannot be compared with the varieties of the Near East. Because date ripening in Mauritania, or in this case semi-ripening, occurs ahead of that of North Africa and the Near East, there is an excellent advantage for a future export to these areas, and possibily to Europe, of such superior fruits, once they become well established here. The third variety will be of date palms resistant to the serious date palm disease Bayoud, which already has destroyed two-thirds of the Moroccan date palms and is now spreading into Algeria. Luckily Bayoud has not yet been reported in Mauritania, but date palm growers should be prepared for this eventualit

4. Other Crops and Nutrition

In order to discuss the technical feasibility of the project it is desirable to look at what has happened in crop production over the past eight years as indicated in Table 1. It is important to point out that this is for the country as a whole and only a few of these crops are currently grown in oases.

Millet is one of the crops that is produced in or near the oases. The data indicate that production has been reduced from 89,000 metric tons in 1969-71 to 45,000 metric tons in 1977. A large part of the reduction in millet production

is due to the physical and social effects of the drought, but part of it may also be due to a lack of nutrients in the soil. (The farmers in the oases usually only fertilize with random droppings of goat and sheep manure).

Special efforts will be needed to bring the production of millet back to previous levels or higher to feed the expanding population, in view of reduced productivity of the land from drought and environmental degradation.

Rice is being partly substituted for millet, but it cannot be produced economically in oases due to its high water consumption. Most of the rice is consumed in the larger cities and villages and transport problems make it less suitable for use in oasis communities.

Table 1 CROP PRODUCTION IN MAURITANIA[1]

Crop	Thousands of Metric Tons Annually	
	1969-71	1977
Rice	1	5
Maize	4	3
Millet	89	45
Roots and Tubers	6	6
Irish Potato	(2)	(2)
Sweet Potato	(2)	(2)
Pulse-Good Grain - (Legume) total	11	10
Groundnuts	2	1
Vegetables and Melons	4	3
Fruits, excluding melons	17	16
Dates	14	14
Watermelons	2	1

1. Source: FAO Annual Report 1978

At the present time the people who live in the oases drink goat and camel's milk and eat meat as their main diet. They also consume sorghum and millet, but they do not currently produce sufficient millet for their own needs, so they trade dates for millet. One kilo of dates can be traded for four kilos of millet. Only a few vegetables are consumed in the oases and they consist of onions, sweet potatoes, hot peppers for seasoning foods, squash and watermelons (mainly for their seeds).

Nutrition

This project offers many opportunities to study and improve the nutritional status of the people living in the oases. The project will approach the study and consequent implementation of findings through the joint efforts of the nutritionist and agricultural specialists working on this project.

a. Background

There has been little study of the nutritional status of the oases populations. What information does exist is often conjectural (i.e. assumed from sketchy look at the diet). The assessment of protein-calorie malnutrition (taken

from weight, height, age, skinfold and albumin data is fairly good. These data show a serious problem of protein-calorie malnutrition in children under 5: 40 percent have weights falling below 60 percent of the standards for their height or age. 35 percent show deficient albumin levels. The dietary availability of Vitamins A and C in addition to a number of micro-nutrients is judged inadequate according to dietary observations and presence of correlation with certain eye problems.

It is very difficult to do much analysis of this data because it is generally not defined in terms of cultural groupings, seasonal changes, weaning and family food habits, or interactions with endemic infectious disease. Lack of food, especially as it is related to drought conditions, is thought by some to be the major problem causing malnutrition. The extremely poor conditions of sanitation (especially lack of water) have been cited as the major cause of diarrhea aggravating malnutrition. It should also be noted that there is no vaccination program in the oases areas. Therefore, immunizable diseases, such as measles, which become serious when interacting with malnutrition, are major causes of child mortality.

The problem of malnutrition is further complicated by the lack of health infrastructure, especially maternal-child centers. While there are some MCH centers in the oases areas, these dispensaries are poorly staffed and not accessible to most of this population. This lack of infrastructure makes it difficult to gather adequate information about the levels and types of malnutrition, much less do anything to improve the situation. Therefore it is impossible to have any kind of useful nutrition surveillance under existing circumstances.

b. Project plans

Until useful nutritional data are collected in the project area, no analysis can be made to define the "system" which is causing malnutrition. Likewise, choices of interventions, via agriculture, education, health infrastructure, etc., cannot be made.

Faced with the importance of really understanding nutritional problems in the project area, the project will hire a full-time Mauritanian nutritionist. (There are Mauritanian nutritionists who were recently trained in France and North Africa). The nutritionist will be assisted by other project personnel such as monitors from the Kaedi Agricultural School, as well as possibly by Peace Corps Volunteers in the region with the Vegetable Production Project. The nutritionist will examine the dietary practices with an eye not only for numbers, but more importantly a perspective of the cultural and economic influences. He/she will assess consumption patterns, including weaning practices and the nutrient composition of these diets (and crops for possible introduction.) The nutritionist will work closely with the other technicians in the project to determine the factors which affect auto-consumption vs. marketing and current diet vs. desired diet. The relative importance of increasing real income through marketing vs. increasing auto-consumption will be looked at. In addition the nutritionist will discuss possible dietary changes and experiment with different fruits and vegetables with oases residents.

This information combined with the understanding of which crops can be

grown and marketed in this area is expected to lead to decisions in the second year as to introduction of new crops or extension of traditional crops.

The nutritionist will develop plans for nutrition education and other activities which can improve the nutritional status of people in this region.

c. Vegetables/Fruits

The adaptive trials for the first year will be only on onions, sweet potatoes, hot peppers, squash and watermelons. The detailed information on establishing the trials is presented in Annex C-3. Other vegetables will be tested if the nutrition study indicates that they may be needed to provide the deficient nutrients.

d. Food Grains

Millet, sorghum and niebe beans are eaten by most of the people in all of the oases. Varieties will be tested to identify high-yielding varieties adapted to environmental conditions in the oases. Plant nutrition trials will also be conducted to determine the optimum level of fertilizer to be applied for economic returns. Trials and research will be coordinated with the SAFGRAD project.

e. Other crops

There will be several other legumes tried, such as peanuts; winged, broad, dry, hyacinth, and mung beans; pigeon peas, cowpeas, chickpeas; and lentils to determine if they can be grown in oases and if they will be accepted as part of the diet by people living in oases.

All of the initial trials will be conducted at the Sani oasis under controlled conditions. The information obtained from these will be further tried and demonstrated in four to six other oases in order to show oasis farmers what varieties to grow and the most efficient cultural practices to obtain high yeilds. The system of conducting the trials is presented in Annex C-3. Possible sources of seed and plant material are also indicated. Citrus and other fruit trees will be included in the nurseries at each location to provide additional vitamins and minerals for the oasis farmers. The nurseries will also produce young seedlings that will be used for planting living fences, windbreaks and woodlots.

Henna and spearmint are grown in most oases. The henna is used as a dye and spearmint is used to flavor tea. Trials will be conducted on these two crops to try to increase their quality and yield. Henna is a particularly prime cash crop possibility. It is not a food crop, but is used cosmetically and medicinally and has local market strength. The oases in the project area are known to produce some of the finest henna in Mauritania. Therefore, the project activities will also include interventions with these crops. Detailed information is presented in Annex C-3.

5. Animal Husbandry

The oases provide wells for watering livestock, which is an essential

requirement for the herders living at the oases and the nomadic herders who graze livestock from one area to another. The importance of livestock to the economy is indicated in Table 2.

The importance of livestock to Mauritanian international trade is presented in Table 3. The international trade in livestock products shows a positive balance of about $10,000,000, but there is a considerable amount of milk products imported. In order to compare the importance of livestock production, it should be noted that there was a negative balance of trade of $39,120,000 for agricultural crops in 1977, with date exportation (the only commodity exported) valued at $200,000. Thus, the net negative balance amounted to $29,120,000 for all the agricultural commodities. Improved production of livestock for export would have considerable impact in improving the nation's foreign exchange earnings.

Current practices of grazing in the immediate perimeters of oases are resulting in extremely serious environmental damage to vegetation, and encroachment of the desert on the oases. Efforts in this project to enhance livestock production by oasis herders must be in an environmentally sound context. Efforts will be made to sensitize the oasis communities to the gravity of their environmental problem (e.g. desert dunes over-running oasis date palms and other vegetation), and to options which they can take to improve their grazing practices. They will be encouraged and assisted to establish protected zones immediately around their oases, which can be planted to windbreaks and woodlots. Demonstration sections of such zones will include fencing to protect them from grazing animals and include living fencing demonstrations.

Training programs will be organized with the assistance of personnel of the AID-financed Range Management Project in Tunisia. The Tunisia program includes elements of particular interest to oasis herders, including the value and importance of rotation grazing, management of sheep and goats, and cultivation of fodder legumes and grasses under irrigated and non-irrigated conditions. Training programs will include observation visits by selected oasis herders to view the activities in Tunisia, arrangements for Tunisian extension specialists to visit Mauritania to conduct training, or a combination of such methods.

Government veterinary services exist in the Assaba Region, but lack of vaccines and mobility limit those services essentially to herds which can be brought to Kiffa, the capital. This project will facilitate the government services by supplying vaccines and medicines for use at the project oases and providing transportation for the veterinary technicians periodically to serve those communities.

Goats and sheep usually are returned to the village every night and are maintained in a corral. The goat and sheep manure that accumulates should be used for establishing forage crops and the production of agricultural crops. Techniques of gathering and composting manure will be tried.

Table 2 LIVESTOCK NUMBERS AND PRODUCTION IN MAURITANIA[1]

A.	Type of Livestock	Number in Thousands of Animals	
		1969-71	1977
	Donkeys	215	180
	Camels	687	180
	Cattle	2,367	1,400
	Sheep	4,427	4,700
	Goats	3,423	3,100
	Chickens	2,500	2,900
B.	Type of Meat	Thousands of Metric Tons	
	Beef and Veal	15	13
	Mutton and Lamb	6	7
	Goat Meat	5	5
	Poultry Meat	2	2
C.	Dairy Products		
	Cows milk, whole, fresh	81	47
	Sheep milk	49	43
	Goat milk	74	61
	Butter and ghee	0.5	0.3
	Cheese	1.4	0.9
D.	Other Products		
	Eggs	2.1	2.5
	Cattle Hides	2.3	1.9
	Sheepskins	1.2	1.3
	Goat skins	0.8	0.9

1. Source: FAO Report 1978

Table 3 MAURITANIA INTERNATIONAL TRADE IN LIVESTOCK/PRODUCTS 1977[1]

A.	Trade in Live Animals	Thousands of Dollars	
		Imports	Exports
	Cattle		$10,000
	Sheep and Goats		11,700
B.	Meats		
	Canned meats	200	
C.	Dairy Products		
	All milk (canned, condensed, evaporated and dry)	10,850	
	Butter	480	
	Cheese	170	
	TOTAL	11,700	21,700

1. Source: FAO Report 1978

6. Women in Oasis Development

Much of the cultivation of food crops in the Assaba oases depends on the women of the community, particularly in those situations where the men of the families are occupied with distant herding, or have sought cash employment in the cities or on road construction. Thus, the term "oasis farmer" as used

throughout the paper may connote women participants as often as men; even more than men in some enterprises such as millet and niebe cultivation, henna harvesting, and water drawing and carrying for watering food crops and for family consumption. The implications of this for project design and implementation are significant since it will bear on who will participate in the extension demonstrations of technology improvements, what will be the needed motivation to secure their participation, and who will be the target audience to view the results of the demonstrations and to adopt them in their own enterprises.

Primarily, the people with whom the project demonstrations and extension adoptions will work will be the mixed herding and farming group, which is accustomed to cultivating subsistence plots for auto-consumption (the women, primarily) and seeking paid employment with herds or elsewhere (men). (See Social Analysis). This laboring group can be expected to appreciate the new techniques which will result in less labor for the same productive output (size of millet harvest per plot; quantity of water raised and distributed to cultivation; cultivation protected and thereby saved from grazing animals through fencing, etc.).

Oases women participants and observers particularly will appreciate techniques which can reduce exertion and speed up essential tasks. Recognizing their importance in the activities of this project, it is planned that women cultivators will be sought as participants for substantial numbers of the extension introductions and demonstrations. The numbers will vary from oasis to oasis depending on the different social mixes and the production emphasis. In some oases, as many as half of the introductions may be with women participants.

Primarily the introduction demonstrations will be conducted on cultivators' plots rather than on plots set aside for communal gardening. The presumption is that participants will be more assiduous in caring for such personally-owned demonstrations, and will gain greater appreciation of their own abilities to improve by innovation. Copying by others will also be facilitated where women see the profits of innovations accruing to selected of their peers.

Project activities to promote cultivation of vegetables will especially involve the women of the oases. Studies of current diets and dietary deficiencies will be conducted during the first year of the project and will be followed by trials at Sani of improved varieties and cultivation methods for selected food crops which can help to fill nutritional needs. Those showing most promise will be introduced to oases with participation of oasis farmers. It is expected that women will more easily be motivated to try adding new vegetables in their cultivations and in the food they prepare for their families; this because of their concern for the health of their family members, particularly children for whom the death rate through age 4 is exceedingly high.

Not all oasis women are involved in the physical labor of farming activities. Bidan Moor women are frequently left behind in the oases to supervise date palm cultivation and other activities while Bidan Moor men are far off with large herds or are engaged in commerce. The Bidan Moor women may also own oasis property or date palm groves in her own right and frequently has considerable knowledge of production, even if she does not directly engage in labor herself. While such women may learn through observing the project techniques more active oasis farmers adopt, they will not be recipients of project commodity assistance which will be reserved for those farmer participants actually working the land.

7. Environmental Protection

A major objective of the oasis project is the maintenance and improvement of the fragile natural environment which includes the raw materials utilized by the people in their effort to survive on the land. Water, soils, and natural vegetation are the key elements in the environmental equation. They are particularly important because they are renewable resources. Often, however, they are mistreated. Water, the bond between soils, vegetation, and human life, is the fundamental resource of each oasis, and yet there is much waste, pollution, and loss. Overgrazing of dunes and other lands adjacent to the oases have left the soil exposed, denuded, and eroded. Existing trees have been mutilated for fencing materials, severely browsed by camels and goats, or cut for fuel, charcoal, or construction. These are examples of environmental degradation prompted by an imbalance between increasing human numbers and diminishing natural resources. Recurring droughts at roughly quarter-century intervals exacerbate these human pressures.

a. Water

All oases are located on wadis or stream channels that may carry surface water once or twice a year or less frequently and where the water tables are 1½ to 3 meters below the ground surface. Where shallow depressions cut below the existing water table within the wadi channel, temporary ponds or "mares" may develop. Palms and fruit trees require this high water table throughout the year if they are to exist. This situation also facilitates the withdrawal of water for domestic use and for the watering of vegetables, specialty crops, and livestock.

The unreliability of rainfall occurance in the oases of the Assaba, where annual averages range from 150 mm - 400 mm, results in random showers of varying intensity and place of precipitation. Flash floods from unusually heavy rainfall may transport and deposit large masses of sand in the wadi channels or alter the course of stream flow resulting in damage to gardens and orchards.

A few localities are so constituted that the subsurface waters are saline and sometimes toxic to plants and humans. Perennial ponds offer the possibility of malaria and schistosomiasis vectors although schistosomiasis does not appear to exist in any of the project oases. If livestock are permitted to drink from such open waters there is opportunity for pollution of the ponds. The open hand-dug wells are sometimes contaminated by collapsing earthen walls or from debris which falls into the wells.

The interventions proposed for the oasis project are designed to improve rather than degrade the existing situation. To illustrate, some wells will be furnished with wooden covers while a few new wells will be constructed with cement liners and wooden caps. For clean drinking water, hand-pumped Tysen bore-type wells will be constructed. Livestock watering points will be situated on the perimeter of the oases to minimize damage to trees and gardens and to lessen the chance of polluting any ponds located in the center of oases.

b. Soils

Oases soils frequently consist of two major categories: (1) the dune sands which are almost ubiquitous along the margin of oases, and (2) the dark gray/black soils of the wadi channel. The first are silaceous, well-drained and somewhat acidic, the second are loamy to heavy clays, poorly drained and alkaline.

Long, linear dune ridges, bordering wadis or plateau escarpments, adjacent to oases, are excellent absorbers of precipitation. So efficient and rapid is this collection that little surface runoff or erosion occurs. Wind is the most effective agent of sand and dust transport, particularly when any vegetation cover has been removed by drought, over-grazing, or trampling by livestock. The steeper the dune slopes the more serious is the soil slumpage.

Clayey soils in wadi depressions form good reservoirs which may retain surface waters throughout the year. Hoofed animals sink deep into such wet clays leaving their tracks during dry periods and stirring up or clouding the waters when drinking. For these reasons watering points for animals will be located on the margins of oases. Any pathways constructed to demonstration plots in the several oases will result in insignificant environmental alteration owing to the levelness of the land, the absorptive nature of the soils, and the shortness of the right-of-ways. The palms, trees and gardens with their shrub fences will enhance the stability of new routeways.

c. Vegetation

The oasis project will exert its greatest impact in the area of vegetation cover for it is designed to improve the efficiency, diversification, and yield of crop production, as well as enhance the quality of reserve pasturage and woodlots by the enclosure of parcels of land by living fences and eventually windbreaks. If successful, the natural environment should improve markedly through dune stabilization, improved soil and water retention, enhancement of the microclimate in the oasis, and the reestablishment of the natural grass and tree cover in the devegetated areas rimming the oases.

First, the open portions of the wadi surfaces within each oasis and the wadis at both extremities of the oases will be planted to Acacia scorpioides, var. nilotica (gonakier), a leguminous, fast-growing hardwood tree which thrives in wet, clayey soils and can endure periodic flooding. These trees will provide shade, and cooler, more moist temperatures, and will assist in nitrogen-enrichment of the soils. They also will help in stabilizing soil, provide highly delectable seed pods for camels and livestock feeding as well as wood for premium charcoal and fuel production.

In addition to the Acacia scorpioides plantations, woodlots and windbreaks or greenbelts will be established on the perimeter of the oases. The woodlots are to serve as a reserve wood supply particularly in periods of drought, while windbreaks will be placed in a circumferential belt around an oasis at a distance great enough to enclose land for reserve pasturage. (See diagram of model oasis). A particularly useful thorny tree for the windbreaks is the

Prosopis juliflora or chilensis which grows rapidly in sandy or heavy, and even saline soils, in regions with over 125 mm of annual rainfall and is useful for firewood, fence posts, food for animals (seed pods), and living fences. The Prosopis becomes very limby, and will coppice easily (reproduce shoots), and can grow in close proximity to one another. Heavy pruning results in further limb development. It is a versatile tree and can also be used for fences, and woodlots. It is easy to establish by broadcast sowing of pretreated seed or from nursery stock. There has been a problem of nematodes attacking the root structures of this pecies in the more humid climate near the Senegal River. Tests for nematodes will routinely be conducted of soils at Sani and the oases to assure that this is not a problem in these drier areas. A second excellent tree for windbreaks, owing to its rapid growth, dense foliage, and general usefulness, is the Azardirachta indica or Neem. It requires 450 mm of rainfall or periodic irrigation. The minimum pH of the soil should be 6.5 or higher. It tolerates sands, silts, and heavy clays and even dry, stony soils, and coppices well. Its wood is a good fuel, provides poles and construction materials, and its twigs are used as toothbrushes.

To stabilize mobile sand dunes, which often exist adjacent to oases, a variety of indigenous trees and shrubs may be planted. They are frequently found growing on or near the dunes in the Assaba Region. They include the Balanites aegyptica, a thorny, durable tree that produces edible fruit, and is used for firewood, tool handles, poles, soap, and medicine. This tree is also useful for windbreaks. Camels consider it a favorite browse; the Leptadenia spartium or Titarik, a tough shrub with long slender twigs and miniature flowers, used for broom-making and thatch; and the Calotropis procera, a hardy, large-leafed shrubby relative of the milk-weed which is useful for fencing and construction. It is toxic to most animals and thrives in dry or moist localities. Finally, there is the Euphorbia balsamifera, a fast-growing shrub which tolerates dry, sandy soils and produces numerous stems.

Where windbreaks or greenbelts are planted in regions with high water tables such as in or along wadis, the Eucalyptus camaldulensis does well. It grows on sandy or silty soils and tolerates seasonal flooding. The eucalyptus, under good conditions, may attain a height of 8 meters in the first year.

Tree species suitable for oasis woodlots include: Acacia senegal which tolerates poor, dry soils and low precipitation (100 mm). It coppices easily, has a hard wood for agricultural implements, fuelwood and charcoal, while its leaves are used for fodder, and its gum (gum arabic) for the baking and medicinal industries; Acacia tortilis or raddiana, a thorny, and very tolerant tree, capable of surviving on poor dry soils under less than 100 mm. It coppices well and its wood is used for fuel.

Living fences are to be planted around each of 30 one-quarter hectare family plots and around each of the 1/8-hectare tree nurseries to be established in each oasis during the first year of operation. This would require 200 meters of live fencing for each 1/4 hectare plot and 150 m of live fencing for each 1/8 hectare nursery.

Wire and posts for fencing will be provided as an inducement for the

oasis farmers to establish the tree nurseries and to transplant the stock along the inside of the wire fencing as they grow into living barricades to protect the crops from maurauding livestock. Once the fences have grown to a meter in height the wire fencing will be removed and used to establish windbreaks or greenbelts which will also serve to protect the reserve pastures and woodlots from grazing animals and wind erosion.

The tree nurseries will include the raising of fruit trees and will be constructed near a well at a central point in each oasis. Seeds will be purchased and planted in plastic bags and watered by the cooperators in the project. Trees for the windbreaks, reserve pastures, and wood lots will be grown in the nurseries and transplanted after the living fences have been established during the second or third year of the project.

Once the lands allocated for reserve pasture have been surrounded by live fencing, the grass seeds present in the soil are expected to germinate following the annual rains and to improve in quality during succeeding years. Seedlings for the trees to be established as "woodlots" in the reserve pasture areas will be planted about 5 meters apart. This technique will be utilized because it conforms closely to the tree-grass relationships existing naturally in the Sahel.

Every effort has been made to select trees and shrubs that are adapted to the soil, water, topographical and climatic conditions of the oases and to replicate as nearly as possible the vegetative patterns that prevail naturally in the hinterland of the oases. In addition, where choices of species exist, those that offered maximum value to the human populations of the several communities were selected.

Each activity is designed to enhance the natural environment which has frequently been allowed to become degraded through drought, neglect, over-grazing, or increasing population pressures.

8. Training

a. Mauritanians who will be trained through the project:

Who	How Many	Type of Training	Duration	Purpose
--GIRM Agriculture Monitors	12 (3 per yr. for 4 years)	On-the-job with TEC and U.S. technicians	1 yr. ec.	To learn skills of U.S. short-term technicians and to replace them in Phase II expansion
--GIRM Agri. Service Tech.	7	Quarterly Seminars	Varied	Upgrade Skills
--Oasis Devt. Workers	6 (plus 6 Assistants)	Course at Sani	3 Mos.	To be able to function as primary level oasis extension workers
--Oasis Farmers	600-700	Extension	Life of Project	To learn new oasis agric technologies
--Oasis Farmers	40	Short-Term 3rd Country Field Visits	Varied	Observe North African range management and oasis agric. techniques
--Long-term GIRM Participants	2 - 3	Academic, U.S. or Third Country	30 Mos. Each	To enable GIRM to expand dev. in second phase (Training subject to be determined after third year evaluation).

b. There are essentially two kinds of training in this project: training of oasis farmers who will improve their farming techniques and training of Mauritanian technicians who will then be able to assist the GIRM in implementing an expanded second phase to reach greater numbers of oasis farmers with the agricultural and water technologies proven effective through this project. The Mauritanians will be able to do this with less reliance on foreign technicians as a result of training received in this project.

Training to be offered under this project will be primarily on-the-job. For the oasis farmers, the training will be in assisting them to understand, appreciate and implement the technology introductions which will be offered through the activities of the project. The Oasis Development Workers (ODW) will be the day-to-day contacts with the farmers to advise and assist them in plot layouts, planting and cultivation methods, systems for water drawing and delivery, fencing to protect cultivations and other basic techniques. The Training and Extension Coordinator from Sani will regularly review the activities of the farmers and the training and assistance which the ODWs are providing and will call on the assistance of skilled specialists from Sani where needed. These specialists will include the agronomist, and TDY consultants who are assigned from time-to-time. The GIRM agricultural agents (Moniteurs) who are detailed to the project will also be receiving on-the-job skills up-grading at Sani, and they will be utilized for supplementing the technical advice of the TDY consultants.

Prior to their assignment to oases, the ODWs will receive a three month orientation and training at Sani under the Training and Extension Coordinator (TEC). The latter will be advised in establishment of a training and extension program by the faculty of the Ecole Nationale de Formation et de Vulgarisation Agricole (National Agricultural School) at Kaedi and will be assisted by them in conducting the training for the ODWs. The skills of ODWs will later be upgraded through regular seminars which will be conducted by TEC at Sani, at which time the ODWs will view progress of the technical trials at Sani, report on progress and problems of introductions at their oases, and arrange for visits of specialists and moniteurs to their oases for particular technical assistance requirements. TEC will involve the Sani specialists and moniteurs as appropriate in these seminars and representatives of the GIRM agricultural service will also participate.

On-the-job training of the GIRM moniteurs assigned to Sani will be provided by the technical consultants under the general direction of the team leader. Their orientation to the extension activities of the project in the oases will be coordinated and conducted by TEC and they will attend the regular seminars of ODWs as mentioned above. One or more of these moniteurs will be identified during the course of their assignments to the project for further training. They will be retained on the project for a longer term period than the others (who generally will be replaced after one year on-the-job). The longer term assignees will then become senior aides to the team leader and/or TEC in trial and extension activities.

One or two brief visitation training sessions will be offered to selected oasis farmers, accompanied by the ODWs and conducted by TEC. Both of these will be to oasis regions in North Africa, probably Tunisia. One visit will be to view the cultivation of dates in a more modern setting. The other wil be to view pasturage methods and range management as practiced in an environmentally

appropriate setting (see Annex C-2 and Part II A-5 for discussions of these proposed training visitations). In each case, the farmer participants will be selected by TEC assisted by ODW, on the basis of those showing the best initiative and receptivity to innovation. The visitation groups will number no more than twenty. This training is provided for in the budget. Training opportunities will be provided equitably to all social groups participating in the project. As indicated elsewhere in the PP, special attention will be given to including women as training participants in technology extensions.

Long-term training of two or more candidates is provided in the project. This would commence the third year after the mid-term evaluation (see Part V). If, at that time, GIRM and USAID agree that this pilot project is showing success at achieving its purpose and that a second phase expanded program will be justified, long-term training will be offered which will help the GIRM to improve its institutional capability to participate in and to administer the broader program. The fields of training to be offered will be determined at that time as agreed between GIRM and USAID. Considerations will be the relative priorities of expertise needed, eg.: agronomy, horticulture, rural engineering, general agricultural extension, administration, rural economics, etc., together with availability of qualified candidates and appropriate training institutions. Particular attention should be given to the feasibility of identifying one of the candidates to be trained in the training and development of extension workers needed in the oasis and dryland agricultural context. Training of two participants is provided specifically in this project budget. However, the possible need for providing a back-up candidate for at least one of the participants to avoid attrition loss will be evaluated when the final decisions on long-term participant training are made. This additional participant could be funded from the third-year contingency funds or additional training funds can be requested.

B. SOCIAL SOUNDNESS

The basic socio-economic situation of direct relevance to the Oasis Development Project can be summed up as follows: oases families can neither exist on a subsistence level nor meet all their basic needs through the pursuit of a single economic activity.

Oasis economy is characterized by both individual and community diversity. Individual diversity is based on the need for each family to engage in a series of activities to minimize economic risks and to obtain necessary cash as well as goods. Community diversity is represented by the division of the population in the oasis zone into the following groups and activities: (a) millet

farming and traditional labor (now paid) - practiced by the poorest elements, mainly Haratin Moors (ex-slaves); (b) mixed herding and date palm farming - practiced by Haratin, both poor and well-off Bidan Moors, and recently a few drought-effected Peuhl; and (c) large-scale herding-commerce-date palm activities practiced mostly by Bidan Moors. Members of this latter group are generally better off than the first two groups. Diversity, however, is also geographic. Bidan Moor men practicing large-scale herding and commerce are often far from the oasis area where agricultural labor is needed and where the women and children are frequently left behind. Increasingly more of the men in the other groups are also seeking paid labor in the urban areas, leaving women behind in the oases. Thus, all of these combinations of lifestyle are intertwined and represent a combination of activities practiced of which agriculture is only one part. (See Figure 1 for economic relationships within oases, as well as Annex C-5).

This situation has several implications for the Oasis Development Project:
(1) There is a need to deal with a representative selection of the diversity of activities and social groupings involved in order for the project to become truly replicable. This can be best accomplished by selecting a variety of target oases representing the different conditions. This has been done, and the four initial project oases sites represent a mix of the diversities discussed.
(2) Loosening of traditional social structures and ties increases the options available to oasis people. The Haratin Moors are becoming more assertive of their rights. At the same time, the richer commercial-oriented people, mainly the Bidan Moors, are beginning to realize their growing dependence on paid labor. In order to forestall the growing pull of Haratin and traditional labor groups to the urban areas, the Bidan Moors are being forced to accept new relationships based more on mutual need than was the case traditionally under slavery.
Traditionally date palms and the oases have belonged to a select group of Bidan Moors because the development of data palms requires a certain amount of capital, unavailable to Haratin Moors (since date palms are not productive for several years). The Bidan Moors still are the traditional source of capital and the continuation and replication of project activities will depend to some extent on their participation. Yet in order for them to carry out these new agricultural practices, they will have to offer sufficiently attractive wages to Haratin Moor laborers who now have alternatives. The project, therefore, should not only increase rural production, but rural employment opportunities as well. Thus the prosperity and development of benefits for each groups is tied to all groups. However, the direct beneficiaries of this project will be oasis farmers, men and women, who choose to participate, with the help of project technicians, in adopting the technologies extended from Sani to the project oasis communities. They will be people who work on their own behalf and are actual oasis farmers themselves rather than people who may hire others to work for them.
(3) Women will be significant among the oases risidents targeted in this project. Haratin women as well as men practice paid labor in agriculture, working for others in oases production. However, there are some Haratin women, as well as poor Bidan and Peuhl women, who do gardening on their own. These women will be

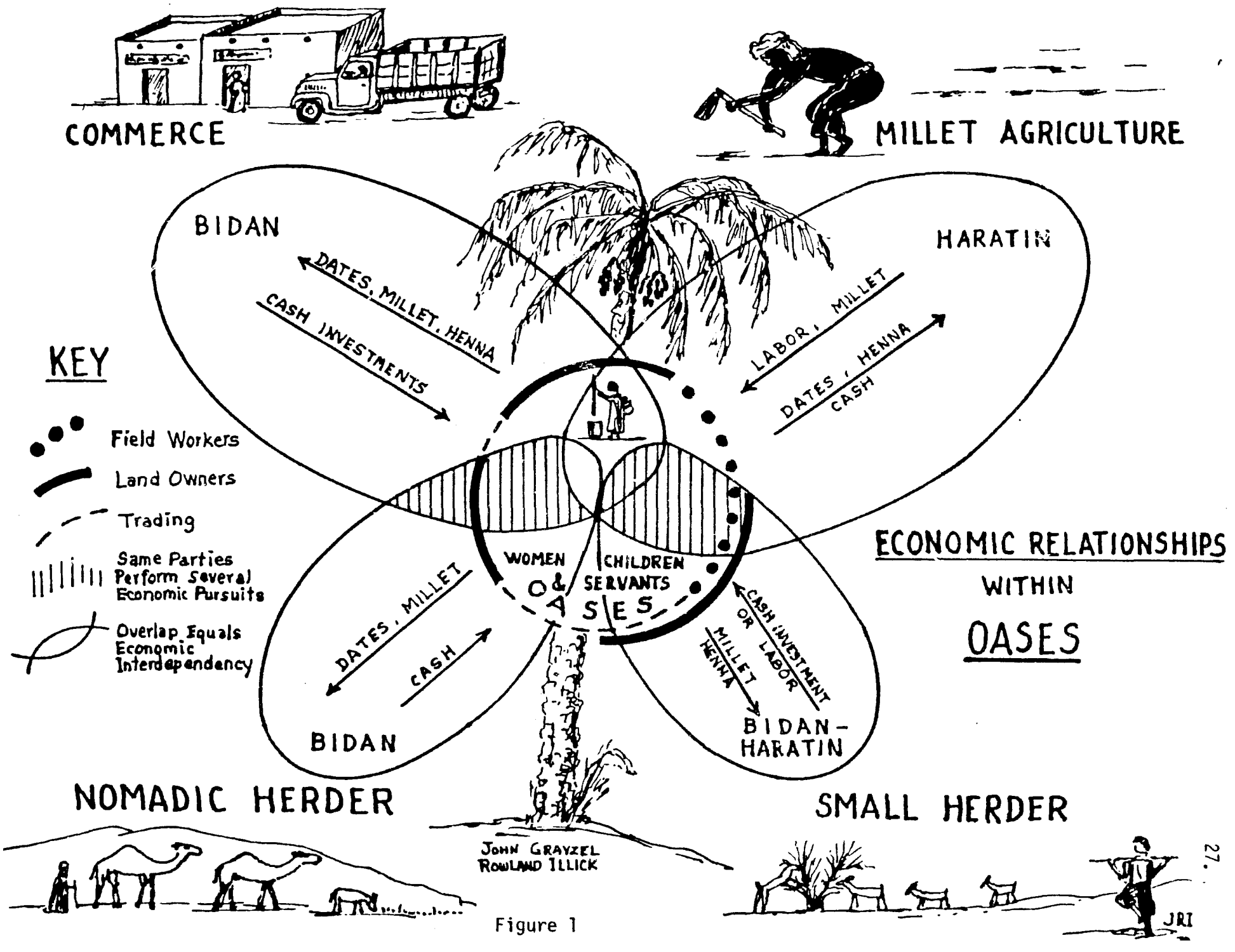

COMMERCE
MILLET AGRICULTURE
BIDAN
DATES, MILLET, HENNA
CASH INVESTMENTS
HARATIN
LABOR, MILLET
DATES, HENNA
CASH
KEY
Field Workers
Land Owners
Trading
Same Parties Perform Several Economic Pursuits
Overlap Equals Economic Interdependency
WOMEN
CHILDREN
SERVANTS
OASES
ECONOMIC RELATIONSHIPS WITHIN OASES
DATES, MILLET
CASH
BIDAN
CASH INVESTMENT OR LABOR
MILLET HENNA
BIDAN-HARATIN
NOMADIC HERDER
SMALL HERDER
JOHN GRAYZEL
ROWLAND ILLICK
JRI

Figure 1

directly involved in some of the project activities and will benefit from some of the commodity and technical inputs. Bidan Moor women whose husbands and male relatives are in large-scale herding or commercial activity far from the oases are also involved in oases production. While they do not perform the work themselves, they supervise agricultural laborers, arrange for their hiring, and often have greater technical knowledge of date palms and other oases agriculture than the male members of their families. In addition, Bidan women are often land owners in their own right and can possess large hectarage of date palms. Thus, it is likely that successful introductions will depend on generating the interest of women producers and adoption by them of project interventions as much or more so than by men.

(4) A livestock component will be integrated into the project. Herding is as primary an element of an oasis family's livelihood as agriculture. Unfortunately herding is also the greatest contributor to environmental degradation around the oases. There is a universal demand by oases residents for fencing. They claim damage to crops by animals is the primary deterrent to gardening and that the situation has become more serious now that the GIRM has forbidden the cutting or pruning of trees. Thus, the project will encourage the introduction of living fences, as well as forage crop cultivation and address livestock watering and veterinary needs.

(5) Mauritanian oasis life is part of a firmly established socio-cultural tradition, the values of which must be carefully considered in any project interventions. The cultural values of Moorish nomadism are still very strong. These values will impact on certain approaches of the project. For example: (a) the project will have to prove its value before people can be asked for their commitment. This proof must be evident, and not just a convincing verbal argument; (b) the project must be prepared to assist any or all the residents of the project oasis in order to avoid community divisiveness; (c) the Moors are strongly individualistic people. Cooperatives have never been successfully started among them; and (d) any project interventions to involve the people must be kept as simple as possible.

(6) The oasis tradition in Mauritania is of such fundamental socio-cultural importance to Bidan Moor society that the future development and continuation of the oases is not only based on economic considerations, but initially on more paramount social grounds. However, the importance of the revitalization of this way of life is also a way of assuring the continued investment by Mauritanians themselves in the development of the interior and that contributes to the redistribution of wealth when externally obtained profits are expended on rural wage labor.

Proposed course of action

Two basic types of communities have been sought and selected for participation in this initial phase. The first, to help insure a viable technical model, will be a progressive population of type "b" herder - oasis farmers. The second will be a new mixed association between the laboring groups and the capital-possessing groups. It will have to be created out of the structure of some existing communities where the more powerful interests are already aware that their dependence on paid labor requires their offering new enticements to this element of the population. It will have to be stabilized by insuring that the laboring population is provided with sufficient

independent economic rights to be able to break the association should it prove more exploitative than mutually profitable.

Actually selected sites

The following sites were selected based on their apparent capabilities for fitting one of the above two criteria:

Sani: This is the most "open" option. Sani is composed of newly settled type "b" herder agriculturalists, mixed Bidan, Haratin, Peuhl (Fulbé). The Sani Agricultural Station and its agent Aziz Barrada provide a leadership resource of immense value.
N'Taka El Wasa: This is a most unusual community of combined Bidan, Haratin, oasis farmer - herders. Should the project as designed interest the people, they are probably the most likely to succeed.
El Grahan and Semoga: These are not particularly rich, Bidan-dominated communities where it should be possible to attempt to work out a new relation among the owners and workers.
Bugara and Billaouare: These communities are very clearly dominated by powerful Bidan families. However, the families are very sophisticated and are capable of clearly discerning their present and future interests. The area is along the route of the now under-construction Kiffa-Nema road which threatens them with the loss of their dependent labor population and an influx of strangers. They seem potentially open to readjusting their situation if only to adapt to changing circumstances they cannot control. Moreover, this area would seem of great importance in that its potential for directed development may greatly diminish once the road is built and the in-migration becomes difficult to control. On the other hand, should the project prove attractive, one is assured of a constantly growing population along the road to participate in its expansion.

C. ADMINISTRATIVE FEASIBILITY

This project tries innovative techniques and then evaluates them (1) for economic and social benefits relative to inputs, (2) for appropriateness in technology, and (3) for replicability by involving oasis farmers in extension demonstrations of the innovations. A controlled administrative mechanism will be essential for efficient, effective and valid trials, evaluations and demonstrations. This will be provided through a contract arrangement with an organization which is sufficiently experienced in rural development ventures in the Sahel with appropriate guidance and support from the GIRM and USAID.

The project should ensure that the contract team is self-sufficient to a maximum degree, including its own administrative support personnel, vehicles and commodities to perform the required functions. The team will contain necessary technical personnel for the trial, evaluation and extension demonstration functions, including the means to secure short-term supplementary technical expertise as needed. Thus, for the most part, the contract team will be able to achieve the project purpose through its own controlled resources.

However, the guidance and support to be provided by the GIRM and USAID are also important. At the start of project implementation, negotiations with the participating oases will be carried out by the GIRM and USAID to ensure

formal understandings and commitments with the cooperating oases. A continuing participation of GIRM Agriculture Service specialists has been included in the implementation plan to insure adequate exchange of information and experience and complementarity of efforts. The GIRM will provide a senior official to participate with AID in project evaluation and in identification of other potential oases for future development efforts. The GIRM also will assign up to twelve agricultural agents over the project period to receive one or more years of on-the-job training in assisting in project rrials and demonstrations. Additionally, the GIRM will make available to the project the government research station located at Sani to serve as project headquarters, site for trials and base for extension activities and will also provide the Training and Extension Coordinator, a vital link in the project. Provision of these substantial elements by the GIRM should not impose a major burden on the Government since they will involve already existing organizations, staff and facilities.

Support and guidance to the project from USAID will be essentially that which normally is provided to self-sufficient project teams: policy guidance and monitoring by a designated Project Manager; preparation and issuance of Project Implementation Orders (PIOs) for major commodity procurement and construction contracts; orientation of project technicians; project evaluations, modifications and re-design as needed.

A unique feature of the implementation plan for this project is a pre-contract start-up phase, which will advance implementation by a year and should ensure that commodities and facilities are in place by the time of arrival of the contract team leader. This period will impose some additional burdens on USAID which will have to cover the first year of a personal services contract with a Project Administrative Officer who will relieve USAID of the major early administrative functions for the project (initial procurement actions, financial ledgers and controls, construction design plans and contracting, securing short-term consultant services, contracting for hydrogeologic surveys) as outlined in the Implementation Plan.

There will be need, as with other projects, for USAID to insure appropriate interchange between this project and other on-going programs, notably the Vegetable Production Project, Guidimaka Integrated Rural Development, and RAMS. These several projects will be mutually supportive through exchange of information and this coordination will be facilitated through the USAID Rural Development Council.

The project, as designed, will not impose administrative burdens on USAID beyond its current staffing capacity. However, much will depend on the capability of the contract organization to provide technicians and administrative personnel with abilities and experience appropriate to the isolated and difficult environment in which they will work. An RFP should seek an organization with extensive "bush" experience in the Sahel and which can secure technicians who can cope with such assignments, with French language capability. Several voluntary organizations have such experience and abilities and should be invited to propose. Ideal staff candidates would be ex-Peace Corps or other volunteers having the necessary technical skills. With careful contracting, a

suitable contractor organization and staff can be found. This could well be the most significant administrative feasibility issue for the project.

Functions and responsibilities of the Team Leader, Training and Extension Coordinator, Oasis Development Workers and Administrative Officer are contained in outlines which follow. These are the key long term managers and extension implementors of the project.

The Team Leader should have a university degree in agriculture (he will serve as the team agronomist, in addition to his management functions), three or more years of practical field experience in rural development in Sahelian countries, and two or more years in agricultural applied research. French or Arabic language at S-3 will be essential and candidates should have their fluency tested at FSI. No candidates who would require extensive language up-grading prior to assignment should be considered, in view of the excessive delay in assuming functions, and the high risk that they might not attain the minimum essential fluency.

The Training and Extension Coordinator (TEC) (Mauritanian) should have substantial field experience in the oases area in agricultural applied research, appropriate technology applications and extension introductions. The GIRM will provide the TEC and pay his basic salary, while USAID will pick up all of the support costs. Since the TEC will be supervising and coordinating the Oasis Development Workers, experience in management and supervision will be essential. Fluency in Arabic and French languages will be required.

The Oasis Development Workers (ODWs) will be the day-to-day "change agents" who work with the farmers in the oases, help them initiate demonstration and adoption introductions, and provide or secure technical advice and assistance to the farmers. They will be of farmer origin themselves, with practical experience in agricultural development activities. Their skills will be at the appropriate technology level, but they must have sufficient basic education to enable them to gather and record field data. Fluency in Arabic will be essential; in French desirable. These workers and their assistants may be selected from among candidates with appropriate experience. Women will be considered as candidates to the extent possible.

The Administrative Officer should have the equivalent of a university degree and two or more years of management experience in Africa (preferably the Sahel). His experience should include some basic accounting and financial management, personnel employment, procurement and contracting, and management of vehicle operations and maintenance. French fluency at S-3 will be necessary.

Although it would not be a condition of employment, special consideration will be given to candidates for Team Leader and Administrative Officer who would be without family, in view of the need for them to be in the field for extended periods of time.

Short-term consultant candidates will be required to possess the education (normally university degree) and field experience appropriate to their specialty. They must have the health and stamina to endure the rigors of days in isolated field locations with minimum creature comforts. Fluency in French at the S-2 level is a minimum requirement.

Functions and Responsibilities

Team Leader (monitored by USAID Project Manager)
- Sani preliminary trials of technical innovations;
- Extension demonstrations in oases;
- Technical assistance to farmers adopting techniques;
- Coordination with GIRM personnel;
- Coordination and adjustment of implementation plan to insure procurement, contracting and consulting services ordered and accomplished when needed;
- Supervision (with Administrative Officer) of employment, payroll, local currency expenditures and accounts;
- Supervision (with Administrative Officer) of standards for administrative management of project vehicle operations and maintenance, buildings operations and management, project commodity controls and warehousing;
- Coordination with USAID Project Manager, including scheduled and informal reporting, US procurement orders, communications with USAIDs re consultant requests, planned training visitations, etc.;
- Assistance to USAID Project Manager in organizing and scheduling project evaluations,

Training and Extension Coordinator (advised by Team Leader)
Management of Project's extension and training program:
- Identification and selection (with Administrative Officer) of ODW candidates for training and employment in project;
- Development of extension and training program (with assistance of the Ecole Nationale de Formation et de Vulgarisation Agricole at Kaedi), and conducting three month orientation and training for ODWs;
- Introduction to oasis communities of assigned ODW;
- Supervision of ODWs in identifying and selecting oasis participants for introduction demonstrations of new varieties and techniques;
- Supervision of Oasis Development Workers (ODWs) in their extension demonstration activities with participating oasis farmers;
- Liaison with Sani technicians and moniteurs to determine when new varieties and techniques are ready for introduction to oases. Liaison with GIRM extension personnel regarding these introductions; assisting them to participate as desired;
- Determining and arranging for commodity assistance to oasis participants in project introductions (tools, seeds, fertilizers, etc.);
- Arranging for technical consultants and Sani moniteurs to visit oases as needed, to advise on installation or implementation of introductions;
- Supervision of ODWs in assisting oasis farmers to adopt introductions they have observed in the demonstrations;
- Coordinating observation training sessions of oasis farmers as initially arranged by date palm specialist or range management specialist. Supervision of ODWs in selection of oasis participants. Conducting observation trips;
- Coordinating and planning, and conducting farmer field day observations, if and as practical, to bring selected oasis farmers to Sani or other oases to observe trials or demonstrations. Liaison with GIRM extension services for involvement by them in arranging these field days and in inviting and assisting other farmers in the region to participate;

- Conducting periodic seminars at Sani which bring together the ODWs from their oases, the technical specialists and moniteurs at Sani, and the regional extension personnel of GIRM;

Counterpart to Team Leader for project operations and liaison with GIRM.

Oasis Development Worker (supervised by Training and Extension Coordinator)

- Collection of field data (production and harvests) for use in evaluating new varieties and cultivation methods (supervised by TEC and advised by technical specialists in this function);
- Observation of oasis farming operations and practices; identification of better farmers to encourage as participants in introduction demonstrations, as animateurs and as participants in observation training sessions;
- Assisting oasis participants to initiate introduction demonstrations on their cultivation plots; securing technical and commodity assistance from Sani and GIRM extension service as needed;
- Monitoring and advising oasis participants in their demonstration cultivations and techniques;
- Encouraging and assisting other oasis farmers to adopt these techniques, and securing commodity and technical assistance from Sani and GIRM extension service as needed;
- Supervising ODW assistants (residents of oases) in tending project nursery plots, and in transplanting stock in oasis woodlot, windbreak and live fencing demonstrations;
- Liaison between visiting project consultants, engineers etc. and oasis community as regards project activities;
- Accompanying oasis participants in observation training sessions and field days;
- Participating in regular seminars conducted by TEC in Sani.

Administrative Officer (under supervision of USAID project manager the first year, and of the Team Leader in subsequent years)

Administrative management functions for project:

- Developing with USAID Controller and implementing a system of financial management for project, including payroll, local procurement, local currency banking and controls, invoice and voucher certifications, accounting ledgers and reports, and periodic audits;
- Supervising motor vehicle services for project, including vehicle procurement and operation and maintenance standards and services; supervision of drivers and mechanic;
- Employment contracting, in coordination with USAID;
- Stateside procurement orders, in coordination with USAID;
- Initiating or authorizing and supervising local procurement;
- Supervision of project commodity controls, warehousing and deliveries;
- Initiating requests for consulting and engineering services per implementation plan. Administrative support to consultants;
- Leasing and managing residential housing and other buildings for project technicians and purposes;
- Coordination, in conjunction with USAID, to secure contruction engineering and contracting services for construction of project buildings;
- Monitoring contractor construction.

D. ECONOMIC FEASIBILITY

This project is designed so that its economic benefits include development of a technological package or system that will induce an increase in agricultural production, and hence increase the well-being of oasis farmers. These benefits can only be quantified during the course of project implementation, as technological interventions are tried, evaluated and demonstrated. While these can and will be judged for individual costs/benefits, the important economic benefits from this project will depend on successful identification of technological interventions which can be extended and replicated in a broader future project expansion. Thus, the costs of this project relate not to the limited numbers of people who will directly benefit from the intervention trials, but to the development of appropriate technology interventions which can be introduced to a broader area. Potential direct beneficiaries of such a broader program would be an estimated 100,000 inhabitants of more than 150 oases which currently support cultivation. This represents approximately 8 percent of the Mauritania population. However, there may also be beneficiaries on a Sahel regional basis from this project, if interventions in oasis technology could be replicated and extended to farmers in oases in other Sahelian countries with similar conditions.

The Economic Analysis of the project is found in Annex C-6. It contains an analysis of the cost effectiveness of the project as designed and under alternative designs. The findings are that it is not likely that costs can be reduced while still achieving the project purpose. This analysis supports the design and input costs of the project. An agricultural economist will be included in an evaluation team in the third year to study in more depth the economic aspect of the project, especially marketing and the proper mix of enterprises given the appropriate technologies developed by the project. At that time more information will be generated by this and other projects.

This initial phase project will, over five years, directly involve up to six oasis communities with a population of between 3600 and 4200. The benefits accruing to participating farmers from extended demonstrations will mainly be in the form of improved techniques and plant varieties for date, vegetable and cereal production, and a more efficient technical assistance out-reach system. As a result of introducing tested new techniques, production output should increase. The magnitude of this increase will depend on relative yields, additional inputs, and participation in each project year. The precise volume of land to be utilized for the new technologies will not be known until the project is under way.

Project benefits will extend beyond the potential quantifiable increases in production. They will contribute to the quality of life for oases people through more nutritious food for their own consumption and through retarding and arresting the environmental degradation which is rapidly turning much of the country into wasteland. The project will vitalize the institutions supplying services and technical know-how to oases farmers and focus attention directly on their problems. Also, as a result of better utilization of land throughout the cropping season and the potential for more land to be put under cultivation, the rate of migration from the oases should slow down. Already in some oases many farmers expressed their willingness to stay in the oases if they could be occupied throughout the year and earn a decent income. If date, fruit, henna, and other crop production activities are expanded, marketable surpluses can be sold in local and regional markets. Thus, increased oasis production capabilities should be an incentive for oasis farmers to remain in the oases. In addition, new techniques of production taking advantage of the dry season, when the normally low level of oasis agricultural activity drives residents to seek economic activity elsewhere, should also encourage farmers to remain in the oases.

A significant portion of the expected increase in agricultural production which results from the new technologies will be consumed locally by farmers and their families. Current cereal and vegetable production in the oases is largel for consumption by producers in their communities. However, a large proportion of date and henna output is marketed to regional centers in exchange for such necessities as textiles, salt, sugar and tea. Lack of information on consumption of vegetables and incomplete data on prices make it difficult to assess the extent of potential vegetable marketing. Information gathering for this will be provided through two other USAID projects (RAMS and Vegetable Production) the results of which will be available to this project.

Under the present prevailing conditions of supply costs and relative prices increases in production must aim at markets in Mauritania principally in Kiffa and Nouakchott. Because of proximity, other markets in Mali and Senegal will also be explored. With the recent completion of a road from Kiffa to Nouakchott, the Nouakchott market is now more accessible. Other roads are being built. However, subsidiary tracks within the region are still primitive. There is good potential for growth in the internal market for dates, henna, and possibly vegetables, given properly organized production, distribution, adequate storage and an efficient marketing system. Widening of the markets will depend on such factors as an improved transportation system and an increased demand in growing urban centers. An initial problem, however, facing farmers in some oases is the availability of transport. What transport is available to regional markets is increasingly expensive and will become more so as the world price of POL continues to rise. Thus, geographic factors of distance to markets will have greater significance for those farmers producing for urban markets. In cases of local markets not far from the oases, output is currently transported on the back of a donkey or a camel. In these instances constraints exist in terms of overall carrying capacity.

Since improvement in road transport will only be realized over the long term, the oasis farmer must adjust to the vagaries of the present situation which is characterized by the saturation of local markets, uneven rate of flow of supplies to market and by sharp fluctuations in market prices, especially for vegetables. One way of controlling factors which adversely affect marketing potential is to cultivate crops which can support longer and rougher shipments such as onions, potatoes and turnips. Prices of dates, henna and vegetables are not controlled by the government, while the official price of millet is determined by the Mauritanian Cereals Office (OMC). There is little that can be said concerning elasticities in the domestic market for agricultural crops. Retail price data needs to be supplemented by information on prices received by farmers, the farm price spread and marketing margin, in order to determine the farmer share of marketing cost. These are topics to be investigated by the agricultural economist to be brought in as a TDY consultant to the project.

PART III

FINANCIAL PLAN

The financial plan consists of:
- total projected costs of the five-year project, by funding source, use, and year of expenditure;
- analysis of financial accountability, including a discussion of financing methods; and
- a discussion of financial viability of the project and recurrent costs.

A. PROJECT COSTS

Total A.I.D. contribution, including inflation and contingencies, is $5,991,000. Cost projections were obtained by quantifying all project inputs, by line item and year of expenditure (see Annex H). These costs are summarized by source, use and year of expenditure, in the following tables:

Table 4 - Summary Cost Estimate and Financial Plan
Table 5 - Annual Breakdown of A.I.D. Contributions
Table 6 - Costing of Project Outputs/Inputs
Table 7 - Projection of Expenditures by Fiscal Year

Table SUMMARY COST ESTIMATE AND FINANCIAL PLAN (US $000s)

AID CONTRIBUTIONS	
Personnel	
Long-term, expatriate	$1,015,900
Short-term, expatriate	663,000
Local personnel	487,400
Local travel and support	155,700
Commodities	
U.S. procurement	446,743
Local procurement	367,200
Third country procurement	282,975
Other Requirements	
Construction	150,000
Studies	40,000
Training	180,000
Evaluations (2)	80,000
Subtotal	$3,868,918
Contingencies (5%)	193,445
Subtotal	4,062,363
Inflation (15%,compounded)	1,928,761
TOTAL A.I.D. CONTRIBUTION,	$5,991,124
Rounded to:	$5,991,000
GIRM CONTRIBUTIONS	
Personnel	150,000
Facilities and land	75,000
Inflation (compounded, 15%)	125,000
TOTAL GIRM CONTRIBUTION	$ 350,000
TOTAL PROJECT COST	$6,341,000

Table 5 ANNUAL BREAKDOWN OF A.I.D. CONTRIBUTIONS

	Year 1	Year 2	Year 3	Year 4	Year 5	FX	LC	TOTAL
PERSONNEL								
Long-term expatriate	85,500	234,600	342,900	114,300	238,600	786,400	229,500	1,015,900
Short-term expatriate	121,000	166,000	225,500	70,500	80,000	663,000	-	663,000
Local personnel	47,250	131,750	151,850	51,950	104,600	-	487,400	487,400
Local travel & support	15,650	46,450	46,800	15,600	31,200	-	155,700	155,700
COMMODITIES								
Procurement - U.S.	269,467	111,452	61,149	4,675	-	446,743	-	446,743
Procurement - Local	113,500	66,000	96,400	31,300	60,000	-	367,200	367,200
Procurement - 3rd Count.	127,400	39,375	110,600	5,600	-	282,975	-	282,975
OTHER REQUIREMENTS								
Construction, studies training, evaluations	166,000	40,000	204,000	-	40,000	260,000	190,000	450,000
SUBTOTAL	945,767	835,627	1,239,199	293,925	554,400	-	-	3,868,918
CONTINGENCIES 5%	47,288	41,781	61,960	14,696	27,720	-	-	193,445
SUBTOTAL	993,055	877,408	1,301,159	308,621	582,120	-	-	4,062,363
INFLATION 15%	148,985	282,964	677,741	231,157	587,941	-	-	1,928,761
TOTAL	1,142,013	1,160,372	1,978,900	539,778	1,170,061	-	-	5,991,124
ROUNDED TO	$1,142,000	1,160,000	1,979,000	540,000	1,170,000			$5,991,000

Table 6 COSTING OF PROJECT OUTPUTS/INPUTS ($000)

	INPUTS		OUTPUTS*		TOTAL
	#1	#2	#3	#4	
AID	1193	2543	1951	304	5991
GIRM	100	120	120	10	350
TOTALS	1293	2663	2071	314	6341

Outputs (prorated)

#1 - initial technology evaluations at San

#2 - extension introductions at oases

#3 - training, including on-the-job

#4 - special studies and reports

Table 7 PROJECTION OF EXPENDITURES BY FISCAL YEAR (US $000)

FISCAL YEAR	AID (Grant)	GIRM	TOTAL
	(including contingencies and inflation)		
1980	600	50	650
1981	1100	60	1160
1982	1500	70	1570
1983	1200	80	1280
1984	1200	90	1290
1985	391	-	391
	5991	350	6341

B. FINANCIAL ACCOUNTABILITY

The project is divided into two phases: first-year, or pre-contract team, activities and contract team activities. Financial accountability varies considerably from the first phase to the second, as discussed below.

1. First Financial Management Phase

First-year activities include preparation for the technical assistance contract, i.e. housing/offices/warehouses constructed or leased; commodity procurement/support effected; land preparation initiated; Oasis Development Workers trained and assigned to designated oases. Annex H includes projected costs for these inputs.

Critical inputs are assignment of the Administrative Officer and the Training and Extension Coordinator, who are responsible for managing implementation of first-year activities. These two positions will be filled as soon as possible (the Administrative Officer through a USAID Personal Services Contract, and the TEC appointed by the GIRM) to insure timely completion of first-year activities. USAID/Nouakchott, JAO and REDSO will assist the Administrative Officer in effecting housing/office/warehouse leasing and construction and commodity procurement.

During this phase, prior to the contract organization selection and arrival of the team leader,project costs will be accounted for by USAID/Nouakchott through direct reimbursement to suppliers and contractors. Where feasible and practical, however, arrangements will be made to provide for the transfer of accountability of recurring costs (e.g., housing/office/warehouse lease payments, utility costs, and guard services) to the contract organization by the second year. Such costs will be incurred by the contract team, which AID will directly reimburse (see following section).

2. Second Financial Management Phase

The arrival of the contract team on or hopefully before the 13th month marks the second management phase. At this point, the Administrative Officer and other personnel become employees or sub-contractors of the contract team. The team, responsible to the USAID Project Manager, assumes the day-to-day administrative and financial accountability for the project's inputs. More specifically, the team will account for and administer, where feasible and practical

- all personnel-related inputs (e.g. compensation, housing, travel),
- commodity procurement/support and land preparation, in accordance with Project Implementation Orders,
- buildings
- travel, and
- surveys.

AID will directly reimburse the contract team for such allowable costs. To the greatest extent possible, a local currency fund, accounted for by the contract team, will provide for costs not included in the contract team dollar

contract budget. This maximizes centralization of the project's administration and financial accountability and minimizes AID's direct involvement in the day-to-day management of project inputs. Major overseas commodity procurement, however, will be affected by AID, through the Afro-American Purchasing Center (AAPC) or similar organization.

C. FINANCIAL VIABILITY AND RECURRENT COSTS OF THE PROJECT

The non-revenue producing, pilot nature of the project limits appraisal of its financial soundness to

- budgetary analysis (see Project Costs and Financial Accountability, above), and
- analysis of project cost-effectiveness (see Annex C-6, Economic Feasibility).

Analysis of recurrent costs is not complicated because the project purpose is to develop and demonstrate formulas of interventions and to provide an information base for future project development. Although the project will be up-grading skills of agricultural agents, no new on-going entity will be established during this phase, nor will any existing entities be expanded. Therefore, there will be no continuing expenses of this phase of the project. The enlargement of facilities at Sani research station will be for project purposes during five years. Upon its return to GIRM, the government may wish to increase its activities over what is the current level, with some modest increase in annual financing. However, this would not be a condition of the project. However, there will be feasibility evaluation for a later phase program of broader geographical scope which would be production-oriented, and such a program would undoubtedly involve new or expanded institutions and recurrent costs.

PART IV

IMPLEMENTATION PLAN

Latest Date Action to be Completed	Action	Action Agent
Est. Feb.'80	Project Agreement signed	USAID, GIRM
Months After Project Agreement Signed	Contract with local architectural firm to produce plans for project buildings at Sani	USAID
1	- PIO/T's issued for contract team, 1st year TDYs	USAID
	- Agreements reached with participating oases to become part of Oases Proj.(see Part IIB3)	GIRM, USAID
	- Administrative Officer hired on P.S.C	USAID
	- REDSO/WA Engineering approves construction plans	REDSO
	- Project financial management system developed	USAID Controller, Project Administrative Officer (PAO)
	- PIO/C's issued for U.S. project commodities procurement	USAID, PAO
	- Begin local purchases; vehicles ordered	PAO
	- Training and Extension Coordinator named	GIRM
1-4	- Geophysical surveys at project Oases sites contracted with GIRM Hydrological Service	PAO, USAID
3	- Date palm expert, irrigation engineer, and appropriate water technology expert arrive for TDY	TDY Consultants
	- Irrigation survey of sites	TDY consultants
	- Candidates for Oasis Development Workers (ODW) identified	Training Extension Coordinator (TEC)
	- Oasis Development Workers hired	PAO

Post ProAg	Action	Action Agent
3-6	- Sani training facilities prepared	TEC, PAO
	- Training plan for ODW - developed	TEC, assisted by consultants, GIRM
	- 3 month training/orientation for ODWs	TEC
	- Mechanical services contracted for repair of project vehicles (Nouakchott and Kiffa)	PAO
	- Buildings leased in Kiffa (residence and warehouse space)	PAO
	- Contract for construction of buildings at Sani and for modifications of buildings at Kiffa	PAO
5	- Contract with Hydrological Service for installation of Tysen (jet) well and hand pumps at project sites	PAO, GIRM
	- Local purchase of furniture and furnishings	PAO
7	- ODWs arrive at their oases sites, accompanied by TEC: prepare shelter, with help of locally hired labor; lay out community-provided nursery sites; coordinate installation of Tysen well for nursery and drinking water	TEC, ODWs, PAO
(Sept.)	- Visit to North Africa and Niger to select parent palms from which shoots to be taken (Feb/Mar)	TDY consultant
	- Identify oasis cultivators who will undertake initial demonstrations of field crops, vegetables and fruit trees	ODW, TEC
	- Employment of Mauritanian nutritionist on PSC, Beginning of in-depth nutritional studies	PAO
	- Collection of baseline data begin	ODW
9	- Identification of date palm cultivators to be considered for North African field visits	ODW, TEC
10	- System for periodic seminars established at Sani	TEC, GIRM
13	- Contract team leader arrives in-country; Admin Officer, PSC personnel on board, become part of contract organization	Contractor
13 (Feb/Mar)	- Collection from North Africa and Niger of shoots for Sani. Collection of Bayoud-	TDY consultant

Post ProAg	Action	Action Agent
	resistent shoots from Morocco. Arrangements in Tunisia for date visits by oases farmers	
15	- Evaluation of adequacy of administrative and financial system for project	USAID controller, Proj. Mgr., PAO
	- Second PIO/C for U.S. commodity procurement issued	USAID,contract team
17	- Animal traction consultation for one month	TDY consultant

NOTE: Several of above implementation steps (e.g. seminars, TDYs, trials are repeated at various times throughout project but are not repeated below in the outline of the implementation plan.

22 (October)	- Observation trip by selected oasis farmers to Tunisia	TDY consultant, TEC
24	- Replacement vehicles purchased	PAO
30-32	- In-depth evaluation	GIRM, USAID, contract team
32	- Subject to positive evaluation, 40 oases surveyed for potential for expanded future development via congract with GIRM Hydrological Services for hydrogeological surveys. Additional surveys on production, social, environmental, and marketing conditions.	GIRM, USAID, contract team, TDY consultant
38	- Based on above survey, PID prepared for a Phase II project for oasis development	USAID
	- Based on evaluation and subsequent survey one or more currently participating oases may be dropped from current project and replaced by others showing greater promise	GIRM, contract team, USAID
	- Final U.S. procurement of commodities by PIO/C	USAID, contract team
58-60	- Final project evaluation	GIRM, USAID, contract team, TDY consultant
60	- Contract team departs; Sani research station returned to GIRM	GIRM, contract team, USAID

PART V

EVALUATION PLAN

Careful evaluation of the results of technology introductions in this project will be a continuing concern, not to be limited to periodic reviews. In order to verify that techniques will be accepted and adopted, they will first need to be verified for technical appropriateness (simplicity), productivity effects substantial enough to interest the oasis farmers, and input requirements (labor and other investments) modest enough relative to benefits.

These "cost benefits" verifications of individual technical introductions will depend on sufficient knowledge of current oasis production practices and harvests. The source of information on these will be the oasis development workers (ODWs) who will be trained to collect data against which the new techniques will be compared. Project specialists concerned with trials at Sani will determine the information needed, and the Training and Extension Coordinator (TEC) will supervise the ODWs in gathering and reporting the data.

Another phase of evaluation will relate to the ease and/or problems encountered by oasis participants who adopt extended technologies. Factors other than relative sophistication or simplicity of the technique may affect the demonstration, such as social acceptance of the technique by the oasis community, competition for cultivable land or water, lack of cash markets, or poorly recognized benefits (improved nutrition perceived as being at the expense of more sufficient quantities of grains/food).

Some of the techniques tried at Sani may be found to be inappropriate, or, although meeting the first test, introduced to the oases and found wanting. For the project to provide information verifying a basis for future project development, sufficient innovations, with significant benefits relative to costs, must be introduced successfully. In-depth evaluations which will be conducted at the mid-point and at the end of this project will assess this success. The in-depth evaluation during the third year of the project will ascertain whether the methods of encouraging oasis farmers to adopt new technologies are viable and whether the technologies are appropriate. This critical evaluation will help to determine whether to continue funding for the last two years of the project. Another factor in the continuation of the project beyond the third year will be the GIRM commitment to future oasis development, by plans to expand project activities.

These evaluations should be performed by senior experienced rural development specialists. The team for each evaluation should include the USAID Project Manager, the project team leader, the senior GIRM official concerned with the project, an AID/W evaluation specialist and an agricultural economist.

The evaluations should consider the number and types of new technologies initiated, verified and extended to the participating oases; the introductions which are clearly or partially succeeding; the apparent potential for additional extensions; the participation and interest of the oasis communities; prognosis for significant improvements in production and/or health to result from the individual technology introductions; and a sense of whether this project is achieving its purpose of pointing to broader future project development.

Evaluation reports will be prepared and submitted to USAID, GIRM, AID/W and the TA contractor organization. The mid-term evaluation will be the basis

for proceeding at that time with surveys of potential oasis sites for a broader, subsequent program (see Part V). It will also be the basis for modifying this project, if changes for example in processes, participating oases, or inputs, are indicated.

A special administrative evaluation has been included in the implementation plan (Part V) to take place about the 18th month. This will study the adequacy of the administrative systems and practices established for the project. It is suggested that the evaluation be conducted by the Project Manager, the USAID Controller and the project administrative officer.

ANNEX A

LOGICAL FRAMEWORK

Life of Project:
From FY 1980 to FY 1984
Total U.S. Funding: $ 5,991,000
Date Prepared: 15 November 1979

Project Title and Number: OASIS DEVELOPMENT PROJECT 682-0207

NARRATIVE SUMMARY	OBJECTIVELY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	IMPORTANT ASSUMPTIONS
Goal: -To improve the vitality and capability of Mauritanian Oases to support their people at a better condition of living; and to diminish migration from the oases to urban areas.	-Increased disposable incomes. -Wage earners spend more time in their home oases areas.	-Project evaluations	-Continuing pattern of cyclical droughts and climatic variations. -Oases communities can make necessary socio-economic adaptations. -GIRM commitment. -Conditions are sufficiently improved to cause people to remain
Purpose: -To introduce appropriate new technology which will help oases people to become more self sufficient in food production; and to provide an information base for future project development.	-Food production increased. -More of oasis cultivatable land under cultivation. -Oasis farmers adopting demonstrated technologies. -Improved forage and pasturage for oasis animals. -More areas protected by living fences and windbreaks. -Calorie and nutritional consumption improved. -Other oases evaluated as participants for broader program.	-Data collected by ODW's. -Observations of project specialist (day-to-day). -In depth evaluations. -Oases site surveys (broader program)	-Environmental degradation can be halted. -Sufficient numbers of appropriate innovations can be developed which significantly improve production. -Oasis people will be motivated.
Outputs: -Trials at Sani of techniques in: wells, water lifting, water delivery systems, cultivations of palms, food grains, legumes, root crops, vegetables,	-Trials: 5 wells, 6 water lifting, 12 water delivery systems, cultivation of palms-12 varieties, cultivation of: 20 food grains, 15 legumes, 30 root crops,	-Project reports. -In-depth evaluations.	-Project technicians are provided on a timely basis. -Commodities are delivered when needed.

horticulture. -Extension of above techniques to 6 oases. -Training of agricultural agents, oasis farmers, long term academic training. -Reports: Geophysical, Hydrogeological, Dietary/Nutritional, Marketing.	50 vegetables, 20 horticulture. Demonstrations: 40 wells, 25 water lifting, 48 water delivery, 1380 palm shoots, 80 grains, 100 other cultivations, 6 nurseries, 4000 meters living fences Training: 12 moniteurs, 850 oases farmers (600 date palm tech. assistants & 200 other demonstrations) Reports: Geophysical-6 oases; Hydrogeologic-40 oases; Dietary/Nutritional-6 oases; Marketing-6 oases.		-Sufficient numbers of introductions at Sani qualify for extension to oasis. -GIRM can assign moniteurs when heeded.
Inputs: US Inputs (See Annex H) Technical Assistance Specialists, Mauritanian Specialist + Support Pers., Local travel and support, Commodities-US and 3rd Country, Local Commodities and Services, Construction, Other requirements, Contingencies (15%), Inflation (15% per year compounded) GIRM and Oases Community Inputs: Approx. 600 person months; Sani research station (5 year assignment)	-See project document narrative for types and quantity commodities	Project records.	-Manufacturers of commodities will produce and make available commodities needed.

ANNEX B

PROFILE OF OASES OF THE ASSABA REGION AND ELEMENTS OF A MODEL OASIS

Significance of the Assaba Region for the Integrated Development of Oases Project

The over 200 oases in Mauritania are widely distributed in a north-south zone through the central portion of the country with a few scattered eastward from Kiffa to Nema. Virtually all oases are situated near the margins of the major plateaus - the Adrar in the northwest, the Tagant in the mid-region, the Assaba in the south-central portion of the Affole in the southeast. Of the four, the Assaba and its near neighbor the southern Tagant produce the greatest runoff of water and together form the largest and most significant drainage basin on the Mauritanian side of the Senegal River.

Situated in the central part of the Sahel between the 200 mm and 500 mm average annual precipitation lines, the Assaba collects more water than any other upland region in the country.

The Assaba and Tagant Plateaus are composed largely of sandstone rocks that, owing to their slight tilt, permit surface waters to drain southward through the Karakoro erosion channels to the Senegal River. The infrequency and variability of this runoff, in combination with a gentle gradient and porous soils, results in rapid absorption of the water, and the retention of some of the moisture in sandy aquifers a few meters below the ground's surface. Where the stream channels cut below the water table, small ponds or "mares" are created around which oases are frequently developed.

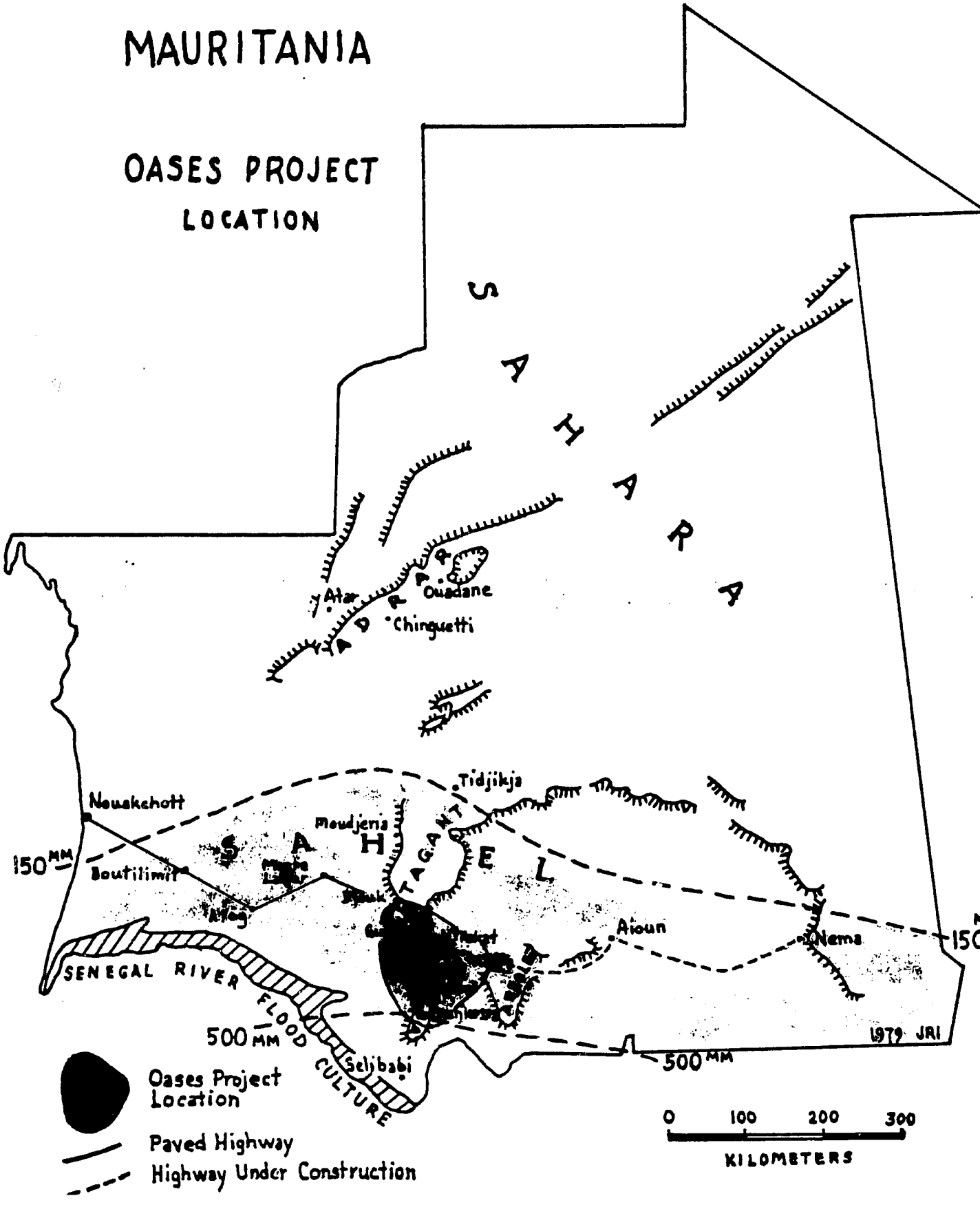
Soils of the Assaba are varied and include abundant sands, clays, and loams as well as alluviums. Various combinations of these soils provide the base for the diversity of natural vegetation (grass, shrubs, and trees) and the domesticated crops planted in the oases. The range and variability of precipitation within the Assaba supports a good cross-section of the plant species found in Mauritania. Only the varieties found in the Senegal River delta and along the very wet portions of its course plus varieties in the southern Guidimaka are not seen.

The Assaba oasis zone lies centrally within Mauritania's agropastoral population and is inter-linked with rain-fed and recession forms of agriculture and their associated livestock components.

Owing to the combination of water, soils, and vegetation adjacent to the Assaba plateau, this portion of Mauritania has a venerable history. It served as a prime commercial routeway for goods and peoples around the western Sahara and linked black, wet Africa with white, Mediterranean Africa, a function which helped to establish the Assaba as part of the Mauritanian heartland.

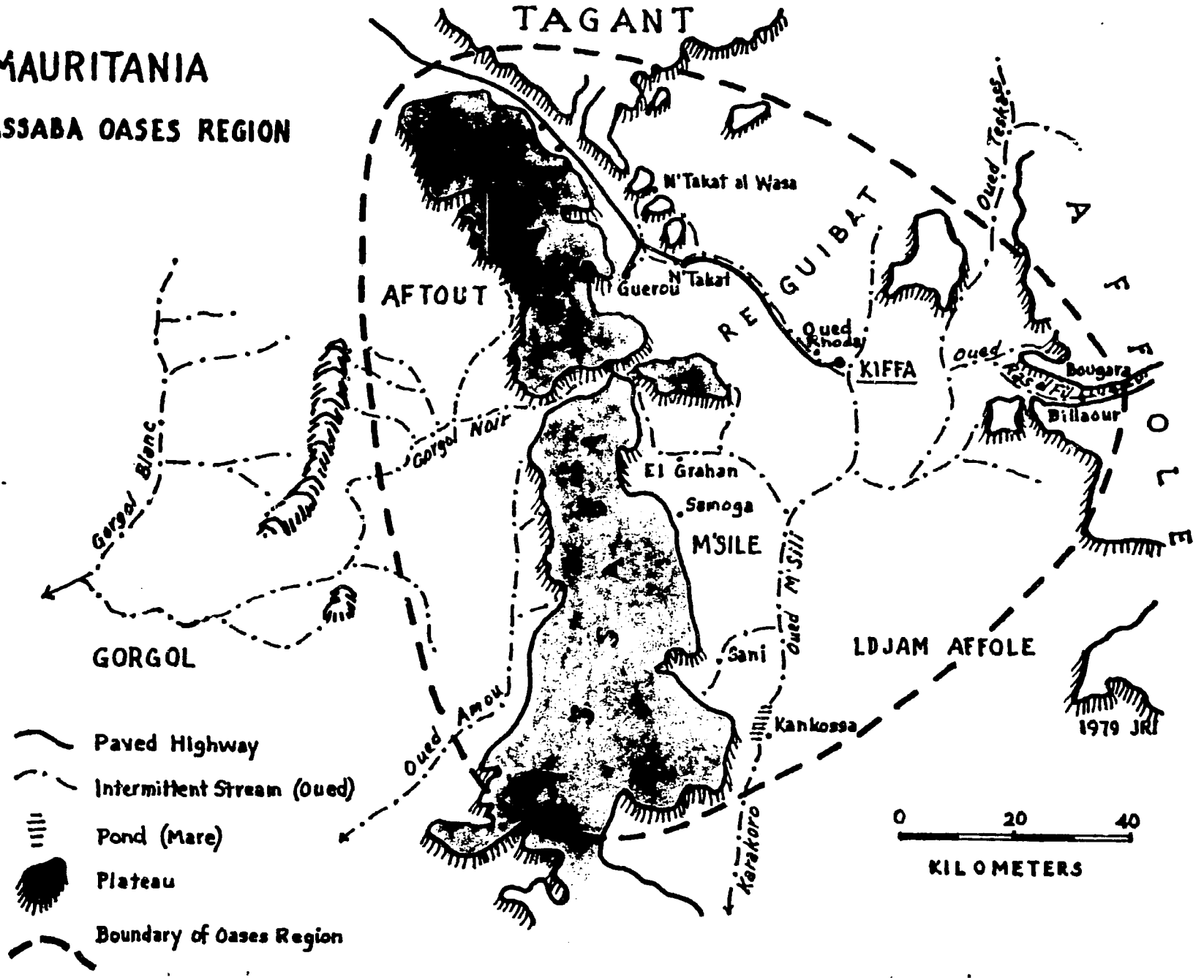
With the completion of the 600-kilometer paved highway from Nouakchott to Kiffa in 1977 and the present extension of the road to Nema by 1981, the Assaba, with Kiffa as the central city, is already demonstrating signs of rapid growth. Supplemental gravel roads, now under construction, linking Kiffa to Kaedi and Selibaby in southern Mauritania are accentuating the nodal character of the Assaba oasis belt.

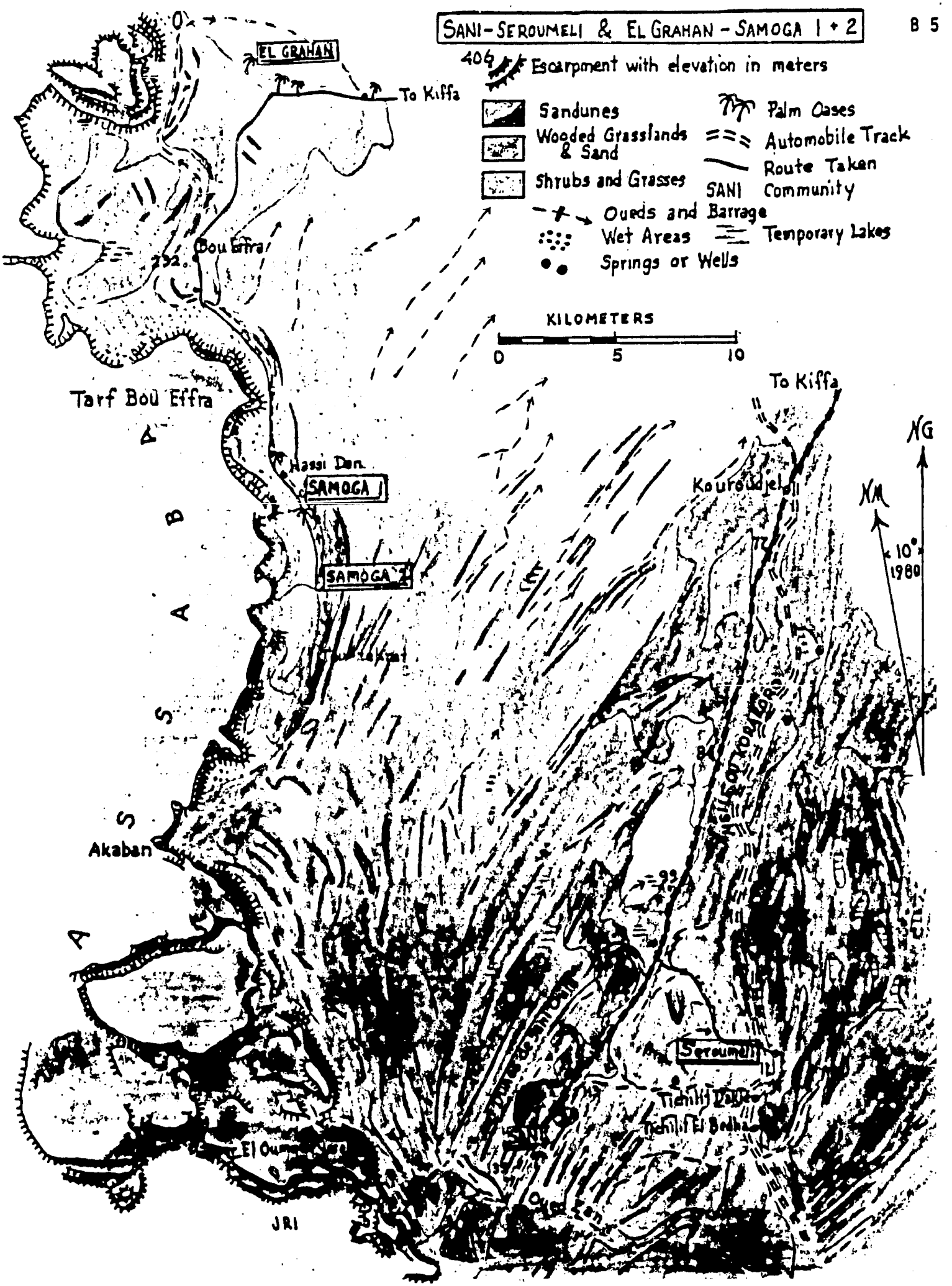
Improved transportation routes and new business opportunities have attracted a mosaic of peoples from the country's southern tier. Today, the Assaba has a mixture of White and Black Moors, Haratins, Toucouleur, and Peuhls. The Assaba's economy rests on a melange of agricultural economies: the diversified activities of the oases, recessional barrage agriculture, rain-fed cultivation, pastoralism, and combinations of each. Nouakchott is but an 8-hour drive from Kiffa, and the developing supply center of Kiffa can provide fuel, transportation and communication services, as well as food, health, security, technical and equipment assistance and weather data.

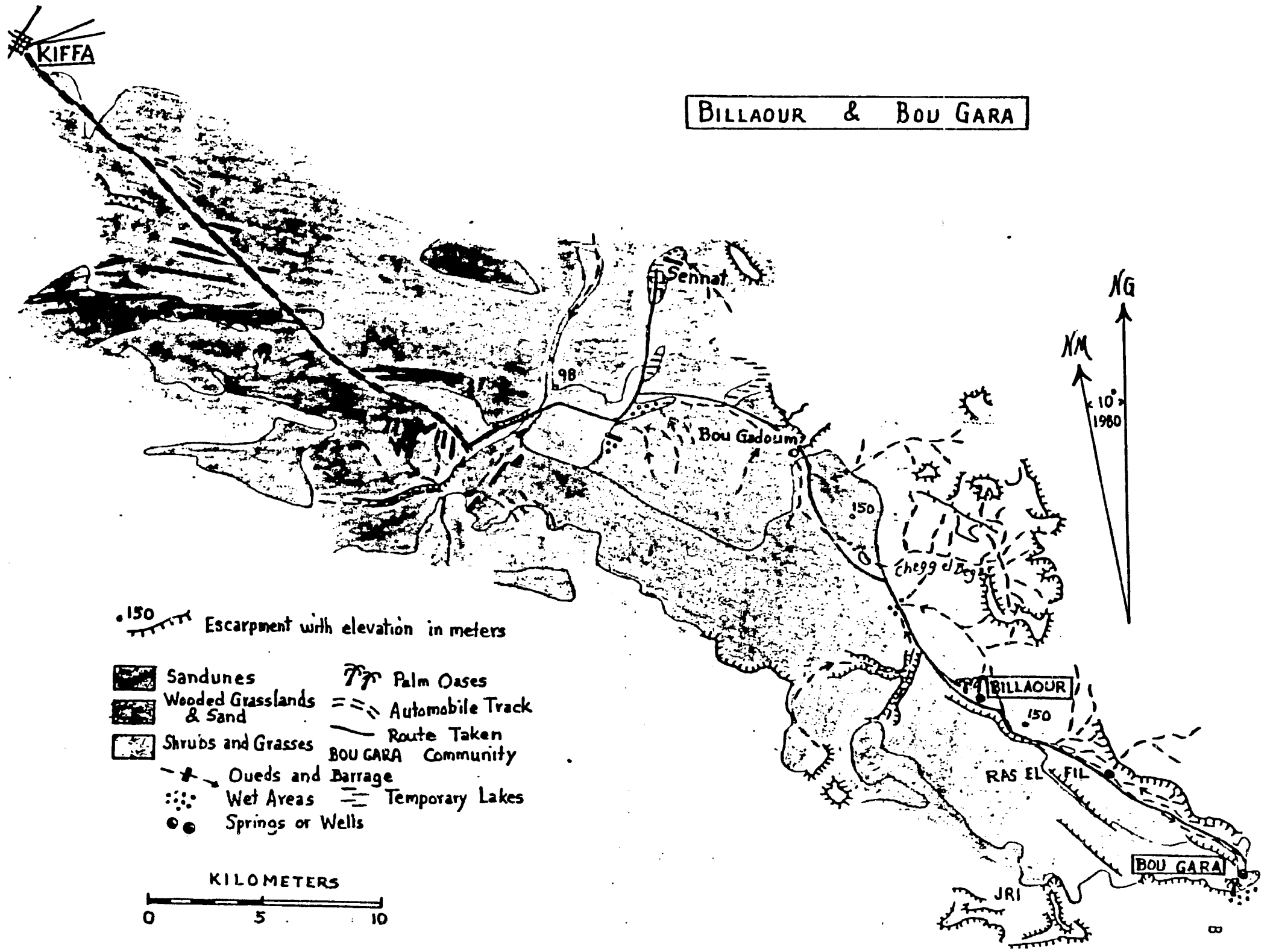

MAURITANIA
OASES PROJECT
LOCATION
SAHARA
Atar
Ouadane
Chinguetti
Nouakchott
Tidjikja
Moudjeria
SAHEL
TAGANT
150 MM
Boutilimit
Aioun
Nema
SENEGAL RIVER FLOOD CULTURE
500 MM
Seljibabi
1979 JRI
Oases Project Location
Paved Highway
Highway Under Construction
0 100 200 300
KILOMETERS

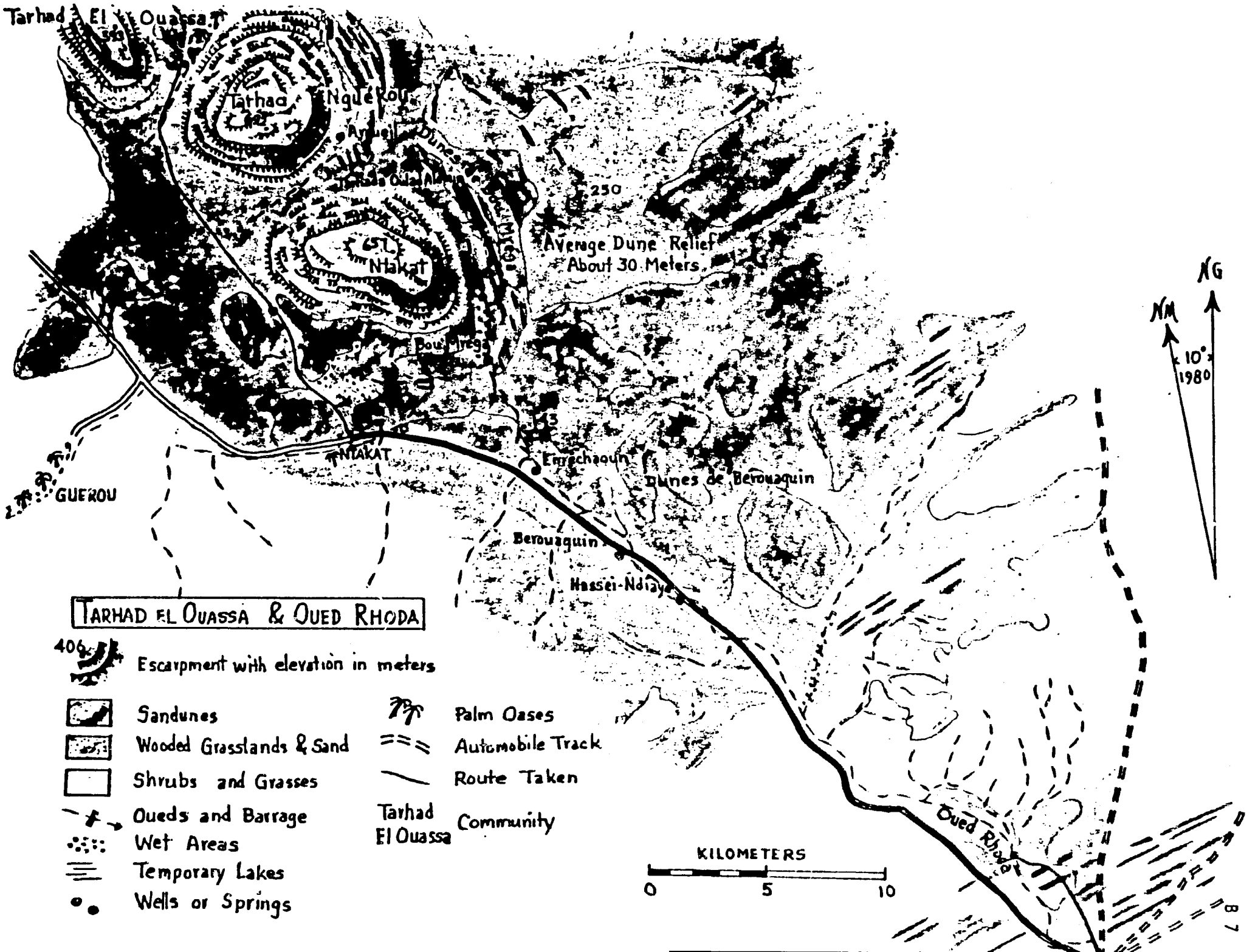
MAURITANIA

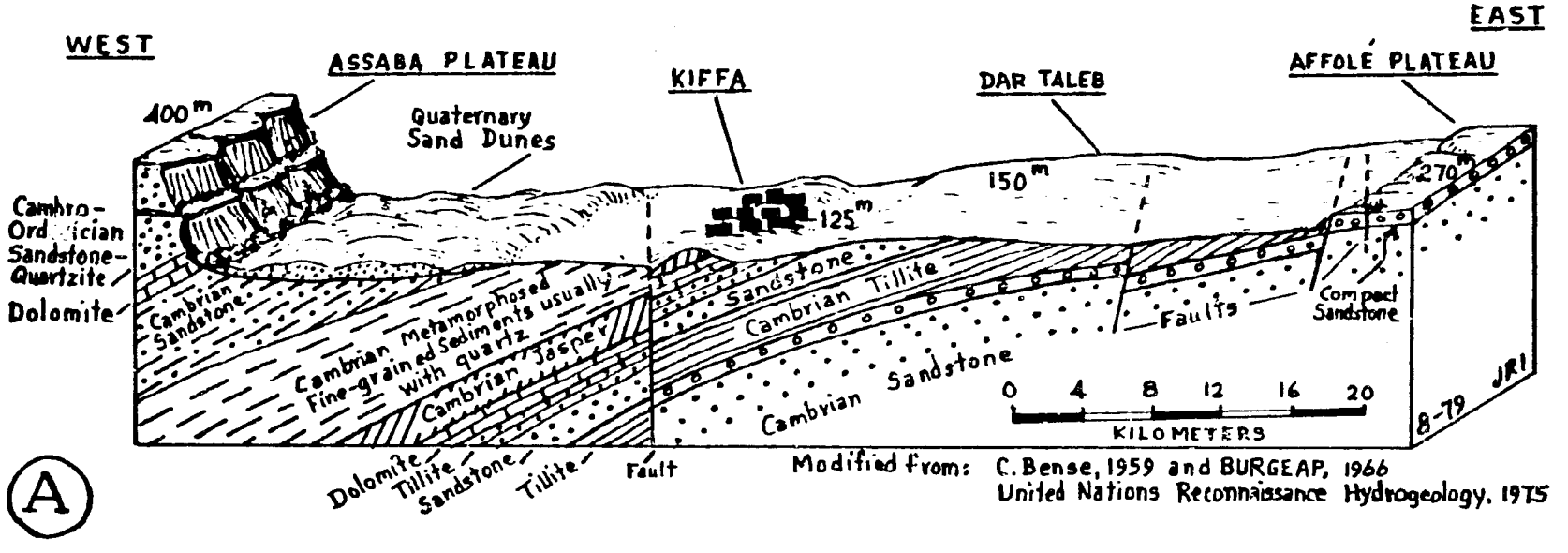
ASSABA OASES REGION

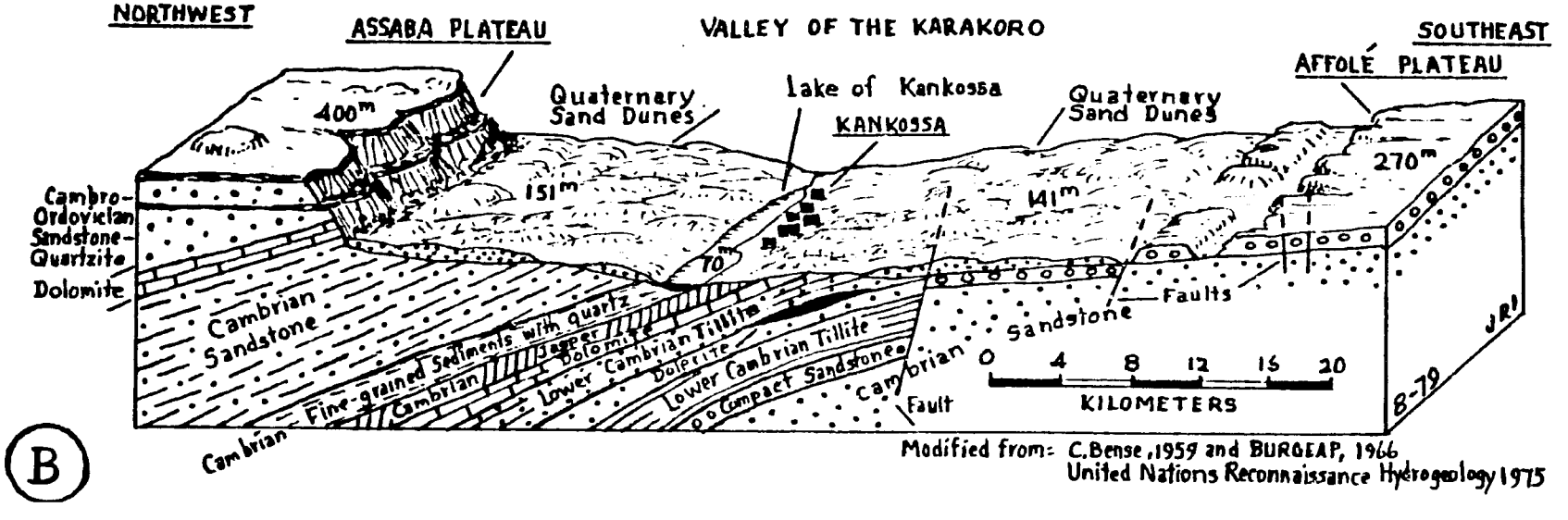



SANI-SEROUMELI & EL GRAHAN - SAMOGA 1 + 2
406 Escarpment with elevation in meters
Sandunes
Wooded Grasslands & Sand
Shrubs and Grasses
Oueds and Barrage
Wet Areas
Springs or Wells
Palm Oases
Automobile Track
Route Taken
SANI Community
Temporary Lakes
KILOMETERS
0
5
10
EL GRAHAN
To Kiffa
Bou Effra
Tarf Bou Effra
Hassi Dan
SAMOGA 1
SAMOGA 2
Kouroudjel
To Kiffa
NG
NM
10°
1980
Akaban
Seroumeli
Tiemiki
Tichilit El Bedha
El Ou
JRI


BILLAOUR & BOU GARA
KIFFA
Senhat
98
Bou Gadoum
150
Chegg el Bag
NG
NM
10°
1980
BILLAOUR
150
RAS EL FIL
BOU GARA
JRI
150 Escarpment with elevation in meters
Sandunes
Wooded Grasslands & Sand
Shrubs and Grasses
Palm Oases
Automobile Track
Route Taken
BOU GARA Community
Oueds and Barrage
Wet Areas
Temporary Lakes
Springs or Wells
KILOMETERS
0
5
10


Tarhad El Ouassa
Tarhad
Nguérou
Ntakat
250
Average Dune Relief
About 30 Meters
Bou Mrega
NTAKAT
GUEROU
Entrechaoun
Dunes de Berouaquin
Berouaquin
Hassei-Ndiaya
Oued Rhoda
NG
NM
10°
1980
TARHAD EL OUASSA & OUED RHODA
406
Escarpment with elevation in meters
Sandunes
Wooded Grasslands & Sand
Shrubs and Grasses
Oueds and Barrage
Wet Areas
Temporary Lakes
Wells or Springs
Palm Oases
Automobile Track
Route Taken
Tarhad El Ouassa
Community
KILOMETERS
0
5
10


WEST
EAST
ASSABA PLATEAU
KIFFA
DAR TALEB
AFFOLÉ PLATEAU
400m
Quaternary Sand Dunes
150m
125m
270m
Cambro-Ordovician Sandstone-Quartzite
Dolomite
Cambrian Sandstone
Cambrian metamorphosed Fine-grained Sediments usually with quartz
Cambrian Jasper
Sandstone
Cambrian Tillite
Faults
Compact Sandstone
Cambrian Sandstone
0 4 8 12 16 20
KILOMETERS
8-79
JRI
Dolomite
Tillite
Sandstone
Tillite
Fault
A
Modified from: C. Bense, 1959 and BURGEAP, 1966
United Nations Reconnaissance Hydrogeology, 1975


NORTHWEST
ASSABA PLATEAU
VALLEY OF THE KARAKORO
SOUTHEAST
AFFOLÉ PLATEAU
400m
Quaternary Sand Dunes
Lake of Kankossa
KANKOSSA
Quaternary Sand Dunes
151m
70m
141m
270m
Cambro-Ordovician Sandstone-Quartzite
Dolomite
Cambrian Sandstone
Fine-grained Sediments with quartz
Cambrian Jasper
Dolomite
Lower Cambrian Tillite
Dolerite
Lower Cambrian Tillite
Compact Sandstone
Cambrian Sandstone
Faults
0 4 8 12 16 20
KILOMETERS
8-79
JRI
Cambrian
Fault
B
Modified from: C. Bense, 1959 and BURGEAP, 1966
United Nations Reconnaissance Hydrogeology 1975

SANI

Location: Roughly 60-70 km south of Kiffa on the Kiffa-M'Bout-Kaedi track.

Land: The Sani oasis occupies 4 hectares on the western edge of a small marsh or 'mare' which is wet year-long. It is situated in a narrow cuvette between two large N-S linear dunes. The land at Sani dips below the watertable and thus exposes the ground water all year.

Water: Sani's water exists as a permanent pool surrounded by grasses. A clay base keeps the water from percolating deeper. Much of the water appears to seep from the adjacent dunes and from a oued originating from the sandstone aquifers of the Assaba Plateau. The oasis is about 5 km long and 250 meters wide, The water table in many places is from 1 to 2 meters below the ground. Assuming a saturated interval of 15 meters (confirmed with a hand augur), the stored water volume would be:

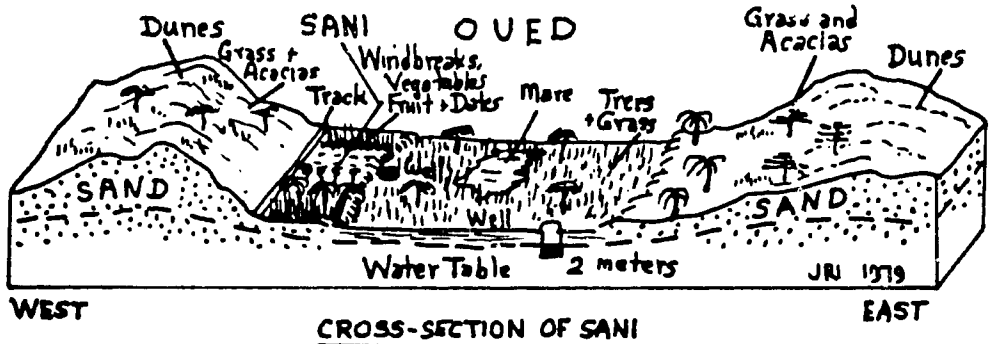
$$(250) \times (5000) \times (15) \times (0.05) = 937{,}500\ M^3 \text{ or } \underline{7500\ M^3/Ha}.$$

Total volume of water looks good and fact that some irrigation is being done with no observable effect on the water table indicates area could be recommended without further groundwater exploration. Just south of the Sani mare are approximately 15-17 oglats or shallow wells used to water livestock.
Water samples were slightly acid - pH 6.7. Cation exchange capacity (CEC) of 2.46 MEQ/100 grams

Soils: Black muck and clayey in the mare, and sandy loam on margins. A pH range of 7.3-8.3. Soils showed a low sodium exchange capacity.

Vegetation: Grasses and shrubs as well as acacia savanna. Doum palms in oueds.

Economy: Aziz Barada supervised early plantings at Sani in 1974. Crops planted include: date palms, guava, ciron, mangoes, vegetables and some experimental plants such as castor and cotton. Also planted were numerous windbreaks of Neem, euphorbia, prosopis, and living fences of rhododendron, prickly pear, euphorbia, and calotropis. His palms are planted 5 m apart. He waters young palms 1x/week for 3 months. Sand and bags are placed around young pams to develop root systems. Some palm suckers are left uncut for several years to protect trees from foraging animals. Farm is fenced for protection from animals. All varieties of livestock are managed on nearby dunes to supplement income. It is reported that one family can live on 2 ha with legumes, fruit, and date palms. One family can live also on 15-20 goats a year. Average size family appears to be 8 persons.



CROSS-SECTION OF SANI

EL GRAHAN & SAMOGA

Location: About 60-70 km SW of Kiffa by desert track (no pavement). Communities are situated along eastern margin of Assaba Plateau and along the edge of huge linear sand dunes with a relief of 40 m.

Land: Generally level along wadi bottom; gently sloping at base of plateau and at foot of the dunes.

Water: At Samoga, 3 springs seep from west base of the dunes. They flow year-round into small ponds located on clay bottoms. Wells near dunes about 2-4 m deep. Wells are rock-lined. No wells seen in oued. Lack of many trees may indicate lack of water within first 6 meters.

$$(50) \times (5000) \times (5) \times (0.05) = 62{,}500\ m^3 \text{ or } \underline{2{,}500\ m^3/Ha}.$$

Oued may have much more water but it is hard to assess (Ovollio). Recommends further explorations.

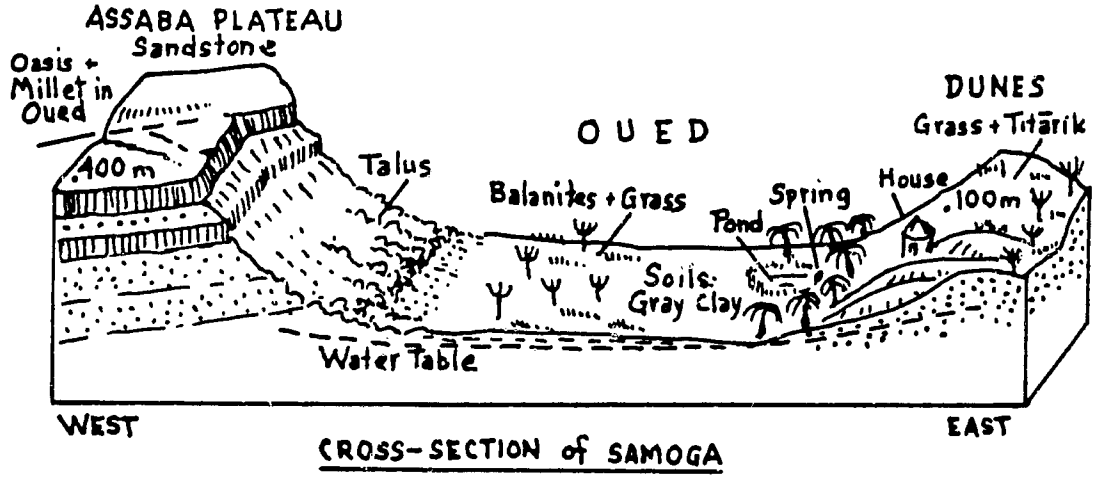
At El Grahan, groundwater level at dune base was 3 m. Groundwater about 1 km north of dune was 10 plus meters in oued. People stated that there is plenty of water here but that it is too deep for easy use Dunes appear to be chief recharge zones. Oued is assumed to be 2 km lon Stored water volume would be:

$$(100) \times (2000) \times (5) \times (0.05) = 50{,}000\ m^3 \text{ or } \underline{2{,}500\ m^3/Ha}.$$

Water quality at El Grahan was 2.37 MEG/L.

Vegetation: Grasses in season, acacias, Balanites aegyptica, and titarik.

Economy: Several barrages in the region were backed by recent August rains. When water recedes, the land will be planted to millet and beans. Millet and sorghum is also planted on top of the Assaba Plateau by haratins in the wadi bottoms during July and August.
Henna is very important here. Dates, vegetables, beans cultivated
Houses are either round or rectangular; numerous hangars (leantos).



CROSS-SECTION of SAMOGA

JRI 1979

N'Takat EL OUASSA

Location: About 70 km NW from Kiffa, partly on paved and partially on track. Situated between the butte called Tarhad El Ouassa and the butte named Tarhad Nguekou. Leave paved road at the oasis of N'Takat.

Land: Oasis occupies a narrow valley between the base of two buttes. A linear sand dune has been created in this depression by the action of the northeast trade winds (harmattan). The oasis is sited along a wadi and the margin of the sand dune.

Water: The buttes and the sanddunes supply much of the water and creates a small oued or wadi. Oued wells are dry until they penetrate a peat layer at 5 or 6 meters, then water rises 2 to 3 meters. Dunes seem to be main recharge source. Wells at edge of palmerie range from 3-4 m deep; 1½ m deep in the bottom of the wadi; and 10 m deep near the base of Tarhad Nguekou. Community is digging a channel to divert wadi flood waters to north and higher end of oasis. Assuming a 5 km long oasis, a width of 500 m, and a saturated interval of 10 meters, the stored water volume would be:

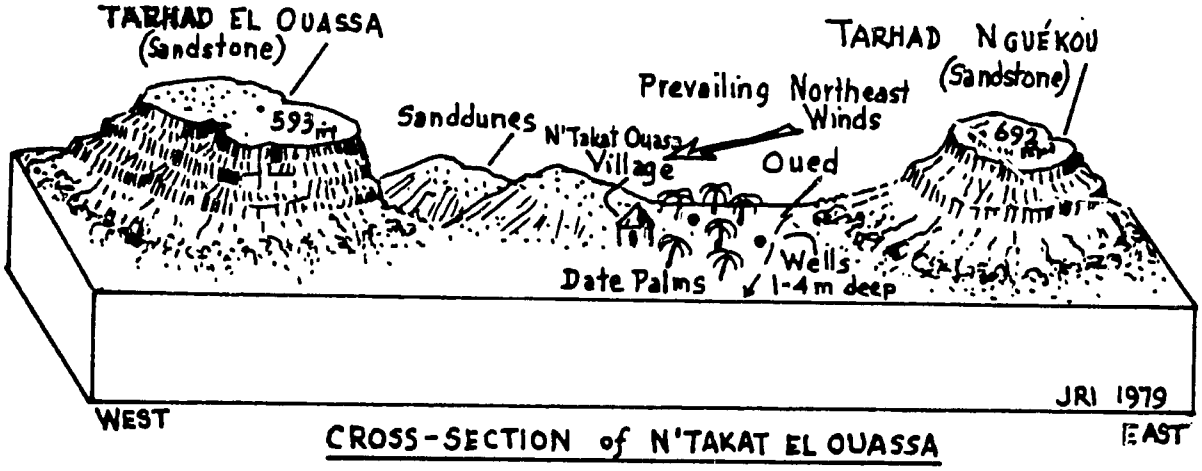
$$(500) \times (5000) \times (10) \times (0.05) = 1{,}250{,}000\ m^3 \text{ or } \underline{5000\ m^3/Ha}.$$

Village could be selected for project. Additional water study suggested. Water is low in sodium exchange values with a pH of 8.0 - 8.3. This is acceptable for crop production with some precautions.

Soils: Gray loams and some clays. pH about 7.5

Vegetation: Grass, bush, and acacia savanna

Economy: Crops include dates, millet, vegetables, henna, livestock, chickens. At south edge of oasis, where wadi widens, a thorn fence surrounds a millet field and vegetables. Shadoof used for irrigating vegetables. Pastures almost non-existent during July. 1979 was a poor date year. A single palm produces about 6 mou/yr. Much trouble with palm (date) diseases. Small woodlot of Acacia, Prosopis chilensis, situated on eastern slope of the large dune.



CROSS-SECTION of N'TAKAT EL OUASSA

BILLAOUARE & BOUGAARA

Location: About 60-70 km east of Kiffa in the valley of an E-W oued or wadi. The two oases lie about 200 meters north of the projected paved highway (now under construction) between Kiffa and Nema. The oued is generally enclosed by the discontinuous and broken ridges of the low Afolle escarpment which rises about 40 meters above the surrounding area. The 2 oases are about 12 kms apart.

Land: Surface is generally level to gently sloping from escarpment to oued. Linear dunes, where present, provide sandy soils and seepage water. Entire area lies in relatively flat plain evolved from erosion of ancient sandstone strata. Dunes cover portions of the escarpment.

Water: Wadi valley has very low gradient and meanders in simuous fashion from east to west. Average precipitation here is 250 mm/yr. Wells in oued or wadi bottom are 2-4 m deep. Water from sandstone aquifers reputed to flow 1.5-3 m^3/hr. No salt water. Sands as well as underflow in oued appear to provide recharge. Villagers use a shadoof for irrigating vegetables. Geology difficult to interpret so water estimates somewhat uncertain. If width of oued is 200 m, a saturated interval of 10 meters is assumed, and an oasis length of 10 kilometers is used, then the stored water volume would be:

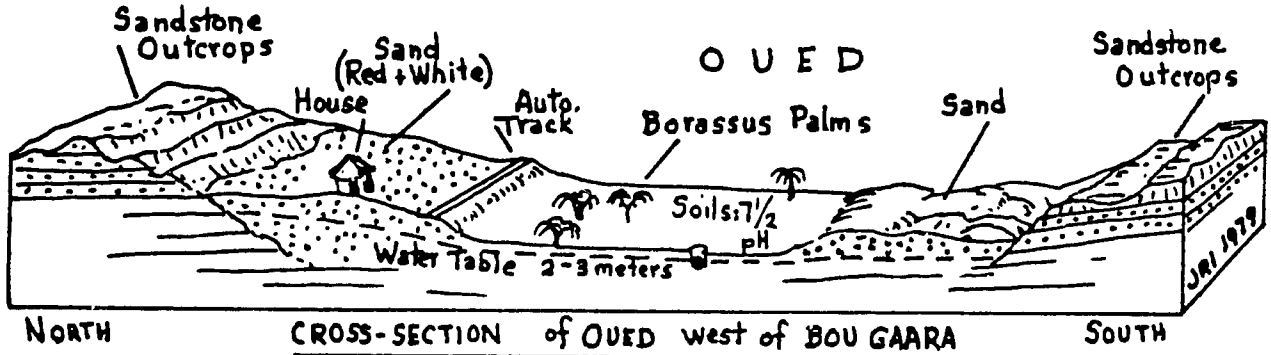
$$(200) \times (5000) \times (10) \times (0.05) = 500{,}000\ M^3 \text{ or } \underline{5000\ M^3/Ha}.$$

Further exploration is recommended to verify this computation.
Water quality in Bougaara was tested as 1.52 MEQ/L.
Water quality in Billaouare was tested as 4.72 MEQ/L
These fugures are acceptable for irrigation use.

Soils: Gray loam, some clays, and much sand. pH was 7.5

Vegetation: Numerous wild doum palms in wadis. Much Acacia aegyptica, titarik, and a spotty distribution of grasses particularly on sandy stretches.

Economy: Crops raised include dates, vegetables, and livestock. Women manage many paleries as men are frequently abroad or in cities for jobs. Palmeries may sell for as much as 200,000 UM for a 40 m x 25 m plot. Cattle often move to Senegal for pastures. Villages often sited on sandy ridges. Communities are rather dispersed. Complex land-use plan.



CROSS-SECTION of OUED west of BOU GAARA

Elements of a Model Oasis

Site Advantages

Within the Assaba oasis region are numerous drainage ways formed by rainwater flowing southward from the Assaba, Tagant, and Affole plateaus toward the Senegal River. This watershed area supplies the greatest water supply to the Senegal from Mauritania. Although numerous oases presently exist along these drainage lines, many unused sites exist. For this reason, a model for new oases is presented here. (See accompanying diagram).

Model (Advantages)

The model oasis is designed (1) to match crops with soil, water, and micro-climatic conditions; (2) to provide subsistence crops (dates, vegetables, grains, and fruit) and commercial commodities (henna, dates, vegetables and fruit; (3) to provide better located corrals and water facilities for livestock; (4) plantations of trees in the wadi (stream bed) for fuel, charcoal, and forage (seeds); (5) space for protected reserves of pasture and trees for periods of climatic stress; (6) living fences to protect field crops and orchards from roaming livestock; (7) sand dune stabilization; (8) micro-climate formation through tree plantings to extend the growing season for vegetable production; (9) a circumferential windbreak to protect the oasis from dust and sand blown by the prevailing NE or SW winds; (10) nurseries to provide tree seedlings for living fences, windbreaks, and fruit orchards; (11) and strategically-placed covered water wells for improved sanitation and health.

Land-Use Analysis of Model Oasis

The wadi or dry surface of the stream bed with its water supply several meters below the ground level is the dominant site factor. Adjacent sand dunes serve as aquifers and direct water flow down slope to the water table which underlies the oasis and which is most easily reached in the wadi channel.

Shallow wells between 1½ m to 3 meters in depth provide adequate year-round potable water for people, livestock, and crops. In the small oasis illustrated, approximately 12 wells are located for maximum convenience. They will be covered for health and anti-pollution reasons. Simple hand-hauled buckets or bags, or shadoofs (counter balanced poles to assist in lifting water) will be used.

Dwellings are situated centrally for easy access to all elements of the oasis, and where the trees offer maximum protection from sun and wind. Each dwelling will be shaded by at least one tree.

Crops and Livestock Economy

Dates symbolize the oasis and identify it from all other agricultural systems. They require their crowns to be in sunshine and their roots in

water. Many wadi channels in the Assaba provide these conditions. The model illustrates the prominence of date palms in the oasis core. They also surround the tree nurseries and vegetable plots to provide a mix of sun and shade as well as a cooler and more moist micro-climate so that vegetables can be produced throughout the year. Without such protection, the summer sunlight and heat precludes vegetable raising.

Vegetables and tree nurseries are positioned at the edge of the wadi for ready access to well water irrigation and shade from the grove of gonakier trees growing in the wadi channel. Farmers also live in easy proximity. Between the farm dwellings and the vegetable gardens are groves of fruit trees and henna plants which can be readily tended, pruned, and harvested by the farmers nearby.

Millet and sorghum, two traditional grain crops, are to be planted at the extremities of the planted portion of the oasis and in proximity to the livestock corrals. The grains are commonly planted during the seasonal rains between July and November. Animal droppings from the corrals can be used to fertilize the soils. Neibe beans, a legume that serves as a host to micro-organisms that extract atmospheric nitrogen and make it available to crops, are grown in combination with the selected grain. Squash, melons, and potatoes also are raised with the beans and sorghums. (See diagram). Well water may be utilized as needed on these fields.

Livestock types are varied and include sheep, goats, cattle, camels, and donkeys. They provide milk, fat, and protein to the diet and complement the carbohydrates, sugars, proteins, and vitamins of the grains and potatoes, dates, melons, vegetables, and fruits. The animals are moved out of the oasis each day to open grazing and returned each evening to the corrals for milking and surveillance. The corrals lie at the extreme ends of the oasis and have a well for livestock watering nearby. Such a location permits the animals to enter and depart from the oasis quickly for distant pastures and keeps them away from cultivated portions of the oasis.

After the grain and associated crops are harvested, the livestock could be permitted to graze the sorghum stubble and bean leaves. In return, the animal droppings would enrich the fields.

Trees and Grass

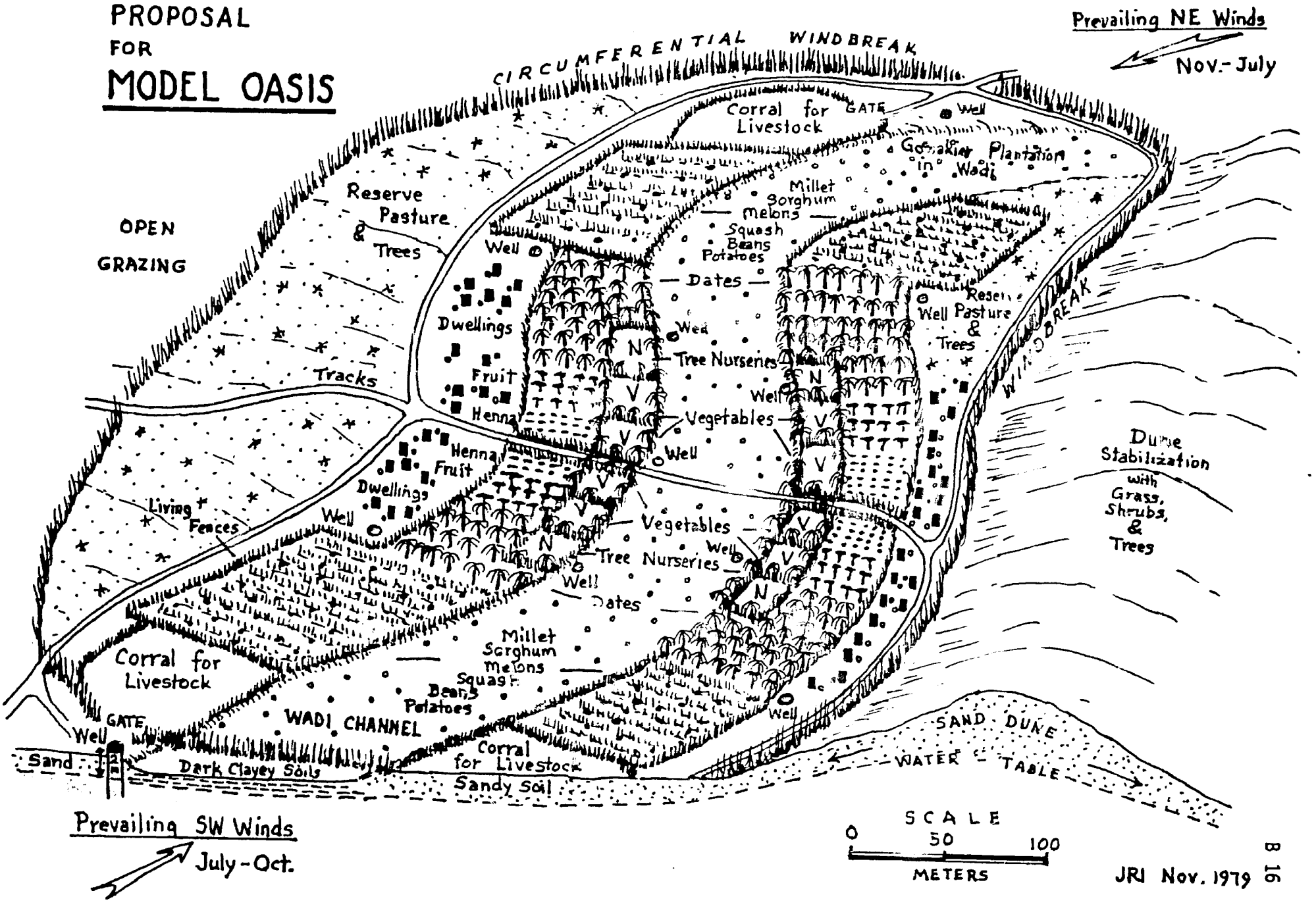
In addition to the domesticated vegetables, shrubs, and trees already described, other trees, shrubs and grasses are to be established as important economic components of the oasis. Living fences around cultivated plots, the windbreak surrounding the oasis, the trees planted for fuel and charcoal in the wadi channel, the shade trees by each structure and dwelling, the trees planted on the outer limits of the community but within the circumferential windbreak as a reserve of wood, and forest products during periods of drought, and the shrubs and trees to be planted to stabilize shifting dune sands are examples of the importance of these plants to the maintenance and improvement of the environment and to the success of the oasis economy.

Summary

With guidance and cooperation, the oases farmers can strengthen their environmental base and maintain its viability even during periods of drought. Each component is a renewable resource, and each will be successful if all parts of the environment are handled in harmony with each other. This model may be modified to suit various environmental and cultural situations or different sized communities.

Some of the elements of this model may be applicable to project interventions developed at Sani and other project sites or in the sites in the oasis development activities which should be a follow-up to this project.

PROPOSAL FOR MODEL OASIS



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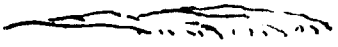
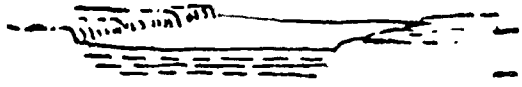
LEGEND FOR MODEL OASIS

LANDFORMS & WATER RESOURCES

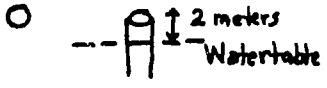
— Sand dunes and sandy soils. Arrows indicate direction of ground water flow.


— Undulating sand and clay surfaces.


— Wadi channel

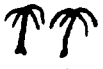
— Clay soils

— Water Table and saturated zone.



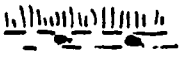
— Wells and well depths

CROPS


— Date Palms

— Fruit Trees

— Henna Shrubs


— Vertical Lines: millet or sorghum crop.
— Horizontal Lines: beans or potatoes
Dark Circles: melons or squash

— Nurseries for fruit, trees, and living fence stock, surrounded by living fence

— Vegetables surrounded by living fence

— Livestock Corral surrounded by living fence

VEGETATION

— Living Fences

— Windbreaks

— Gonakie Trees or Shade Trees

— Trees (*) and Grass (∴) for Reserve Use

CULTURAL

— Dwellings

— Tracks

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ANNEX C-1 WATER

a. Trials and Demonstrations, Water and Irrigation

1. Introduction

Field trials and demonstrations as to use and conserve water have been found to be a good means (a) to test various methods and technologies in order to select the most appropriate approaches, (b) to show to oasis farmers how to improve their practices, income and health, and (c) to promote the replication of the most valid and viable techniques and practices. They also help to keep the project realistic, and consistent with the habits and limited capabilities of the involved populations.

In the Assaba region, the oasis populations are farmers as well as herdsmen, and they lack agriculture, irrigation and water development espertise. Hence, the need and usefulness to include water-related demonstrations in the project, and to keep them simple, anything fancy being unrealistic.

Trials, and especially demonstrations, should thus be developed following such an approach and progress in accordance with local conditions. However, the suggestions described in this report involve a catalogue approach including ample provisions for various tests so that project implementors may select what fits best the local situation as they perceive it. Also, they may decide to test and evaluate, from the technical and economic viewpoints, a broad spectrum of approaches and techniques (including plastic pipes, simple drip irrigation) for long-term and country-wide applicability. Since water and irrigation is but one part of a larger whole defined as the development of oases, water-related trials and demonstrations would be best implemented in conjunction with other activities at Sani integrated model site. Replication would then be possible, ideally during the lifetime of the project, at oases such as Ntakat El Wassa, Billaouar-Bougara, Samouga, El Grahan and/or others. Populations in the region would be expected to apply, through their own initiative, the tested and demonstrated techniques and practices which are applicable.

Problems in water and irrigation to be addressed in the Assaba region include those related to wells, water lifting, water distribution and water conservation, and also water-related diseases. Other aspects such as water availability, water requirements, training, etc: must also be considered.

2. Water wells and Shadoufs

Presently, wells for irrigation, livestock and domestic water supply are traditiona shallow dug wells called oglats, half-a-meter or more in diameter, lined with wood or stones, and with about half-a-meter of water depth at the bottom. Water is lifted by hand, using a dalou (goat-skin bucket) attached to a rope, or using the shadouf (or achilal), a traditional device consisting of a pivoting pole with a counter-weight at one end and the dalou attached to a rope at the other end (see figure 1). The yields of these wells are limited but remain consistent with the capabilities and safe yield of the aquifer. Such yields are about 1-3 m3/hour (dalou volume being about 15 liters, and lifted and emptied 1 to 3 or 4 times per minute. The lifetime of these wells is about 2-3 years (more if lined with stones).

In order to improve the efficiency of wells, trials would be made to increase their diameter and depth. For instance, larger diameter wells could accommodate two shadoufs or the use of two or more dalous for hand water lifting, i.e. higher water yields. An increased depth of the well, through a higher penetration of the aquifer, would also allow for higher water yields. All of that should, however, remain consistent with the capabilities of the aquifer which, although limited, seem generally sufficient in the Assaba to allow for rates of use higher than the ones achieved with present shadoufs.

Modern dug wells, with concrete lining and 2-5 meters of penetration (into the aquifer) below the lowflows water table (and with or without a drilled small-diameter cased hole at the bottom) would be, where technically feasible, more efficient than oglats but they are a costly technology (about $600 per meter).

A cheaper "semi-modern" version may be possible. Also, well-cum-pump wells (Tysen-type well point developed in Chad by AID/Peace Corps) of small diameter may be used, especially for providing a reliable and sufficient water supply at trial site and nurseries.

Trials would be made as to the number and spacing for wells in conjunction with the extent of arable land and the location of crop areas, while insuring that the rate of water consumption is not higher than the rate of aquifer recharge. The approach of using one "high"-yield central well per hectare would be tested as opposed to using several traditional wells.

3. Water Lifting

Water lifting means (including pulleys versus hand-lifting of dalou) would be studied in order to optimize the efficiency of the wells. In addition to use of the shadouf, the use of manual and/or animal-powered pumps would be tried and evaluated.

Hand pumps (AID-type or other types manufactured in Africa, the United States or Europe) allow for yields much easier and higher than with the shadouf but they are expensive and require maintenance,

although they would liberate manpower for other tasks (agriculture). The same could be said about the "Vergnet" foot-pump recently developed for Africa where it is much appreciated. Windmills, solar pumps and small motor-pumps would not fit, being too sophisticated for this project. However, there is an African windmill, type "Savonius" (cost $1600+) developed at Institut Universitaire Technologique de Dakar which might be considered. Motor-pumps would not be used except during construction of modernized version of wells (or if much water were needed at the trial site).

Animal power to draw water from wells is not much used in Western Africa, except for very deep wells. "Maneges" (improved persian wheels) are expensive and have been found to be a failure in Western Africa (need to train and guide animals, mechanical problems due to connecting gears, and maintenance problems). However, the Centre National de Recherche Agronomique at Bambey (Dakar, Senegal) works on the improvement of animal traction, which should be kept in mind. There are plenty of animals in Mauritania and the Assaba, and trials-demonstrations into water-lifting by animals seem worthy (see figure 2) since a donkey can develop about 2.5 times as much power as a man, the respective figures for a cow and a camel being 3.5 and 4. Also, the persian wheel (called noria in North Africa) has been successful elsewhere and should be considered (see figure 3).

4. Water Use and Irrigation

Distribution of water and irrigation as presently practiced in the Assaba region and project area offers room for improvement. Once ground water is lifted from oglats with the dalou or the shadouf, it is either carried by hand, using a dalou or a sprinkling can, to the date-palms (only baby palms) or vegetables to be watered, or poured into an open-surface earthen reservoir (next to the well) from which water is distributed to the plants by gravity via openings at the bottom of the reservoir and furrows running through the plot under cultivation. A well usually serves 30-50 date-palms (closely spaced) or about one half to one third of an acre. Such a system of irrigation is not efficient, involving losses of water from the well to place of water use in the irrigation ditches and furrows, as well as hand carrying of water.

Surface water is also used during the rainy season, i.e. in summer, through impoundment behind 1-3 meter high earth dams called "barrages" for recession agriculture (millet, sorghum). This is the case at Ntakat El Wassa through a "barrage" located downstream the oasis which needs repairs. Such "barrages" are constructed using mechanical means or by the local populations (in which case they are not very stable and need improvements). Also, at El Wassa, a ditch has been dug by the local population in order to divert flood water to place of use.

Trials and demonstrations would be implemented as to the distribution of irrigation water to reduce the water losses in earth ditches and render water transportation more efficient and easy. Portage of water from the well to satellite basins in production areas could be envisioned as follows: dalous suspended at both ends of a pole carried on the shoulder as done in Eastern Asia; large dalous carried by donkeys or camels; rolled 55-gallons drums towed by donkeys; etc. Distribution of water, either from the central reservoir next to the shadouf or from satellite basins, could be rendered more efficient by using lined ditches (plastic, clay, cement) or other conveyance and distribution system (plastic pipes, hoses, simple drip-irrigation).

on the long-run and country-wide basis even if the above "sophisticated" approaches and techniques are of limited applicability in the immediate and in poor oases. Also, plastic sheets could be used to cover reservoirs next to shadoufs and satellite basins in order to reduce evaporation losses. Likewise, watering should be tested in the morning and late afternoon (versus noontime) when evaporation rates are lower; improvements seem possible as to the quantity, frequency and timing of watering. Field leaching trials may be done.

Incidentally, the large number of off-shoots which is characteristic of many date-palms should be reduced significantly by cutting such off-shoots because they consume water while they produce nothing and reduce the yields of the date-palms; also selection of water-efficient plants as melons, beans, sorghum, millet etc., should be considered in order to help conserve water and make best use of it; cultivation of vegetables under date-palms should be tested, resulting in economies of water due to the micro-climate and reduced evaporation losses because of shade from the trees.

In addition to the design of improvements to the irrigation systems and techniques, and conservation of water, attention would be given to the need and possibility, at such sites as Ntakat El Wassa and others, to make improvements to the control and best use of the natural surface water system: low dikes to protect the oases from wadi floods; diversion channels for flood-water to cultivation areas,

Also, evaluations could be made of crop water-requirements (amounts, timing and frequency), including for adult date-palm. These are not irrigated, being supposed to obtain all the water they need from the water table aquifer through their root-system, while irrigation (as done elsewhere) in the right amount and at the right times might result in increased date yields (especially if coupled with fertilizers, nitrogen, phosphorus).

5. Water-related Diseases

Water-related diseases are of concern, and in cooperation with the Centre National d'Hygiene, improvements should be attempted. Where water is vector-supporting element (for instance, at Sani, mosquitoes in the low areas with water ponds), malaria develops. Populations should settle in high elevation areas, away from those ponds in order to reduce health hazards.

Diseases borne and transmitted by water (dysenteries, typhoid, cholera, etc.) should be considered (as well as those due to the insufficiency of water such as parasites, nutrition, etc.).

Modern health planning should be tested. For instance, the use of well(s) reserved for domestic water supply (other wells being for irrigation and for livestock) should be tested and demonstrated. Such wells would be constructed with a filtering gravel-and-sand pack; water would be drawn by and AID-type or other hand or foot pump (possibly tested, as previously mentioned) into vessels which would be kept clean instead of moved around in the dirt, or lifted by a dalou (by hand with a rope and pulley, or using a shadouf) which would be kept clean, avoiding contact with the soil around the well and elsewhere. All of that would have to be demonstrated to the populations, along with sanitation training for them to develop an appreciation for the health benefits which could result from more sanitary water handling.

Also, testing should be made of an elevated basin (in earth, with plastic or clay lining, and covered at its top, and with an opening and simple spigot at the bottom) filled with filtering clean dune-sand, plus interbedded charcoal, and gravel at the bottom lying on a screen, and located next to a gravel-and-sand-packed domestic water supply well. Such a basin, with periodic changing of the sand and daily refilling with well water, would allow for the domestic water needs of ten or twenty families if of sufficient size. It could be in concrete.

Domestic water well(s) would be located in the "village"/compound while those for gardens and irrigation would be next to such production areas, and those for livestock would be at a distance, for instance along the wadi, if any.

All of above would be studied, designed, tested and demonstrated during the implementation of the project at Sani and other sites.

6. Other

Other tests and studies would be considered such as evaluation of water quality and availability (including geophysical surveys), water requirements, ensuring that the rate of water consumption is not higher than the rate of natural recharge, possibility of increasing such recharge through simple artificial recharge means that maximize infiltration and which could be implemented by the local populations (series of ditches, low dikes, etc., in wadis).

Such an approach, at Sani trial-site and throughout other places in the project area such as Ntakat El Wassa, etc. would allow (during the project implementation phase) for establishing water availability, quality, and needs; and for designing and operating maintaining efficient systems to develop, lift, distribute, control and conserve ground and surface water, and to practice a productive irrigation and improved domestic and livestock water supply.

This should be done in cooperation with Service Hydraulique (especially for water and geophysical surveys, wells and pumps), Genie Rural and SONADER (irrigation); and taking advantage of USAID experts in water resources and irrigation at Nouakchott headquarters and on other projects such as Vegetable Production Project and Rural Land Reclamation Project, and USAID experts on short-term missions.

The geophysical survey for the purpose of locating best areas for groundwater occurrence and water well yields could involve (i) a first phase for reconnaissance of 4 oases including a detailed exploration for the trial-and-demonstration site area, and (ii) a second phase phase for detailed exploration of the remaining 3 above oases and for 2 other alternative sites. The geophysical survey would be contracted to Service Hydraulique. Also, advice may be asked from Service Hydraulique about wells and pumps, and such Service has expertise and equipment for modern well construction.

Through an inventory/study of the small oases which have potential for development throughout Assaba , their water resources would be assessed at reconnaissance level. Then, the most promising of these oases could be studied in more detail (including geophysical surveys by Service Hydraulique), which would involve recommendations, guidelines and general layouts for water resources development. Also, some of them might be studied still more in-depth, including specific layouts, designs and estimates for water development and irrigation. However, all of this would have to be determined at time of project evaluation.

7. Training

Training in well construction, water lifting, irrigation, surface water control, and water-related health would be achieved on the sites through tests, trials and demonstrations. As needed, some of the most capable farmers and technicians could be sent to irrigation sites of interest in Mauritania. Also, visits to Centre National de Recherche Agronomique at Bambey (Dakar, Senegal) as well as to places in Mauritania where animal traction is practiced for water lifting, could be organized for same people. Places of use of noria (persian wheel) could be visited in North Africa, as well as places of oasis irrigation.

b. Water Quality

In the Assaba region, water quality is generally good, and even excellent. In the Adrar region, it is more variable, usually good to fair; sometimes poor, especially under conditions of over-pumpage of alluvium groundwater, as is the case at Atar.

Assaba

The quality of water is good because of the geologic nature of the region. Groundwater from dune sand has usually a low total dissolved solids (TDS) content (100-250 mg/l), a low (to medium) electroconductivity, a low sodium adsorption ratio (SAR) and an acidic to neutral pH (6 to 7). Groundwater from wadi alluvium is also fresh (150-500+ mg/l). However, where the groundwater level is very shallow, the salt content of water increases because of higher evaporation. Also, where the alluvium is clayey, water quality becomes fair, and even poor (with a higher pH).

The water used for agriculture in the oases (and also for livestock and domestic water supply) is from shallow wells in wadi alluvium (and dune sand); surface water is

sometimes used for recession agriculture. Such waters are suitable for agriculture (and water supply), including a large variety of crops and cropping/irrigation system

Samples of groundwater in the cases under study were taken mainly by the Hydrogeologist of the project team, and analyzed by SONADER (a GIRM authority for rural development).

Available results of the analyses are presented below:

(mg/l)	TDS	Ca	Mg	Na	K	Cl	SO_4	HCO_3	pH
A. Ntakat El Wassa	122	.4	7	13	6	19	-	73	7
B. Billacuar	320	33	20	26	13	54	40	134	7.3
C. Bougara	565	23	14	109	25	71	24	299	7.9
D. Oued Rhoda	555+	32	32	225	9	199	58	?	8.3
E. El Grahan	184	19	6	21	5	18	19	96	7.4
F. El Grahan	184	9	5	21	18	30	-	101	7

(mg/l)	TDS	$EC \times 10^6, 25^0$	Na	K	Cl	pH
G. Sani	109	91 micromhos	7.4	7	12.4	6.7

(meq/l)	SAR	$EC^* \times 10^6$	Ca	Mg	Na	K	Cl	SO_4	HCO_3
A. Ntakat	0.66	155	0.18	0.6	0.58	0.16	0.54	-	1.2
B. Billacuar	0.64	511	1.6	1.65	1.15	0.32	1.52	0.83	2.2
C. Bougara	3.16	710	1.13	1.13	4.75	0.63	2	0.5	4.9
D. Rhoda	4.57	1332	1.55	2.65	9.8	0.24	5.6	1.2	7.6
E. El Grahan	1.28	261	0.92	0.48	0.92	0.14	0.52	0.4	1.53
F. El Grahan	1	241	0.44	0.44	0.93	0.46	0.84	-	1.65

	SAR	$EC^* \times 10^6$	Na	K	Cl	(meq/l)
G. Sani	0.42	91	0.32	0.18	0.35	

*Electroconductivity is in micromhos

(mg/l) samples:	A.	B.	C.	D.	E.	F.
$Ca(HCO_3)^2$	15	130	92	126	75	36
$CaCl_2$	-	-	-	-	-	-
$Mg(HCO_3)^2$	44	24	83	106	25	32
$MgSO_4$	-	50	-	72	8	-
$MgCl_2$	-	10	-	-	-	-
$NaHCO_3$	17	-	222	373	35	46
Na_2SO_4	-	-	35	-	8	-
NaCl	22	67	80	313	22	22
K_2SO_4	-	-	-	-	-	-
KCl	12	24	47	18	10	34
TOTAL	110	325	559	1008	183	17[illegible]

(meq/l) samples:	A.	B.	C.	D.	E.	F.
$Ca(HCO_3)^2$	0.18	1.60	1.13	1.55	0.92	0.44
$CaCl_2$	-	-	-	-	-	-
$Mg(HCO_3)^2$	0.60	0.60	1.13	1.45	0.34	0.44
$MgSO_4$	-	0.83	-	1.20	0.14	-
$MgCl_2$	-	0.22	-	-	-	-
$NaHCO_3$	0.20	-	2.64	4.44	0.42	0.55
Na_2SO_4	-	-	0.50	-	0.12	-
NaCl	0.38	1.15	1.37	5.36	0.38	0.38
K_2SO_4	-	-	-	-	-	-
KCl	0.16	0.32	0.63	0.24	0.14	0.46
TOTAL	1.52	4.72	7.40	14.24	2.46	2.27

The available literature includes the following results (in "Synthese Hydrogeologique et Amenagement Hydraulique du Sud-Est Mauritanien", by BURGEAP, 1966):

(mg/1)	TDS	Cl
Ntakat El Wassa	320	
Billaouar	-	60
Bougara	-	170
Oved Rhoda	-	10
El Grahan	114-235	-
Samouga	-	20
Sroumeli	-	330
Sani	-	10

In conclusion, groundwater in the project oases of Assaba is generally suitable for the planned agricultural use, as already noted from a long time by previous investigators with much experience in the region.

c) Water Availability and Development

In the Assaba region, surface water flow is limited to the months of June, July, August and September, i.e. the rainy season, but water may stagnate for a long time in ponds in clayey areas (e.g. Kankossa). Surface water flow is more significant in the southern part of the region (i.e. downstream part of the hydrographic system), Wadi Msile or Karakoro (from Kouroudjel and Kankossa) being the main wadi which drains the region. Small earth dams are used for recession agriculture (in Mauritania there are about 500 traditional dams and 75 modern dams).

Groundwater occurs both under deep and shallow conditions. Deep groundwater is 100-300 meter deep, in fissured sandstone and other hard rocks; drilled wells (cost, $300/meter) are in a small number and can yield a few to several tens of cubic meters per hour. Shallow groundwater occurs in dune and wadi alluvium. Its depth ranges from half-a-meter to about ten or more meters, being generally a few meters below ground level, and more shallow in wadi alluvium than in dune sand. Such groundwater is recharged by rainfall and mainly wadi water infiltration. It is developed by local populations through numerous traditionally dug wells. This report addresses only shallow groundwater.

In the Adrar region, surface water flow is more limited than in the Assaba, because of the desertic climatic conditions. However, wadis do flow when intense rainfall occurs (July to September), wadi Seguelil and its tributaries being the most important in the Atar area. Shallow groundwater occurs in similar conditions as in the Assaba region. Its development is intense in the Atar area where water level decline and water salinization are noted from several years because of over-development of groundwater using motor-pumps for irrigation. Deep groundwater may be found in limestone and dolomite (with perhaps well yields of up to 50-100 cubic meter per hour), but this remains to be demonstrated.

ASSABA

There are many traditional small earth "dams" (up to 2 meter high, up to 800 meter long and 8 meter wide at the base) constructed by the local populations, using picks and shovels. Most of them are in poor shape (example: Ntakat El Wassa oasis). It is reportedly possible to construct such works at the rate of 100 meter in length (dam height 0.50 meter) per month, using 20 workers. For higher dams, a worker can build a length of 5 meter in two weeks. These small dams and construction approach are suitable for recession agriculture in the oases of the region. Same approach could be used for flood water diversion channels (Ntakat El Wassa) and small dikes for flood protection. Recession agriculture can be increased.

Modern earth dams have also been constructed in the Assaba region (example: the Oued Rhoda dam which needs to be repaired). They are up to about 3 meter high, and cost about $2,000 per meter (including costs for trucks, bulldozers, truck-loaders, compactors, etc.). They allow for agri-production.

Groundwater availability has been determined as sufficient for oasis development from a long time by professionals with much experience in the region. In 1960 the soil scientist F. Dugain (Prospection des Palmeraies de l'Assaba en vue de leurs Possibilites d'Extension) mentioned that groundwater resources are suitable at Sani, Sroumeli, Samouga and El Grahan, as well as the soils of these oases. He recommended to rehabilitate Samouga, to concentrate the date palms of El Grahan within a smaller area, to develop 15 hectares at Sani (50 meter in width along 3 kilometers), and to take advantage of the good soils of Sroumeli (although groundwater was 4 meter d-ep).

In 1966, Lemoine (in a fundamental report, "Synthese Hydrogeologique et Amenagement Hydraulique du Sud-Est Mauritanien) explained that, in Assaba, about 10 percent of the rains are of 10 millimeters or more (and involve an intensity over 50 millimeter per hour). Such rains recharge groundwater in dune sand and wadi alluvium (in a 100 sq. km. watershed, one 50 mm/hour rain results in a 30 percent runoff, which is a water volume of 1,500,000 cubic meter out of which about 10 percent or more infiltrates in the wadi alluvium). He also reported that (1) traditional wells (oglats) in wadi alluvium yield 0.5 to 2 cubic meter per hour and more, while in dune sand they produce higher yields, and that (2) modern wells (with 2-3 meter of water depth) can yield 5 to 10 cubic meter per hour. Lemoine's report includes good hydrogeologic maps showing the potential for oasis development using wadi alluvium and dune sand groundwater as well as small dams throughout the Assaba and other regions of southeastern Mauritania. In the vicinity of the oases selected for this project, the following might be investigated: area of Teghadet Ad Elemine to the southeast of Ntakat El Wassa; 40 hectares with water for development at Sani; 100 with suitable groundwater prospects at Tientiena, i.e. 10-18 km to the southwest of Kouroudjel; rehabilitation of the Kouroudjel oasis; 50 hectares at Kouya and 30 hectares at Mseygil, (to the southeast of Kouroudjel) with suitable groundwater resources.

Groundwater Storage in wadi alluvium was evaluated by the project team Hydrogeologist as follows:

Oasis	Groundwater Storage (cubic meter)	Storage per ha (m^3 per hectare)
Ntakat El Wassa	1,250,000	5,000
Sani	937,500	7,500
Billaouar-Bougara	500,000	5,000
Sroumeli	175,000	2,500
Samouga	62,500	2,500
El Grahan	50,000	2,500
Rhoda	20,000	500

These figures are preliminary, tentative estimates. They do not, in general, take into account groundwater stored in dune sand beyond each bank of the wadi areas. Therefore, they are probably under-estimated, inasmuch as they prssibly involve conservative assumptions about porosity and saturated thickness of the groundwater reservoirs. As a matter of fact, geophysical surveys have been recommended (and will be part of the project to determine the geometry (thickness and extent) of the groundwater reservoirs, and the best locations for groundwater occurrence and wells.

Groundwater safe yield (natural groundwater recharge) is extremely difficult to determine, and such investigators as Lemoine and others with tens of years of experience in the region have never ventured into such determinations. However, as previously mentioned, rains of more than 10 millimeters and with intensity over 50 millimeter/hour do occur, and result in recharging dune sand and wadi alluvium groundwater.

In order to rank the oases and give a conservative idea of the order of magnitude of such recharge, the following estimates may be attempted for the oases segments considered for the project, but it should be borne in mind that they are only tentative speculations (with the assumption that 20 rains of 10 mm or more would be infiltrated at 15 percent):

Oasis	Assumed Watershed area (sq. km)	Infiltrated Water per year (cubic meters)
Ntakat El Wassa	70	2,100,000
Sani	30	900,000
Billaouar-Bougara	50	1,500,000
Sroumeli (much run-off)	40	1,200,000
Samouga	15	450,000
El Grahan	8	240,000
Rhoda (much run-off)	10	300,000

Rainfall and climatic data at Kiffa station are recorded from 1924 and may be summarized as follows (from "Donnees Climatologiques en Mauritanie", Bureau Hydrogeologique, 1968):

Number of days Rainfall/year			Yearly Rainfall(mm)			Maximum Rainfall in 24 hrs	Percent Rains over mm 20	50	Percent Rains intensity over 50 mm/ha
Aver	max	min	aver	maxi	mini				
28	36	25	353	620	142	98mm	70	4	3

Rainfall (average) in millimeters (per month)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
-	-	-	-	-	24	86	133	85	17	-	-

Pan Evaporation (in millimeters) = 3353/year (corrected = x 60 percent)

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
297	322	405	415	552	361	259	174	158	408	255	260

At Kankossa, average yearly rainfall is 436 mm (583 mm maximum; 237 mm minimum) as follows (June, 43; July, 110; August, 145; September and October, 138). The maximum in 24 hours was 142 mm.

At Sani, rainfall in 1975 was 545 millimeters (June, 17 mm; July, 247; August, 84; September 151; October, 45), while at Kankossa, it was 388 millimeters (June, 31; July 229; August 61; September 58; October 9).

Present Groundwater Development in the study area oases is limited. It is achieved using traditional wells (oglats), which are lined with logs or stones, about 0.6 to 1 meter in diameter and do not penetrate into the water table by more than about half-a-meter. These wells do not last more than a few years. Water is lifted using the shadouf (see Figure 1) or a goat-skin bucket suspended at a rope. Their yield is about 0.5 to 2 cubic meter per hour.

Potential for Additional Groundwater Development does exist in the project oases, especially where groundwater storage is significant (and at least 1.5 times as much as yearly natural recharge or safe yield). This is especially the case at Ntakat El Wassa, Sani, Sroumeli and Billaouar-Bougara.

Wells should be constructed in a modern way (cement-lined wells, or driven or jetted wells, including the Tysen well-cum-pump AID-Peace Corps well developed in Chad) where they are needed on a permanent basis, (one central well per hectare) and should penetrate into the water table by 2-4 meters below the dry season water level. This would allow for higher and dependable yields, especially if the wells were equipped with hand or foot pumps. However, such wells cost about $550 per meter, and the use of pumps necessitates maintenance and spare parts which has proved to be a problem very difficult to solve in this and other

regions of western Africa. Efforts in this direction are worthy to be continued.

Water lifting from wells should be improved. The study "Les Moyens d'Exhaure en Milieu Rural" by Benamour (CIEH, 1977) should be used as a reference book. Also, the results of the study for wells and pumps (1978) in the Upper Region of Ghana (Bolgatanga) by Canadian aid should be used. Animal traction (Figure 2) and persian wheels (Figure 3) are not recommended by those experts familiar with the region (water lifting depth are not high; the equipment is relatively costly; space is needed, as well as need to train and guide animals). Perhaps, these devices should be tried on a testing/pilot basis. Windmills are costly and involve maintenance problems, while the use of solar energy for water lifting is far beyond what oasis populations can afford. As for motor-pumps, they are expensive in initial cost and in operation and maintenance, and there is the risk of over-pumping as is the case in Atar.

In conclusion, there is room for groundwater development in the project oases, and hope for improvement in wells and water lifting, especially as time progresses, with a progressive shifting from traditional, limited systems to more modern and efficient ones. Also, this would be less costly than improvements in the efficiency of water distribution and irrigation systems, such as ditches lining (cement, pipes, etc.) which would be very expensive (and would anyhow necessitate modern and efficient wells and water lifting equipment).

Irrigation and Water Conservation. Presently, irrigation is very limited in the oases. It consists in watering young date palms for a few years until their root system reach the water table. This is done by using buckets to carry water from the well to the small basins around the palms. Also, some kind of gravity irrigation is accomplished by distributing water from earthen reservoirs next to wells to plants, using earth channels. Same type of irrigation is practiced for other traditional crops. Water losses in earth channels are important. Hand-lifting of water from wells (although the water table is shallow) and portage of water require relatively much manpower. Such manpower could do other productive tasks if water lifting and portage as well as water losses, were reduced.

Improvements in wells and water lifting are suggested in previous paragraphs. Improvements in water distribution and irrigation practices should be attempted. Reducing water losses in earth channels is expensive, although technically feasible. The economics of the question should be evaluated. Club des Amis du Sahel ("L'irrigation en Mauritanie", by Des Bouvries, 1977) recommends to expand recession agriculture, irrigation of date palms and alfalfa (using modern wells) and small dams, and to rehabilitate and expand small oases (because they are the locus of trade and exchange between nomads and other populations). As a matter of fact, there are about 70 oases in Assaba (about 40 in Affole, and around 65 in Tagant), which according to Munier (LePalmier Dattier en Mauritanie, 1955) are partly fit for development, which might be investigated (see Map 1)

Perhaps, prospects for modern date-palm plantations in Mauritania should also be studied. A forthcoming study financed by the African Development Bank called the 64-water well project, will determine the technical and economic feasibility of developing groundwater through high-yield deep wells throughout

the country. Such wells could supply water to plantations capable to produce dates for exports in western Africa. The desirability and technical and economic feasibility of such plantations remains to be proven. Good water prospects would be especially in the southeast, the Trarza, and Benichchab areas and others.

Irrigation, water conservation and distribution efficiency could be achieved by lining of channels and ditches. Concrete or plastic pipes are, however, very expensive; lining with plastic sheets would be less costly. All of that may be tested, and there may be room for application in the future (including in other areas of Mauritania), especially for crops which would yield a high return. Simple drip and sprinkler irrigation may also be tested, with same assumptions and long-run possibilities. However, for the immediate and for demonstrations, efforts should be concentrated on simple, technology and practices involving modest costs. Improvements in water conservation may include use of water-efficient plants and reducing of transpiration losses (by destroying offshoots and phreatophytes, and using windbreaks).

Artificial Groundwater Recharge has been studied by Schiff (1977) for Atar and Tidjikja where it is believed necessary for allowing for sustained use of the wadi alluvium groundwater, rehabilitation of water quality, and continuation of agricultural development. As a matter of fact, over-pumping a groundwater basin for intensive agricultural development (and economic taking-off), and sustaining such basin with artificial groundwater recharge for continued operation has been achieved in various places in the world, and may be a valid approach if technically and economically feasible. In the Assaba region, no over-pumping is contemplated. If significant groundwater development was to take place along wadi Msile or Karakoro (Kouroudjel and Kankossa area, and downstream), maybe, sometime in the future, artificial groundwater recharge aspects and prospects could be studied, as Schiff did for Atar and Tidjikja. Authors of "Recherches sur le palmier-dattier" (IFAC, 1974) suggested an artificial groundwater recharge dam at Kankossa, which may be assessed further. This may be of interest in the second phase oasis development project but will not be done during the present project.

d) Activities for key personnel/Project Implementation

The following key personnel with much field experience and interests will be needed: a TDY Irrigation and Rural Works Engineer, a TDY Appropriate Technology Engineer (Pumps), a TDY Animal Traction Specialist, a Mauritanian Rural Works/Mechanics Technician. Also, a TDY Hydrogeologist would be needed if an inventory-study is made of a certain number of oases with potential for development. This personnel will work in close coordination/cooperation with other project team members, including Oases Development workers and their helpers. The attached schedule for water and irrigation presents personnel and activities.

1. Irrigation/Rural Works Engineer

A TDY Irrigation/Rural Works Engineer would be needed for a total of 9 months as follows:
- first year (3 months): to layout and do the field engineering design of trials and demonstrations sites (water and irrigation infrastructure, i.e. wells, pumps, water distribution, water supply, dikes, channels, irrigation, rural works, water-related disease aspects, etc.), including preparation of quantities and cost estimates for commodity purchasing, cooperation with the Pumps Engineer, and Service Hydraulique for geophysical surveys (including terms of reference for contracts) and well installations, and with Genie Rural (irrigation), as well as assistance for construction launching.

- to assist in selection of Mauritanian Rural Works/Mechanics Technician and his helpers

- to prepare the scope of work for water and irrigation trials and demonstrations, based on the technical analysis and background information of this project paper (modified as needed), including the tasks and training program for the Rural Works/Mechanics Technician and his helpers and associates
- to prepare procedures for review and evaluation of work progress and trials and demonstrations
- second year (2 months): - to review work progress, to re-orientate infrastructure construction, as needed, as well as layouts for trials and demonstrations (and next geophysical surveys), and to assist in construction supervision and project launching, as well as to implement, as applicable, water and irrigation aspects described in this project paper (including assistance for dikes construction).
- third year (2 months): - as above as applicable, as well as trial evaluation and demonstration launching, preparatory work for oases inventory/study and participation in oases inventory/study as applicable.
- fourth year (1 month): - as above as applicable, including remaining field design work and demonstrations, as well as trial and demonstration evaluation.
- fifth year (1 month): - to review work progress, to evaluate trials and demonstrations including their economics and applicability/replicability.

2. Appropriate Technology Engineer (Pumps)

A TDY Pump Engineer would be needed for a total 6 months as follows: first year (1 month), second year (2 months), third year (1 month), fourth year (1 month), fifth year (1 month). This personnel would be from Georgia Institute of Technology or similar. He would substantially have same type of activities as the Irrigation/Rural Works Engineer (with whom he will coordinate), except that his work will be related to pumps and water lifting.

3. Animal Traction Specialist

A TDY Animal Traction Specialist would be needed for two months (years two and four) to handle animal traction aspects of the project.

4. Rutal Works/Mechanics Technician

A Mauritanian Rural Works/Mechanics Technician would be needed on a full-time basis for the project lifetime. He would have a technical background and interest in water and irrigation techniques. Any capabilities in plumbing, electricity, etc. would be useful. Of more importance, in addition to mechanics, are rural works and irrigation aspects: wells and pumps, surveying, land preparation, irrigation channels and ditches, dikes, diversion channels, pipes, fittings, etc. Training would be on the job and as needed, through visits of places of development and implementation of irrigation, rural works, wells, pumps, etc. primarily in Mauritnaia.

5. Hydrogeologist

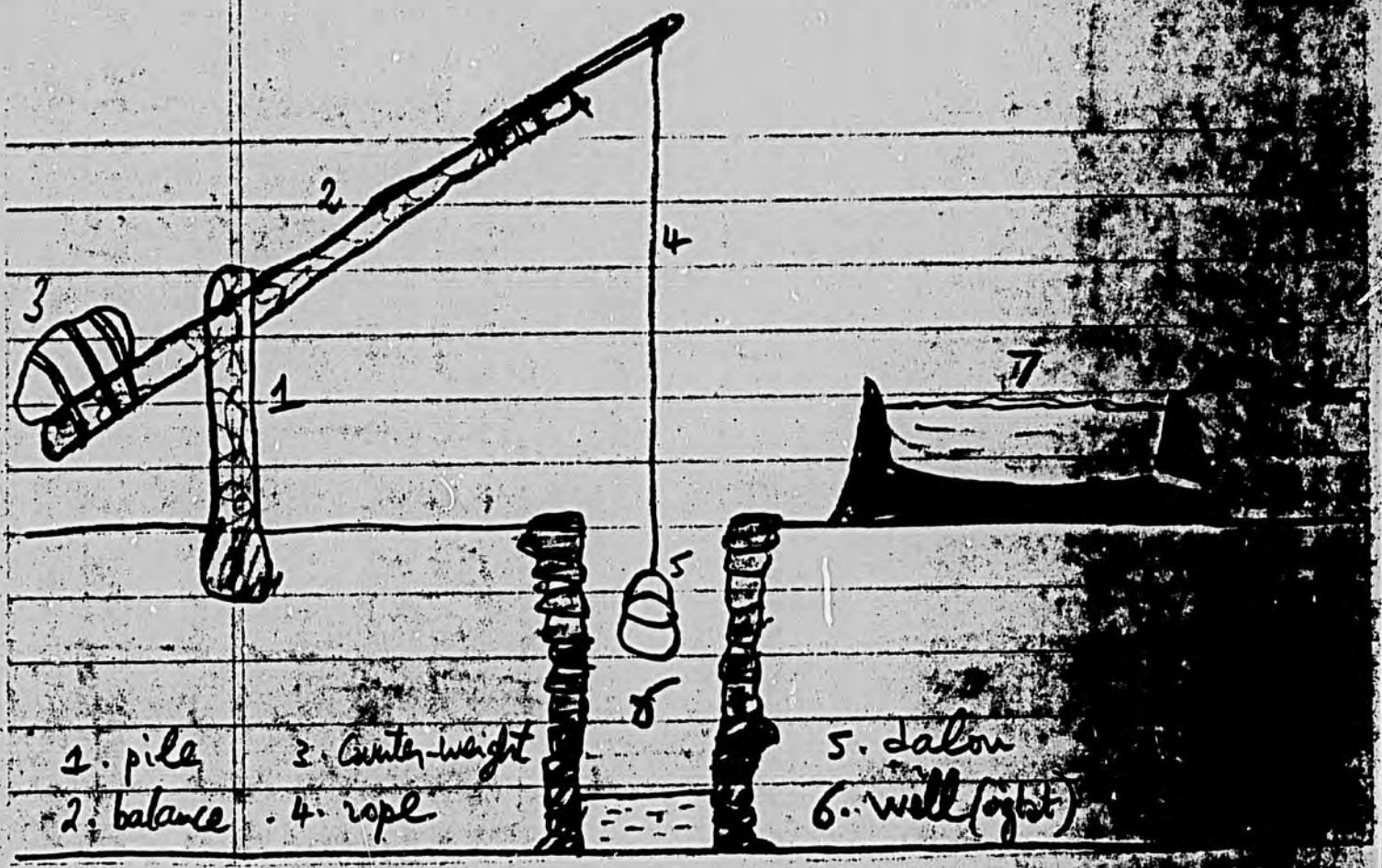
A TDY Hydrogeologist would be needed for about 4 months by the third year for the inventory/study of a number of oases with potential for development. He would evaluate water availability and quality in those oases. He would coordinate with the Irrigation and Rural Works Engineer, and with Service Hydraulique. He would prepare a report establishing the water availability and quality in the oases, and recommendations for water development.

6. Other

The following approach may be implemented as such or modified:

- the geophysical surveys would be reconnaissance and detailed at Sani, recommaissance at three other sites (year one); reconnaissance, and as needed detailed (for three above sites or others), at two other sites or more (year three); reconnaissance of a certain number of oases (year four). This would be achieved through contract with Service Hydraulique (about $4,000 per week, i.e. per site).
- Tysen-type well would be installed through subcontract with Service Hydraulique (Sani and three other sites, year one; two other sites, year four).
- Wells would be constructed by project personnel (with advice of Service Hydraulique as needed): Sani (year one), three other sites (year three), two other sites (year four).
- Irrigation infrastructure would be set up by project personnel; same schedule as for wells.
- Trials would start by year two, and demonstrations by year three.
- All of above plans entitled as activities for key personnel and project implementation are tentative and subject to adjustments by project implementators, as necessary, including for reflecting changes of situation and conditions.
- The task of project implementors will be, on the basis of the framework provided in this paper, to test approaches and techniques they will judge of interest, and to implement and extend what they will perceive as applicable. They should also operate keeping in mind long-term applicability.

Figure 1- Shadouf



1. pile
2. balance
3. Counter-weight
4. rope
5. dalou
6. well (right)

Figure 2. Animal Traction for Water Lift

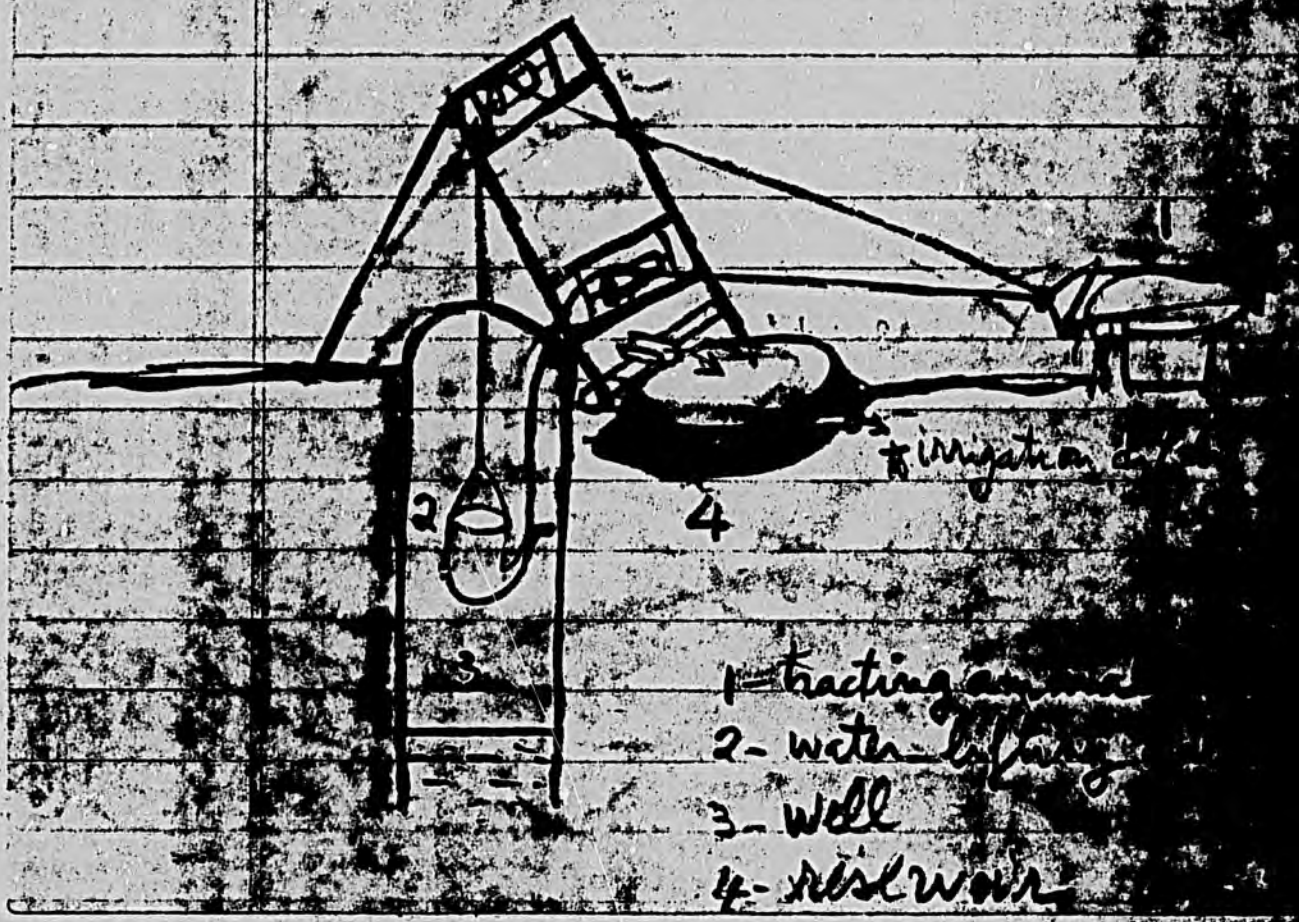
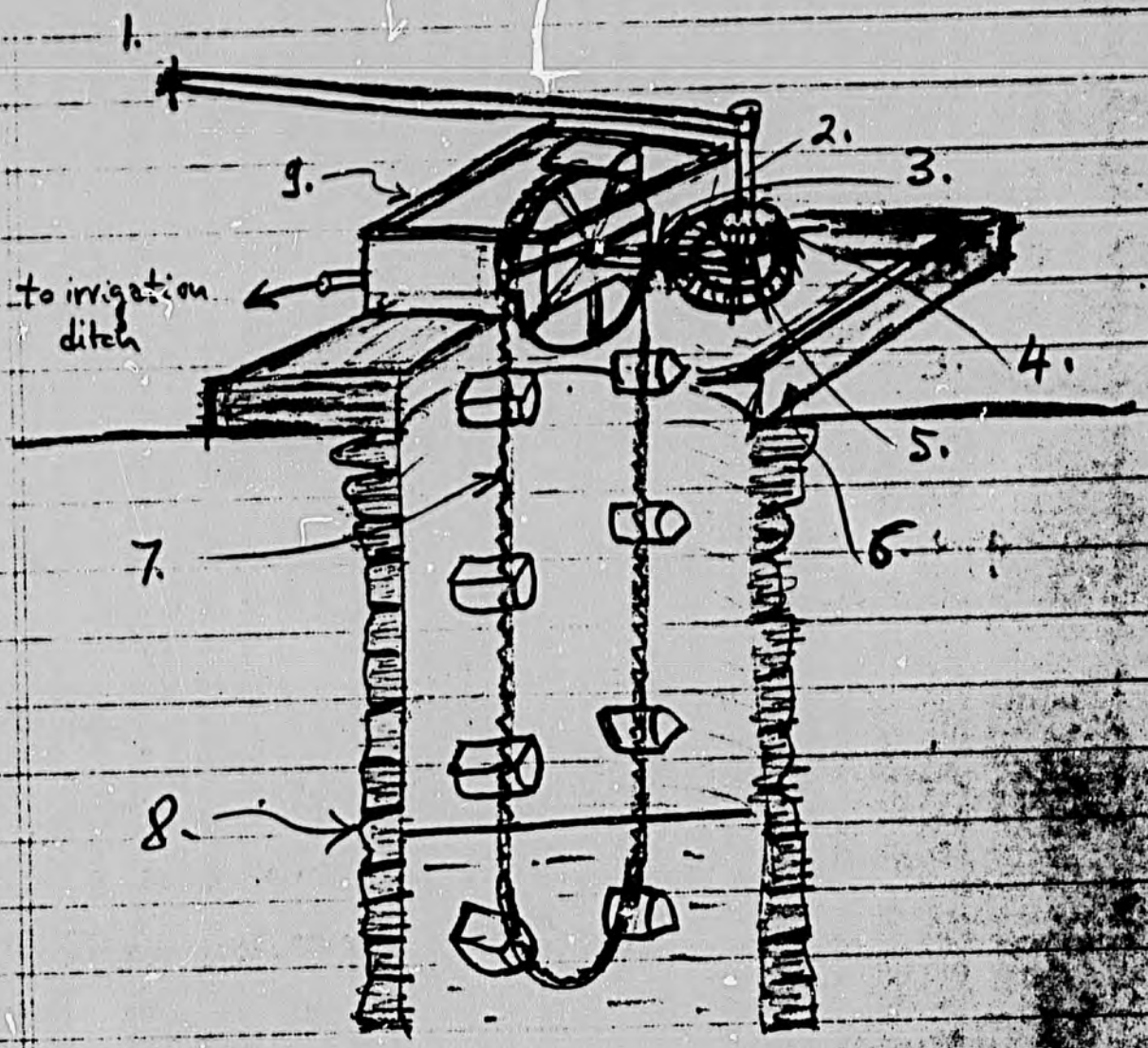


Figure 3 - NORIA (PERSIAN WHEEL)



1. Draft-pole (for person or animal)
2. Vertical shaft
3. Horizontal shaft
4. 45°-Angle gears
5. pillow block w/ bearings
6. beam/support
7. Bucket chain gear*
8. well
9. basin

*-buckets: 5-15 liter capacity
-chain moving at a rate of 0.15 to 0.30 meter/second

Note: an old car rear axle could be used to perform a similar task.

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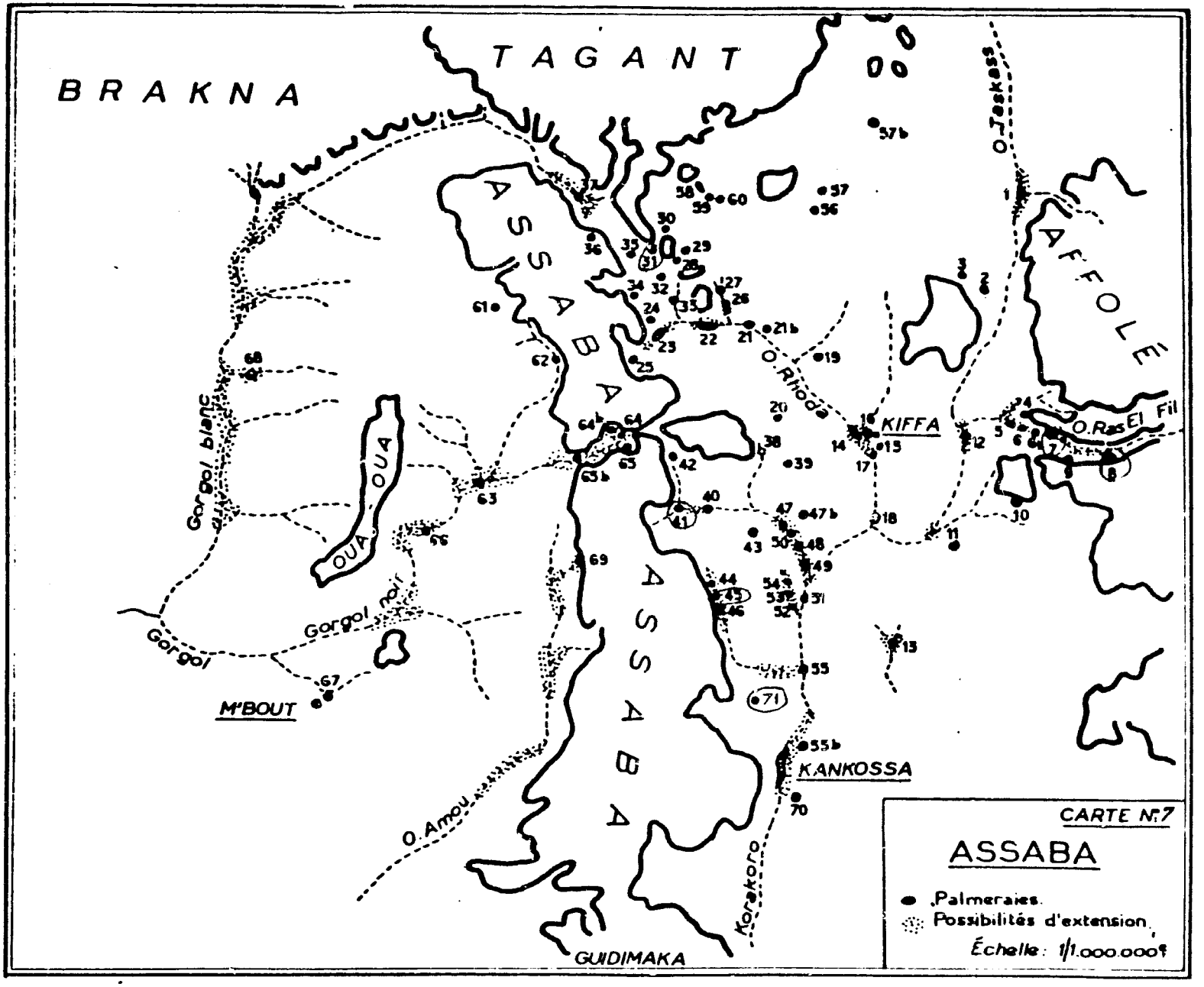
ASSABA OASES

Palmeraies de l'Assaba :

1 - Oum el Rheuze
2 -
3 - Charouet
4 - Tamouirat
5 - Touekride Bechichi
5 bis - El Garfel el Hara
6 - Badeizoug
6 bis - Zraïef
7 - Billaour
8 - Bougara (Djam Affolé)
9 - Oum el Emhar
10 - Aïoun en Nag
11 - Fonteilli
12 - Melgué el Ouidaye
13 - Sadra
14 - Kiffa
15 - Hassei el Bakaï
16 - Bou Melane
17 - Ghilé
18 - Adzara
19 - Aaziou
20 - El Kantara
21 - Emchaoune
21 bis - Hassei el Hedid
22 - N'Takal
23 - Guérou
24 - Kouiket
25 - Aouinet Ideran (Guérou)
25 bis - Oaillar
26 - Hasseï el gherb (Bou Mrega)
27 - Tarhadat ouled Alimine
28 - Tarhadat N'Guékou
29 - Laouije
30 - Tarhadat Rhiz N'Degué
31 - Tarhadat el Ouassa (Ntakat el Ouassa)
32 - Aouinet el Ba
33 - Agueni Aouba
34 - Bou Batha
35 - Aouinet el Batha
36 - Kamor
37 - Diouk
38 - Hasseï Naklat
39 - Beïda Kandea
40 - Hasseï el Nouss (El Grahan)
41 - El Grahan
42 - Hasseï el Fouhouz
43 - El Mejoul
44 - El Djeb
45 - Sumoga
46 - Tézékré
47 - Soudou
47 bis - Lemrhaïmodh
48 - El Feyed
49 - Kouroudjel
50 - Lemrhaïfeg
51 - Mefga
52 - Tenteïna
53 - Daouda
54 - Aouinet Cheib
55 - Seroumeli
55 bis - Defa
56 - Tamourte Guissi
57 - Hasseï el Rherb (Nouameline)
57 bis - Affrate Amoura
58 - Touergé (Bougara)
59 - Tingueni
60 - Bou Erch
61 - Lemseiguem
62 - Guiller
63 - Barkiol
64 - Lictatine
64 bis - Oumou Louroug
65 - Goussas
66 - Hamodia
67 - M'bout
68 - Bou Damiane
69 - Aouinet Labarak
70 - Agmamine
71 - Sani



ASSABA OASES

ANNEX C-2 PROPOSED IMPROVEMENT OF THE DATE PALM CULTURE IN THE ASSABA AREA

History of the Assaba date palm groves

In a not very distant past the Assaba area was a part of an almost exclusive cattle raising, nomadic region which also included a large part of Mali and the Eastern Senegal.

The first palm grove in the Assaba was planted in 1921-22 by Mahamed Mahmud Ould Sidi Mokhtar, Chief of the tribe Ahel Sidi Mahmud. He used palm shoots from Tagant.

Then in 1925 Captain de Larminat who was the District Chief of Kiffa began a date planting program starting with Gerou and N'Takat. The date shoots were taken in Tagant. In some places seedlings were planted as well as the off-shoots of growing palms. The count of growing palms was in 1929 1,611. In 1938 the number of palms was around 10,000 and in 1955 it was estimated that the number was somewhere over 100,000. The present number is not known, but considering some losses during the present drought, there probably are not many more than were estimated in the 1955. It appears that not many new palms were planted lately in the Assaba area.

The possibilities of expansion of the date palm culture in Assaba

The desertification which recently took place in the northern reaches of the Sahel, which produced drying up of some of the northern oases, appears also to indicate that the climatic conditions suitable for production of mature dates have moved southward. Hence, what was previously considered the southern most suitable date growing area, in our case the northern Assaba, should now include the central and possibly southern Assaba. We are speaking of production of ripe dates which require hot and dry period of 3 to 4 months for complete maturity of dates.

With this in mind consideration of utilization of southern oueds, which now have only doum palms growing, should be made. The vigorous appearance of doum palms is a good indicator of a growing site for the date palms. One of such oueds with a thick stand of doum palms is being considered for a trial site for introduction of certain varieties of date palms. More about this later.

The problems

The people of oases are primarily cattle herders and are only to a relatively small degree cultivators. They do take care of pollination of date flowers in a primitive way but they neglect to keep the palms clean of the excessive root sprouts. Other than that they grow some millet and sorghum and some beans. Vegetable and fruit growing in the microclimate under palms as it is done in Adrar and to some extent in Tagant is rare and in some cases nonexistant.

There is no control of harmful insects or diseases. The people there are ignorant the simplest methods of pest control. However, they appear to be interested to learn about it and would like to receive assistance in combating the plagues.

Because of neglect and ignorance, the date production is low, probably below 20 kil per tree. In North Africa the average production is about 40 kgs. per tree.

The quality of dates is low. They are usually small. To some extent this is due to the fact that the early plantings were sometimes done with any shoots available even from seedling dates. And some planting was done by seeds.

When harvested, dates are not treated for elimination of insects. As result the dates that are consumed or sold are usually infested with the insects.

Consumption of Dates

In the desert oases of North Africa the yearly consumption of dates is from 100 to 150 kgs per person.

The consumption of dates in Mauritania, for the whole country, is 15 kgs per person. On the date oasis the figure is probably not more than 30 kgs of ripe dates per person.

Peculiar to Mauritania is the consumption of half ripe dates at "Guetna" time. In June and in the first part of July the dates are still quite juicy, they contain but little sugar and are probably quite rich in vitamin C. At this time all sectors of population converge on date groves. They buy the right to harvest certain trees from their owners and start eating the immature dates and keep on eating them for several days until their trees are bare of fruit. This is considered a cure by these people who eat meat and starches the rest of the year.

This custom appears to be growing in popularity which means that progressively more dates will be consumed locally in a half ripe state.

Proposed assistance to the date growers

No advanced date palm cultural methods such as for example, those that are used in California can be introduced in Assaba. Such methods require clean cultivation, copious irrigation, fertilizers and mechanization of pollination and harvesting. For one thing, the microclimate under the date palms is needed here for the supplementary autoconsumed and cash crops. The dates are to a great extent a locally consumed crop and what dates are sold on local market by no means can compete on the world market as the American dates do. Hence, it will be a mistake to try to teach Mauritanians the complex intricacies of American way to raise dates, that is, if this could be possible, which it is not, considering the technical level of local agriculture.

The limited capacity of the people of Assaba oases to accept and to retain the technological improvements and their ability to maintain in function any mechanical devices must direct our approach of the assistance to them in improving the production and quality of dates and of other crops of oasis agriculture within realistic goals, possibly trying to approach as much as possible the level of the peasant oases agriculture of North Africa.

Such approach must be arrived by placing ourselves firmly in their sandals and by acquiring to the best of our ability their way of thinking and by understanding how they go about to get things done within their ways that are peculiar to them.

There are however examples where the people of Assaba, relatively new to the date culture which started barely 50 years ago, have accepted improved methods of date culture and adaptation of new crops. There are, on the other hand, places in sub-Saharan dry belt where doing artificial pollination of dates is considered too much trouble and where the haphazard pollination occurs only when pollen is carried from male trees by wind. In Assaba, the laborious climbing to the top of the palm to place strands of male flowers among clusters of female flowers is universally performed. Introduction of a simple improvement of pollination technique will be discussed later.

A novel method of biological control of the very harmful to date palms white scale Parlatoria blanchardi Targ. was developed in Mauritania by workers of the IFAC (Institut de Recherches sur les Fruits et Agrumes). After a number of trials with various species of the ladybugs some of which are predators of the white scale, a specie introduced from Iran Chilochorus bipustulatus proved to be the most voracious enemy of the scale. A method of multiplication of this lady bug was developed and distribution of them was started. New as the method was (and it was for the first time demonstrated in Mauritania) the oasis people went for it with alacrity. There were even reports of stealing the bugs to increase their own platoons of predators. Such direct result activities are readily understood in oases.

The other injurious pest Oiygonichus Afrasiaticus Mc.Gr., locally known as Taka, is the date mite which attacks the date fruits from the early stages of their development. The standard method to combat Taka is to dust the fruit bunches as soon as the silky spider web appears on the developing fruits. Early dusting is very important because in later development of fruits the mites are not as exposed to treatment as when the fruits are still very small and hard. Sometimes, if Taka persists, the treatment has to be repeated from two to three weeks later. This method is being used with satisfactory results in California and the Near East. In Mauritania, it appears, the method produced not very satisfactory results due to the fact that people here neglect doing the dusting at the early stages and do it when they get around to it, which is usually too late for satisfactory results. Another problem is that the dusting when it is done requires climbing up the palms which is laborious. A duster with a long extension tube will make the dusting much easier. This will be one of the technology introductions of the Oasis Project. It will facilitate a proper timing of application.

Traditional method of cleaning the Taka out of the date fruit clusters in Mauritania
(From: Expose sur la Citation de la Palmeaie de Tichit. Par Claude Lenormand, 1975)

"Every week for 3 months (April through June) man climbs up the palms where he harnesses himself close to hanging clusters of fruit. He has a 10 to 15 liters cont in of water (delou) and a ladle made from a gourd. He dips water with the ladle and with a precise and violent movement (accompanied by a gutteral sound created by quick expulsion of a volume of air from his lungs) he projects water into the cluster of fruits. This practice requires considerable practice and adequate physical resistance."

According to Lenormand there was a considerable increase and spread of the date mite during the last drought. (O. Afrasiaticus thrives on the dry weather). He believes that in the case of Tichit oases if the above described weekly cleaning were not done as much as 95% of the crop would be lost. P. Murnier, in his book Le Palmier Datier, says that the losses due to date mite could be the total crop.

Proposed Trials for Development of a Method of Biological Control of the Date Mite

Olygonichus afrasiaticus, the date mite, is a spider and as a rule the entomologis do not work with spiders. The proposed trials of the biological control of the date mite will have to be done by an acrologist. Following several inquiries, the leading British acrologist, Donald McFoirlane, of the Commonwealth Institute of Entomology, has suggested an American acarologist Dr. Harold A. Denmark of the Division of Plant Industry of Florida Department of Agriculture and Consumer Services, in Gainsville, Florida, to address this problem. Dr. Denmark was tentatively approached, and he

agreed, if invited, to make an exploratory trip to Mauritania in order to study the possibility of attempting the biological control of the date mite. He also has agreed to assist in designing a method of approach to such biological control and to help in selecting someone qualified to do such trials in Mauritania, for about 2 years, during which time it should be determined if a practical biological control of the date mite is possible.

Such activity would involve obtaining the known predators of the date mite such as several species of the genus Scolothrips and of the genus Stethorus (a ladybug which feed on date mites of California, O. simplex;) and possibly some other mite predators known elsewhere, and to bring such predators to Mauritania where their adaptation to the local climatic conditions would be observed. Then the best candidates would be tried for their ability to feed on the Mauritanian date mite O. afrasiaticus. After the best ones are selected, the trials of mass propagation and of release of the predators in the palm groves, suffering from infestations of mites, would be done and their efficiency in eliminating the date mites observed.

To do this work a controlled condition of habitat of the date mite will have to be created in a laboratory, which might be set up in Nouakchott adjacent to the living quarters of the acarologist, perhaps one room in his house.

Such trials should include at least three periods of the high activity of the date mite, which are from April through June. So, the acarologist should be engaged for 2½ years of work in Mauritania and perhaps for as much as 6 months for the period of obtaining the predators before bringing them to Mauritania. If such predators are available in the U.S. Biological Agents Resource Centers (which exist in some State Agricultural Experiment Stations, in Federal and State laboratories and in some universities) then the matter of obtaining them is simplified, provided such Centers can spare their biological control agents. If not, the collecting the predators and keeping them until taken to Mauritania will involve time and expense, for facilities to keep them etc.

The suggested activities proposed for developing biological controls for date mites appear to be technically feasible, but would require modern laboratory and controlled methods which are beyond the capabilities of the research and development facility planned for Sani. The cost might approach $500,000, or even more, depending on the magnitude of the search for predator agents. The benefits to derive from an effective biological control might well justify the cost since they presumably would extend to many date-producing countries in Africa. However, there is no certainty that the efforts to develop this control will succeed. Given the modern, controlled requirements for this venture, the length of time it would require, the basic research involved, and the potential for benefits to be a broader area than one country, it is proposed that this research and development be considered for implementation as a part of the Integrated Pest Management Project for the Sahel (CILSS), rather than for inclusion in the Mauritania Oasis Project.

Diseases of Date Palms

At present there are no serious diseases of the date palm present in Mauritania. However, a killer disease caused by the Fusarium oxysporum, known in the North Africa by the name of Bayoud, is spreading in Morocco where it destroyed about two thirds of the date palms. Some parts of Algeria is also affected by this disease. The quarantine established by the former French Administration in Mauritania in order to stop the penetration of the Bayoud in this country appears to be not very effective

at present.

Resistant to Boyoud varieties are found in Morocco and their propagation is being done there. Isolation of such varieties in some locality outside of date growing areas and rendering them free of the pathogen should be done in order to introduce such varieties to areas threatened by this disease. More about this under introduction of new varieties of dates.

Some spotty presence of the bud-rot disease caused by Botryodiplidia Theobromae and of the trunk-rot Thielaviopsis paradoxa at this time are not of epidemic proportions. However, such occurences are to be watched for and the date palms and the often associated with them doum palms affected by these diseases should be destroyed by fire to stop the spread of diseases.

Introduction of Date Palm Varieties from outside of Mauritania

In Mauritania, the large proportion of the date crop is consumed in a semi-ripe, juicy state. In the Near Eastern countries there are certain varieties that produce large dates which are very attractive and have very palatable fruity flavor when they are in semi-ripe state. They are mostly sold in city markets as choice fruits and some are exported to Europe. In Mauritania where semi-ripe dates are consumed in quantities, such improved varieties should become the choice item. The flowering of dates, development of fruits and especially maturing, is earlier in Mauritania by a couple of months than it is in the Near Eastern and N. African countries. So, if there could be a development of export to North African, Near Eastern and possibly to European markets, the fresh dates of Mauritania would have a distinct market advantage.

There is a way of forcing the newly planted date shoots to produce some fruits as early as two years after they are separated from the mother tree and planted. Such shoots must be, to begin with, of a large size, that is over 20 kilos in weight. They should receive adequate fertilization, copious watering and protection from wind and from too much sunlight. This forcing of the imported shoots will produce early indication of the relative quality of the fruits on the date plants transported to new climatic conditions. The imported varieties tried in this project will be generally of this type.

Introduction of high starch date varieties

High starch, dry dates, of characteristically light yellow color are brought to Mauritania and are sold in the Nouakchott market. Some dry dates of not very starchy kind are grown in Adrar. In Niger and in northern Chad, however, there are dates of high starch content. This kind of dates compliment the grains of millet and sorghum in the diet of oases people in the above sub-Saharan countries. The attractive side of such additional starchy product is that it is easier to grow in oases conditions than the field grain crops. Mauritanians in oases are high meat consumers and balancing their diet with the starch of the grain crops is a particularly strenuous enterprise in their conditions, especially because these crops must be irrigated and sometimes watered by hand with the scarce availability of water to begin with. The date palms on the other hand reach for their water with their long roots and are watered only for 2 or 3 years after they are planted. Therefore, introduction of sub-Saharan high starch dates from Niger is planned for this project. There will be no need to test for their performance in Mauritania. Previous exchanges of date shoots between sub-Saharan countries indicate that Mauritania has much the same climatic conditions as northern Niger or northern Chad.

Introduction of the date varieties resistant to the Bayoud disease from Morocco

The first requirement in obtaining such varieties will be an official contact dealing with subject between the U.S. Government and the Government of Morocco. The Plant Introduction Service of the U.S. Department of Agriculture which is familiar with such transactions, might be of help in getting the agreement of the Moroccan Government to release 120 small offshoots (20 each of the 6 varieties) of the resistant-to-Bayoud date palm varieties. These varieties are Boustamini, Iklane, Taadmamt, Bou Zaggar, Tacorbouchi, and Bou Ijjou.

If and when the agreement of their release is obtained, a French-speaking horticulturist who is familiar with date culture should visit Morocco to collect the 120 offshoots, treat them with an appropriate fungicide and to bring them to either Glendale or Miami quarantine stations of the Plant Introduction Service where the shoots would go through treatment for complete elimination of the spores of the Fusarium albodinis. After this, the shoots could be taken to Mauritania to be planted at the Sani nursery. In about two years, if properly taken care of, the young palms will be producing small offshoots which will be planted in plastic pots-baga; after several months they can then be planted in such date palm groves where an adequate care of them for the first three years can be assured.

The propagation of more of the resistant-to-Bayoud date palms can be continued in such a manner at Sani and in the date palm groves which will produce after several years a substantial reserve of the resistant-to-Bayoud plant material. This could be used to forstall disaster in the event of the arrival of the Bayoud to Mauritania.

Pollination

Artificial pollination is practiced, in a traditional way, by introducing several strands of male flowers into the freshly opened cluster of female flowers. Selection of the male donors of pollen is important for the early production of pollen. Planting the male palms in a location well exposed to sunlight will hasten the early blooming and maturing of pollen. Mixing the pollen from various male palms will tend to insure that the mutual incompatibility of male and female is avoided.

Methods of blowing the pollen into female clusters are used in California and some places in the Near East. A simple variant of such methods consists in a long plastic tube attached to a pole and connected on the lower end to a jar, which contains the pollen, equipped with a rubber pear blower. On the high end a spout with a flat opening directs and spreads the pollen which is blown through. For this method, pollen has to be freshly dry to conserve its viability. The drying is accomplished by placing the strands of the male flowers on a screen under which the pollen collecting pan is placed. This operation must be done in cool, shady place which is protected from wind which can blow some of the pollen away.

For better distribution of pollen and the economy of its use, the pollen can be mixed with talcum or some other inert light powder, such as slaked lime. Ashes, finely screened, could be used if other fine powders are not available.

Increasing the size of dactes

Reduction of number of dates on a given cluster will result in an increased size of them. The reduction is accomplished by cutting back the female infloressances before pollination, by as much as a third from the tip of the strands. The

varieties with short strands can be thinned cut by eliminating some of the strands.

Training of the oases dwellers

Possibly the most effective training results could be obtained by "peasant to peasant" associations for a couple of weeks on the oases of North Africa, taking some selected Mauritanian oases farmers to North Africa to view oases where dates have been grown for many centuries and are maintained productive by simple and effective methods which are still in daily use. The average production of dates in North Africa is about 40 kilos per tree whereas in Mauritania it is less than 20 kilos. The Mauritanians from oases can learn by observation and by actually participating in the activities with their northern counterparts. This process of learning by doing will impress them much more realistically than listening to lectures by strangers. The most important activities for the Mauritanians to observe will be lifting, distributing and conserving water, and production of crops under cover of palms. The best time to take the Mauritanians there will be at the date harvest time which is in October-November. To assist in the contacts and logistics, the Training and Extension Coordinator and the Oasis Development Workers should accompany the Oasis farmers on this observation trip. This would also give recognized technical authority status to the TEC and ODWs which should facilitate their technical advisory efforts upon their return.

ANNEX C-3 OTHER CROPS

As the present time the GIRM has a very limited agricultural research program so it will not be possible to obtain reliable research information on which to develop demonstrations. The AID Vegetable Production project will test vegetable production techniques along the Senegal River and in some parts of the Assaba Region, mostly in non-oasis areas. The results obtained from the vegetable variety trials will be beneficial to the Oases project. Vegetable production is only a small part of the overall project, which will include grain food production, legumes, horticultural crops, animal husbandry, irrigation techniques, fencing, wood production and nutrition. There will be a synergistic effect of all the elements interacting in the oasis community.

Technical assistance will needed since there is a dearth of agriculture research personnel in Mauritania. A full-time agronomist will be assigned to the project. Short term personnel will be needed in nutrition, appropriate technology, forestry, horticulture, animal husbandry, soil science, plant pathology, seed production and conservation.

The people living in oases have limited resources: therefore, the project will depend on limited resources whenever possible, including biological control of diseases and insects as well as the use of organic fertilizers when it is feasible.

The project will concentrate mainly on the crops which are now being consumed in Mauritania. They are classified into groups as follows:

1. Food Grains
2. Legumes
3. Root Crops
4. Vegetable Crops
5. Horticultural Crops

Table 1 indicates a suggested implementation plan for adptive trials and demonstrations.

Food Grains

The major food grains grown in or near the oasis are millet and sorghum. Adapted research trials will need to be conducted to determine the best improved varieties and the optimum level of fertility for the available water supply. Sorghum varieties will be tested to determine high yielding adapted varieties and varieties that tend to repel birds, which cause a considerable amount of damage at harvest time.

Seed of high yielding sorghum varieties should be obtained from Dr. Ernest Sprague at CIMMYT in Mexico and from Dr. J. W. Johnson, Texas A & M University at the field station in Lubbock, Texas.

The varieties should be placed in variety trials along with the variety of sorghum that most of the farmers are presently producing in the oases. The project will also coordinate with SAFGRAD.

Seed of high yielding millet varieties should be obtained from the International Center for Research in the Semi-Arid Tropics (ICRISAT) in Segundabad, India as well as varieties from the International Center for Research in the Arid Tropics in Syria. These varieties should be placed in a variety trial along with the variety that the farmer is presently growing in order to determine the highest yielding variety.

It would be desirable to concentrate on open-pollinated varieties at the present time so that the farmers can save their own seed after a high yielding variety has been located.

TABLE 1

IMPLEMENTATION PLAN FOR FOOD CROPS

	Year 1	Year 2	Year 3	Year 4	Year 5
Vegetable Adaptive Research Trials	XXXXXXXXXXXXXXXXXXXXXXX				
Vegetable Demonstrations		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Fruit Introductions	XXXXXXXXXXXXXXXXXXXXXXX				
Legume Adaptative Research Trials	XXXXXXXXXXXXXXXXXXXXXXX				
Legume Demonstrations		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Millet Adaptive Research Trials	XXXXXXXXXXXXXXXXXXXXXXX				
Millet Demonstrations		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			
Sorghum Adaptive Research Trials	XXXXXXXXXXXXXXXXXXXXXXX				
Sorghum Demonstrations		XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX			

Fertility trials will be needed on sorghum and millet in order to determine the optimum level of fertility. It would be desirable to use treatments that use animal manure alone, animal manure plus chemical fertilizer and chemical fertilizer alone. The level of fertilizer should be determined by a soil analysis and only the nutrients that are deficient should be included in the experiment. A complete factorial design should be used with three levels of fertility for each deficient element.

High analysis fertilizer should be used for all the trials to reduce the transportation cost. Ammonia sulphate could be used for nitrogen, triple superphosphate for phosphorous and potassium sulphate for potassium.

Legumes

The niebe bean is grown in most all of the cases at the present time. Several other legumes were observed in one oasis near the date palm trees and they may have provided a source of nitrogen for the palm trees. It would be desirable to import seed of several legume species that might produce well in the oases. The following legumes should be tested:

Broad bean - Vicia faba
Dry bean - Phaseolus vulgaris
Hyacinth bean - Dolichos lablab
Mung bean - Phaseolus aureus
Pigeon pea - Cajanus indicus
Cowpea - Vigna sineusis
Chickpea - Cicer Arientinum

There are two other legumes that might be tried on a small scale such as lentils and the winged bean. Research will also be necessary on inoculation of rhizobium for new legume introductions.

Most of the adaptive research effort should be concentrated on cowpeas. Dr. P. R. Goldsworthy at the International Institute of Tropical Agriculture in Ibadan, Nigeria has done a great deal of work on cowpea improvement. Seed should be requested of at least 10 of the highest yielding varieties to determine if they yield more than the niebe bean which is being produced at the present time.

There are also some high yielding varieties in the U.S. that should be tried. These are Calhoun Crowder, Dixilee, Texas Purple Hull 49, Alacrowder, Alalong, California Blackeye 5, Cream 52, Texas Cream 8, Big Boy 343, Brown Crowder 344, Cream 12, Cream 40, Knuckle Purplehull Mississippi Silver, Purple Hull Pinkeye, Six Week Browneye, Vining Purplehull, Whippoorwill and Topset. There are also foreign varieties that should be included in the variety trial such as Poona from India, Reeves from Australia, Garbaucito, Chinito and Azulgrande from Costa Rica which are resistant to mildew and Acre from Jordan.

Fertilizer trials should be conducted on bean species that yield the highest under the oases environment. Since cowpeas fix nitrogen, it may be necessary only to compare organic fertilizers with phosphorus and potash applications at different levels.

Dr. Hyo-Guen Park has developed several high yielding varieties of mung beans at the Asia Vegetable Research and Development Center (AVRDC) in Tainan, Taiwan. The vegetable production specialist should obtain seed from the AVRDC so they can be included in variety trials as well as from India, Thailand and the Philippines to determine which varieties perform the best under the oases environment.

Dr. Silvio Orozco at the International Center of Tropical Agriculture (CIAT) in Cali, Columbia has developed some high yielding dry bean varieties. It would be desirable to import several of the high yielding varieties to see how they perform in Mauritania.

Peanuts - Archis hypogaea L.

A few peanuts are grown in oases but usually not enough to meet their total needs, so the farmers occasionally buy peanuts from the market to satisfy their limited demand. Since more peanuts might be grown in oases, trials might be desirable to determine which varieties are adapted and the cultural practices that promote high yield.

Peanuts are cultivated from 40°N latitude to 40°S latitude and prefer soils that have a pH in excess of 7.0. Most of the soils tested in the oases have a pH over 7.0 The peanuts prefer a soil loose in structure, fertile, well drained and high in calcium, phosphates and potash.

There are two types of peanut varieties grown. The bushy or upright type is determinate and are easier to harvest. The trailing or vining types are indeterminate. Most of the varieties in the U.S. are of the determinate type. The Virginia varieties have thick-walled pods and the Spanish types are thin-walled pods and have fewer seeds in them.

Excellent varieties have been developed and should be tried under the environmental conditions in oases. Seed can be obtained from the following sources:

Dr. D. E. McCloud, Department of Agronomy, University of Florida, Gainesville, Md. 32611
Dr. R. O. Hammons, Department of Agronomy, University of Georgia, Coastal Plains Station, Tifton, Georgia 31794
Dr. D. A. Emery, Department of Crop Science, North Carolina State University, Raleigh, N.C. 27607

Peanut seed varieties can also be obtained from the Director of the International Center for Research in the Semi-Arid Tropics at Segundabad, India, Indonesia, and Senegal.

A variety trial should be conducted to determine the highest yielding varieties and after the best varieties have been identified, fertility trials should be made to determine the optimum level of fertility.

Wilt caused by Pseudomonas solanacearum can be a problem so it would be desirable to request wilt resistant varieties such as Schwarz. No. 21. If the plants are not over-irrigated, wilt may not be a problem under oases conditions.

Training will be needed for personnel not familiar with the crop since delayed harvesting will result in overripe peanuts that have begun to germinate.

Peanuts are also grown for forage, hay, pasture and silage for animals. The young shoots can be eaten as greens. They are rich in proteins and calcium. Fresh peanuts contain 25 to 32 percent protein and 40 to 50 percent fat in addition to cystine, thiamine, riboflavin and niacin. They are highly nutritious and could be an important supplement for the diet of the people living in oases.

Root Crops

There are several root crops that are being grown in Mauritania at the present time. It would be desirable to conduct some variety trials on sweet potatoes and onions to determine what varieties are adapted to the oases.

The plant breeders at the AVRDC in Taiwan and North Carolina State University have developed sweet potato varieties that produce high yields per hectare. It would be desirable to import some of their high yielding lines to see how they yield under oases conditions. The people prefer a sweetpotato with white internal flesh color of the Puerto Rica type so it would also be desirable to import high yielding varieties from Puerto Rico for variety trials. (The tips of sweet potato vines are eaten in Taiwan and

are high in vitamins.)

Figure 1

SAMPLE OF A PLOT LAYOUT FOR A VEGETABLE VARIETY TRIAL ON ONIONS

(Randomized Block Design)

Border Row 5 10 11 7 2 4 8 9 6 3 1 Border Row

Block 1 3 m

1 m Border between replications

1 3 5 9 10 6 11 2 8 7 4

Block 2

9 1 8 11 2 3 10 5 7 6 4

Block 3

1 4 3 7 6 5 8 11 10 2 9

Block 4

4 2 5 9 7 1 6 11 10 8 3

Block 5

30 cm 50 cm

9.9 meters Total area 188.1 m^2

Onions have a good market and are high in price. The yellow varieties should be tested since they are preferred by the people in Mauritania. It might be desirable to test the following listed varieties. The U.S. varieties should be compared with the French varieties that are being grown at the present time. Fertilizer trials will also be required on the higher yielding varieties.

Onion Varieties

1. Highest Yielding Variety Being Produced now in Mauritania (Check Plot)
2. Yellow Bermuda
3. Texas Yellow Grano
4. New Mexico Yellow Grano
5. Yellow Creole
6. Yellow Globe Danvers
7. Iowa 4, Yellow Globe
8. Southport Yellow Globe
9. Southport White Globe, D Strain
10. Brigham Yellow Globe
11. Downing Yellow Globe

The onions will be planted with two rows of the same variety on a raised bed. The beds will be 30 cm wide with the onion seed or transplants planted near the edge of the bed on each side. A 50 cm irrigation ditch will be used between each of the beds. The highest yielding variety being grown now should be used to plant the border rows. Yield data should be recorded on marketable yield and culls for all varieties separately except for the onions on the borde · rows. A statistical analysis will be made on the yield data.

Vegetable Crops

Vegetables are not produced or consumed in large quantities in the oases and as a result many of the people suffer from a lack of vitamins and minerals that are necessary for good heath. The foods that make up the staple diet in the oases are meat, millet and nieba beans. A few vegetables should be encouraged for production in the oasis such as squash, watermelons, okra, hot peppers and tomatoes.

Squash

Squash can be stored and transported easily. The plants require wide spacing and simple methods of trickle irrigation could be tried. It would be desirable to try the following varieties to determine which varieties yield the best under an oasis environment: Buttercup, Zucchini, Royal Acorn, Table Queen, Waltham Butternut and Gold Nugget.

Fertility trials will also be needed after a high yielding variety has been obtained. Manure and commercial fertilizer should be tried. The manure should be placed in the planting hole and covered with dirt before the seeds are planted on top of the dirt. Four or five seeds should be planted per hill and the hills can be spaced one meter apart in rows that are two meters apart.

Watermelons

Watermelons are planted in the oases at the present time and the flesh as well as the seeds are consumed. The most common variety has white flesh and a small green fruit. The seeds are ground up and cooked together with "cous-cous" (sorghum, millet or rice). The melon seed contain 20 to 25 percent protein. This variety may be highly resistant to diseases and insects because no plant protection methods are being used. It would be desirable to send seed of this variety to plant breeders in the U.S. to determine if it is resistant to any of the diseases or insects found in the U.S.

All of the introduced varieties should be compared with the local variety in a variety trial. It would be desirable to obtain seed of the following varieties for trial: Charleston Gray 133 which is resistant to authracnose and fusarium wilt, Congo, Desert King, Dixie Queen, Jubilee, Mountain Hoosier, Petite Sweet, Sugar Baby, Supersweet and Tendergold. If the U.S. varieties are susceptible to some diseases in the oases, it might be possible to cross them to the local variety to obtain higher yields with disease resistance.

Since watermelons are a cross-polinated crop, the insects will do the crossing if they are planted in variety trials. Controlled pollinations would be desirable but this would require the skill of a plant breeder.

Fertility trials will be needed after a high yielding variety has been obtained.

Hot Peppers

At the present time there are varieties of hot peppers that grow very well but it might be desirable to order a few varieties from other countries to compare their yielding ability. It would be desirable to request seed from Senegal, Liberia, India, Pakistan and Brazil. Some of the high yielding varieties that could be tried from the U.S. are Anaheim Chili Sandia, Cayenne Long Red Narrow, Chili Red Small, California Long Green Chili, Chili Serrano, Chili Fresno, Hungarian Yellow Wax, Red Cherry Hot and Caloro Yellow Wax.

Fertility trials will be needed after a high yielding variety has been located. It might be desirable to try the plants as a temporary living fence until a permanent living fence can be established. If the animals try to eat the leaves and fruit on the plant they may not come back to try them again due to the hot taste. The plants should be placed close together if they are tried for a fence and only the bush type plants should be used which are hotter than the determinate type plants.

Tomatoes

The most common tomatoes grown in Mauritania at the present time are the paste type tomatoes which are high in soluable solids and have a thick skin. It would be desirable to continue with this type of tomato if transportation to market is required since they do not break as easily as the table varieties used in the U.S. If the tomatoes are grown in an oasis and consumed there, a few of the other varieties should be tried which have a better flavor than the paste type tomatoes.

Dr. Ruben L. Villareal at the AVRDC has developed some excellent tomato lines that grow under tropical conditions. They are resistant to bacterial wilt and produce under fairly high night temperatures. It would be desirable to import some of his lines for testing.

Dr. J. Gilbert at the University of Hawaii has released some tomato hybrids that are resistant to eight different diseases including nematodes. Nematodes are a problem in the Guidimaka, Region, bordering the Assaba. It would be worthwhile to import tomato varieties and hybrids from Hawaii to see how they perform in the oasis. Varieties should be selected that adapt to high pH soils. Some U.S. varieties that should be tried are Ace VF Improved 55, Early Sun VF, Homestead No. 61 FR, Floradel, Indian River, Manapal, Manalucie FR, Walter, Tropic, Red Top, Roma VF, San Marzano Large Fruit, Red Cherry, Red Plum, Red Pear, Yellow Pear and Tiny Tim.

Fertility trials will be needed after the replicated variety trials have indicated which varieties yield the best under the oases environment.

Horticultural Crops

Several fruit trees have been tried in an oasis at Sani and the most promising appear to be lime, guava, pomelo and mangos.

Fruits are high in vitamins and essential minerals; therefore, it might be desirable to try a few fruit trees for self-consumption. The oases are not suited to commercial production due to limited water resources.

Lime

Seed for lime trees could be obtained from the Sani oasis to start a small nursery. Bud wood also could be obtained from the lime tree at Sani which appears to be a high yielder for budding resistant root stock. It would also be desirable to import small

budded plants of Key lime, Mexican lime and West Indian lime to see how they compare with the lime trees in production at Sani. It would also be desirable to import the Tahiti, Persian and Beares types which are tryploids and are resistant to the witherings disease. It would be desirable to bud on sour orange which is available at Sani or Cleopatra mandarin if budwood is imported to avoid gummosis in the future.

Guava

Guava seed could also be obtained at Sani for planting in other oases. The fruit can be eaten fresh but is also used to make jelly, puree, paste and jam. The guava has a high vitamin C content which may be five times as high as the orange. Guava can be grown on soil which has a pH up to 8.2. The pH of the soil is very high under conditions in the oases. Guava can stand flooding for a short period of time which is common during flash floods near oases.

It would be desirable to import seed of the following varieties from Florida for trial: Supreme, Red Indian, Rolfs and Ruby. The Supreme variety has white flesh but the other varieties have red flesh. The trees will bear fruit in the second or third year after transplanting.

Fertility trials will be required after high yielding varieties have been identified

Pomelo

Pomelos were observed growing at Sani and producing well. The trees are tolerant to high pH soils and the fruit are high in Vitamin C. It would be desirable to increase the production of this fruit for local consumption. The fruits can be transported by camels for short periods of time which will provide vitamin C and liquid for the goat herders.

Improved varieties can be obtained from India, Pakistan and Indonesia. It would be desirable to obtain budded plants since there is a great difference in plant material. If it is necessary to ship budwood, a nursery of young plants will have to be available before the budwood is shipped.

Fertili ty trials will also be needed to determine the optimum fertility levels for pomelo.

Henna - Lawsonia inermis

Henna is grown in many oases and used as a dye. It is commonly used on the hands and feet of people that participate in different types of celebrations including marriages. The designs made are very interesting. It is also commonly used as a hair dye.

It would be desirable to collect seed and plant material from several locations in Mauritania as well as other countries to determine what varieties yield the best. The highest yielding plants should be propagated and distributed to the farmers in other oases. Fertility trials should also be conducted in order to determine the optimum fertilizer level. The leaves sell for $14.00 a kilo at the present time so it may be possible to use commercial fertilizers economically. They should be tried along with manure and separately to determine the most economic returns.

Henna is a shrub, its height depending on its genetic constitution and the environment. It processes large clusters of small fragrant, white or rose-colored flowers. Henna oil, extracted from the flowers, has been used in perfumes for many centuries. Synthetic dyes have largely replaced henna for dyeing

fabrics; however, if the price of energy for synthetics continues to go up, henna may once again become economic as a fabric dye.

The primary producers of henna are India, Egypt and the Sudan.

Soil, Water and Tissue Analysis

In order to determine the spread effect of the project it is necessary to do a chemical and physical analysis of the soils and water in the oases. One oasis has been selected for adapted research trials in order to determine which practices should be demonstrated in three to five other oases. Soil and water samples will be taken in all of the oases in the target area to determine if the environmental conditions are similar among the oases selected for the adaptive research and the target area. The demonstrations will be conducted only in the areas that have similiar soil and water conditions.

Soil analysis will be conducted with all of the fertility trials in order to obtain a correlation among the nutrients in the soil and yield responses. This will provide information that can be extrapolated to predict fertilizer applications to other areas where trials have not been conducted based on soil and water analysis.

Tissue and soil analysis will be used on the perennial crops to provide a correlation among the nutrient levels in the plants and yield data. This information will be used as a guide to indicate nutrient deficiencies in similar plants at other locations.

Farming Systems

At the present time it is common to see several crops growing together in an oasis. Niebe beans are usually grown with millet and planted in the same hill. The farmers have probably learned that the millet produces better when it is planted with beans. It is common to see dry beans and corn planted together in Latin America. The beans can fix nitrogen from the air which can be used by the corn plant to increase yield.

Several different types of farming systems should be tested. It would be desirable to test the yield ability of legume crops with non-legume crops. Several crops need to be tried under the micro climate of date palms at different stages of development. It is important to remember that the nutrient level may have to be increased to reduce the competition for nutrients among the different species.

SOILS - UNDER SEMI-ARID / ARID CONDITIONS

Generally, two soil conditions can cause harmful effects under dry, arid systems for plant growth. These conditions are excessive concentrations of soluble salts, which give rise to saline soils, and conditions where exchangeable sodium known as alkali soils, may be observed.

A soil condition where both high soluble salts and an excess of exchangeable sodium is found is referred to as saline-alkaline soils. Saline soils are encountered when salt content of the soil exceeds 0.1 percent. Another measurement of a saline soil would be if the solution extracted from a saturated soil paste had an electrical conductivity value of 4 millimhos per centimeter (4 mm/cm) or 4000 micromhos per centimeter (4000 micromhos/cm). An exchangeable sodium percentage of 15 has been used as a boundary between non-alkali and alkali soils.

Saline soils are fairly common in arid or semi-arid climates. Salts from other locations usually are carried by water to cause a saline condition in a specific site. Calcium and magnesium are the principal cations found in soil solutions resulting in a saline soil.

Sodium may replace these two elements in the soil solution, hence an alkali soil can become the dominant cation replacing calcium and magnesium cations.

Excesses of salts or exchangeable sodium render soils unproductive for agriculture. Fortunately, some plants tolerate salt conditions better than others. The date palm has a rather high salt tolerance whereas orange, grapefruit, lemon and avocado have a low salt tolerance.

Soils samples give an indication if and what type plants can be expected to be produced productively under certain soil conditions. Vegetable crops such as garden beets, asparagus and spinach tolerate high salt conditions, whereas radish and green beans are very sensitive. Alfalfa as a forage crop is favored as a crop in an oasis since it is fairly tolerant of salt and produces a very nutritious feed for livestock.

The indication of bare spots in many areas can be attributed to a saline condition. In walking over many areas in the Sahel, a black alkali condition can readily be observed usually in Wadi bottom areas. Some native plant species once they have been identified can be noted which can tolerate saline conditions.

Irregularity of vegetation can mean, to a practiced eye, the indication of a salt condition which brings into play the art of being a close observer.

WATER QUALITY - SEMI-ARID / ARID CONDITIONS

The characteristics of water proposed for an irrigation system are important for :

1) Total concentration of soluble salts.

2) The relative proportion of sodium to other cations

3) Boron if present.

4) The bicarbonate concentration as related to calcium and magnesium.

The total concentration of soluble salts in water to be used for irrigation can be expressed in terms of electrical conductivity. For irrigation water to be useful for crops, a conductivity level value of less than 2,250 micromhos/cm or 22.5 millequivalents per liter (MEQ/L) is generally considered the upper limitation.

Irrigation water is satisfactory if conductivity values are below 750 micromhos/cm. Irrigation water in the range of 750 - 2,250 micromhos/cm is widely used in desert agriculture, but saline conditions will develop if leaching or drainage is inadequate Ground waters are generally more variable than surface waters. Variations in ground water will occur even when wells are in close proximity.

Irrigation water can also be classified according to concentration classes:

Class I	-	250 micromhos/cm.
Class II	-	251 - 750 micromhos/cm.
Class III	-	751 - 2,250 micromhos/cm.
Class IV	-	2,250 micromhos/cm.

Class I water would, therefore, be useful for irrigation without any deleterious effects on plants or soils.

The pH value of an aquous solution is the negative logarithm of the hydrogenien activity. A pH of 7.0 means a soil or water sample being tested is neutral whereas a pH of 7.5 would imply an alkaline solution: pH values below 7.0 would indicate an acid condition in the soil or water being utilized for plant production. Different plants require different pH values for best response. Tomatoes require a pH of 6.8 (slightly acid) for best results. Alfalfa will respond under slightly alkaline soil conditions of pH 7.0 or higher.

SOIL ANALYSES RESULTS

Soil samples were taken in the Assaba and Adrar Regions as a preliminary investigation of crop potentials in those two distinct areas. Due to the low water tables and aquifer recharge probelems in the Adrar Region, any intervention in that region at this time has been ruled out.

SOILS

Soil samples were taken in seven (7) different oases locations in the Assaba Region. The oasis of Sani, where it is proposed to set-up a series of adaptive treefruit and vegetable trials, showed a low sodium exchange capacity, a pH range of 7.3 - 8.3 and a cation exchange capacity (CEC) of 2.46 MEQ/100 grams.

Soils in the Sani area, therefore, appeared to be suitable for expansion of adaptive field trials as proposed.

As with other sites for additional water sampling, additional soil samples should be taken for a more complete history of the Assaba Region where it is proposed interventions will take place.

Sourmeli has been ruled out for any development of a new oasis site due to the high sodium exchange percentages and definite observations of a black-alkali soil condition in the Wadi area.

Soil samples in N'Taka El Wassa showed low sodium exchange values with soil pH ranges between 8.0 - 8.3, making this area acceptable for crop production expansion with some precautions.

The oases around Bougari, Le Gran and Samouga should all be sampled in more depth to attain a more detailed description of these areas.

WATER QUALITY

Samples of water for testing of quality in the Assaba Region indicated pH levels from 6.7 - 8.3. Sani water samples were slightly acid with a pH of 6.7 for all samples.

Water samples from Le Gran averaged 2.37 MEQ/L; N'Takat el Ouassa 6.3 MEQ/L; Bougara 1.52 MEQ/L; and Billouar 4.72 MEQ/L which would be acceptable for irrigation purposes. Additional water samples should be taken, as the project becomes operational, in more well sites for more information.

ANNEX C-4 ECONOMIC ANALYSIS

The major objective of the proposed project is to revitalize oases systems of Mauritanian agriculture through various intervention measures, at a relatively minimum risk and cost. The project would represent the first major effort in Mauritania to benefit oasis producers. The primary activities of the project will be in trials and demonstrations in up to six oases, for efficient use of limited water resources, improved varieties and techniques of date and food crops, improved cultivation of cereals, utilization of the microclimate under cover of palm trees for growing vegetables, and diversification of cultivations to include vegetables, fruits, improvements in animal husbandry, living fences to protect planting area from livestock, and woodlot cultivation for environmental protection and for fuel. Once this technological package is developed and proved to be technically and economically successful in the trial plots, it will be extended for demonstration in the oases communities.

While it is possible to estimate the project's cost, it is not possible at this time to put a value tag on benefits generated as a result a technological package which is yet to be tested and adapted. Not withstanding, a priori there are significant indirect benefits to the total economy in general and small holders in particular from this type of program. In fact, the entire development process demands that investments of this nature be made. Cost effectiveness is a more appropriate method than cost benefit analysis to economically justify this type of project. When technological packages have been developed and adapted, "ex post facto cost benefit ratios" can and will be determined.

The economic analysis is divided into two parts (1) examination of alternative designs for the project that might achieve the same objectives with lower costs, (2) a discussion of benefits and their implication.

Cost Effectiveness

Part II of this project paper presents the rationale for the proposed project; it is considered highly suitable for achieving project objectives. The specified inputs are also correctly justified as necessary to achieve the specified targets. The analysis implies that the stated investment is a cost-effective method of implementing initial activities and initiating trials and demonstrations. This part of the analysis will examine alternatives to the proposed project design.

A cost effective alternative is to conduct the trials activities of the project on some existing research location other than Sani where infrastructure and facilities, say in Kaedi, are more readily available. Under such alternative the cost of the project infrastructure might be reduced by the cost of buildings, although it is doubtful whether existing buildings at Kaedi could accommodate the oasis project needs and some construction/modification would almost certainly be necessary. Also, the climate in Kaedi (Senegal River) is not the same as in the oasis area and therfore is not suitable for palm and vegetable trials. The Kaedi station is a full day's trip from the Assaba by Landrover over very rough roads; it would be inefficient to headquarter project technicians so far from the oases which they will be assisting. Thus, locating the trials and the extension base at Sani is clearly moredcost effective.

A second alternative is to by-pass initial research station trials altogether and go directly with new unproven technology trials and demonstrations to participant farmers in the oases. This will increase risks and inefficiencies because of possible failure of certain trial techniques or variety trials. These apparent

failures will confuse and discourage farmers from adoption of other already proven innovations. Obviously the project must include trial activities not ultimately productive in terms of positive benefits. As a consequence the designed arrangements for initial trials away from the farmers' cultivations is essential and economically sound.

A third alternative to lower project costs is to reduce the number of trials. Under this approach however, we will not be able to test sufficient numbers of interventions to justify the project.

A fourth alternative is to apply the proven results in fewer oases, with reduction in costs. However, this will not give us sufficient verification that the results can replicated generally throughout the oases system.

A fifth alternative would be to reduce the training component of project. Since training represents an incidental cost item in the project's budget, a reduction would have a minimal impact on project costs. GIRM extension capacity is weak and must be upgraded if services and information are to be effectively delivered to farmers on timely basis. The training to be provided to farmers is essential to achieve effective demonstrations. Training provided through the project is thus essential, and the on-the-job mode is cost effective.

In summary, the analysis above and elsewhere in the paper supports the design and input costs of the project. It is not likely that costs can be reduced while still achieving the project objectives.

Project Benefits

1. The pilot project would, over 5 years, directly involve up to six oasis communities with an average population of between 600 and 700. The benefits accruing to participating farmers from extended demonstrations cannot be quantified in the short run and would be mainly in the form of improved techniques and plant varieties for date, vegetable and cereal production, and a more efficient technical assistance out-reach system. As a consequence of introducing and demonstion a tested new technologica package, output of dates, vegetables and cereals should increase. It is not possible at this time to measure the value of this output to the farmer without making prejudgement assumptions on yields, demand, additional inputs. and participation in each project year. Also the precise volume of land to be covered by demonstrations will not be known until the project gets underway. The project would have other intangible benefits which are hard to measure except in the long term. Certain activities will contribute to improvement of health and nutrition of farm families and halt/reverse their environmental degradation.

2. The technological package thrust will require considerable innovative thought and action to devise technical systems that will improve the agricultural crop production under oases conditions, an important part of the equation in the traditional food system. Some of the technology is already available, though it must be integrated into a workable package. The spectrum covered by trials and demonstration will focus on food and agricultural production and conservation of soil and water resources. A significant portion of the expected increase in agricultural production which results from the trials and demonstrations will be consumed locally by farmers and their families. Findings suggest that current vegetable and cereal production in the oases is largely for consumption of producers in their communities. However, a large proportion of date and henna output is marketed to areas away from the oases in exchange for necessity items such as sugar,

tea, cloth and salt. Increase in date and henna output will provide additional opportunity for participating farmers to earn cash or bartering income after satisfying their own needs. Lack of information on consumption of vegetables and the incomplete data on prices make it impossible to convincingly assess the extent of potential vegetable marketing. We believe most of the increase in vegetables and cereals will be used for local consumption and hence will contribute more to the nutritional well being of farmers. At present vegetables are not produced on large scale in the oases and are regarded by most farmers as an incidental activity. The project will encourage cultivation of the land under palm trees for growing food crops including vegetables, and the consumption of vegetables for improved health.

3. Numerous efforts have been made to measure the economic impact of research and technology. These measurements are difficult to make because in general, gains in productivity which are attributable to improved technology involve a variety of inputs of which the technology itself derived from research is only one. Yet without the technology the utility of other inputs is frequently minimal.

4. The successful application of systematic new techniques depends upon: (1) the efficiency with which key operations are carried out, (2) the correct timing of these operations and (3) the implementation of the system as a whole. The project will suggest better ways of using existing technology and second the use of improved technology through trials and demonstration to increase production and protect the environment.

Consideration will be given to ways in which research results are to be made available to farmers. Recommendations will be not only technically feasible but presented so that their uptake will be as attractive a proposition as possible. In short the recommendations must make economic sense to the farmers.

5. The approach will not be limited to the promotion of better techniques and improved cropping systems but will take account of grazing and livestock development and the general improvement of rural facilities. This design approach of the project focuses on the production side of the entire food system through demonstration and testing agronomic and environmental options. For the technological recommendations to be successful, it has to be economically sensible to farmers. Therefore consulting services of an agricultural economist are programmed in the project during implementation, to collect and analyze the economics, marketing, and economic nutritional aspects of the intervention activities.

Constraints

Obviously the project would lead to diversification of food and agricultural crops which in turn tend to spread farmer's risk. There are constraints on the size of land that a single farm unit will put under a given crop. The individual farm holding faces constraints in terms of labor available to be allocated to any given crop output. Vegetable production may compete with millet production for labor time. Would good millet harvest diminish farmer interests in vegetable production or henna for that matter? Of course the answers depend, inter alia on prices or other perceived benefits received for competing agricultural commodities. Would expansion in the level of production of certain crops during the dry season measured in terms of land cultivated increase the demand for labor and consequently slow down the exodus from the oases?

In addition to the limits on land extension and the small size of holding facing the individual farmer, physical and technical constraints set an upper limit on the total land that can be brought under cultivation in a given oasis. The technical constraints are well advertised and are revealed in low yields, low productive techniques and practically non existant out reach system (the project of course will address these problems). A major physical constraint on the total cultivated area that can be supported within a given area is the availability of water and the quality of soils. For any specific area, the scale of palm, vegetable, millet and henna farming and hence the number of farmers producing for themselves and for the market will depend upon water supply conditions. In some oases, water and/or soil conditions. In some oases, water and/or soil conditions are such that new farmer entrants into farming are limited to less than 50 families. In other words the physical resources in a given oasis could not support an unlimited number of families.

Agriculture in Mauritania has been dominated up to the present by stock raising with a herd of 1.4 million beef cattle, 5.2 million sheep and goat in 1973 (compared to 2.5 million beef cattle and 6.6 million sheep and goats in 1970 before the major effects of the drought were felt.) There has been some stability since 1973, but the 1977 drought may have further reduced the herds. The severe irregularity of the rainfall makes rainfed cultivation risky. Consequently, apart from river plain farming which depends on the extent of flooding, most other agriculture in Mauritania depends to a greater or lesser degree on water available for irrigation.

Production and Marketing

Production of millet and sorghum is about 50,000 tons in normal years covering only 60 percent of the requirements. Date output amounts to 13,000 tons in 1977-78 (Table A). Productivity per tree is low averaging 17 kg as compared with average of 40 to 60 kg per tree in North Africa and in the Middle East. Date palm pursuits as is the case for agriculture was largely a secondary activity of the landowning class. Palm trees require significant initial investment with several years of gestation period. For the property owner to gain was not only in production, but in establishing claim to the land. Most of the output was consumed in the country with some exports to Mali and Senegal.

The size of individual holdings in the oases is small and ranges from 0.5 to 1 hectare per family where palm dates, henna and vegetables are grown. Much of the date production is sold on trees during Guetna and the rest is either consumed on the farms or marketed directly to neighboring towns. Such vegetables as are grown are primarily for home consumption and are limited to those varieties which reflect local dietary preferences and tradition, e.g. neibe, onions, and peppers. Seeds are preserved by the farmers and planted during the rainy season. Henna is a second major cash crop and most of the production is marketed; the demand is high especially during holidays. The volume of millet as in the case of dates, vegetables and henna is very imperfectly known because of inherent difficulties in measuring subsistance crop production, limited availability of statistical services and scarcity of special studies.

There is a debate as to whether oases farmers sell only their "disposable surplus" or whether they are more fully integrated into the money economy, buying and selling millet, dates and vegetables in good years and bad. The issue remains unresolved because of the absence of microstudies at the oasis community level. The most reliable data for marketing are quantities handled by the national grain marketing agency. These have usually amounted to less than quarter of total estimated

domestic marketings.

Under the present prevailing condition of supply costs and relative prices and for some time to come, increases in production must aim at markets in Mauritania principally in Kiffa and Nouakchott; because of locational proximity other markets in Mali and Senegal should be explored. With the recent completion of a road from Kiffa to Nouakchott, that market is now more accessible. Other roads are being built. However, subsidiary tracks within the region are still primitive. There is good potential for growth in the internal market for dates, henna, and possibly vegetables given proper organized production, distribution, adequate storage and efficient marketing system. The widening of the market would be traced to such factors such as improved roads to major consuming towns, the gradual sedentarization of nomadic populations and rural migration to urban centers. Initial problems, however, facing farmers in some oases is the availability of transport. What transport is available to regional markets is increasingly expensive, and will become more so as the world price of POL continues to rise. Thus, geographic factors of distance to markets will become increasingly significant in comparative advantage of those farmers producing for urban markets. In many cases for local markets located not far from the oases, output is currently transported on the back of a donkey or a camel. In these instances constraints exist in terms of overall carrying capacity.

Since improvement in road transport will only be realized over the long term, for the immediate future the oasis farmer must adjust to the vagaries of present situation which is characterized by the saturation of local markets, uneven rate of flow of supplies to market and by sharp fluctuation in market prices for some products especially vegetables grown in some oases. One way of controlling factors which adversely affect marketing potential is to cultivate crops which are able to support longer and rougher shipments such as onions, beets, sweet potatoes and turnips.

TABLE A

AGRICULTURAL PRODUCTION, 1973-78
(in millions of tons)

	1973-74	1974-75	1975-76	1976-77	1977-78
Millet Sorghum	50,000	45,000	36,000	21,000	14,000
Maize	1,500	2,500	2,000	1,500	1,200
Niebe	2,060	3,000	2,500	2,000	1,000
Beref	700	1,000	800	700	400
Potatoes	700	800	750	650	500
Rice	3,000	3,843	3,960	5,000	6,000
Wheat & Barley	150	400	350	300	350
Dates	10,400	10,000	11,000	12,000	13,000
Other Fruits	2,600	-	-	-	-
Vegetables	1,400	1,600	1,800	2,000	2,000

Source: World Book

ANNEX C-5A: SOCIAL

A. Summary Observations

Oasis areas are traditionally a nexus of nomadic life. Their present decline is both symtomatic and causitive of an on-going rural exodus in that, while some areas have been deserted because people are going to the major cities, in many cases it was the case of the oasis' viability due to drought and war that forced their populations to flee. In other areas the remaining functioning oasis have become the focal point of new non-nomadic communities. These and new or regenerated older oasis could be an important final determinant as to the future practicality of Mauritania, non-river oriented, rural life.

In calculating the value vis-a-vis cost of oasis improvement,recognition must be made of the socio-cultural as well of economic importance of oasis to Mauritania life in general, which is much greater than the direct material benefit that will accrue to any specific target population. The project's final purpose should be the reconstitution of an entire way of life and not just assistance to particular community members. It will be prepared to assist many members of the community and an incremental planning capacity for such site-specific interventions as may arise in the future and which could threaten the communities' basic viability.

Oasis property has traditionally belonged to a select group, among other reasons, because adequate remuneration from tree crops (dates) only comes after several years of labor input. Therefore, the development of an oasis plot requires the possesstion of adequate financial resources to weather the initial lean years or the backing of someone with such capital.

Since the project is to help the truly poor element of the population, it will insure the provision of commodities on a selected-as-needed basis to participants in the technology introductions (for project-related inputs such as tools, wells, cement, etc.)

Oasis economy is characterized by both community and individual diversity. Community diversity is seen in the basic division of the population into a commerce-herding oriented group that controls investment capital (the Bidan) and an agriculture labor group that provides most of the manpower (the Haratin). This division has a geographic component in that large scale herding and commerce often takes place in areas and countries far removed from the local home territory where the family (women and children) is settled and agricultural labor is needed. This necessitates the symbiotic split and interdependance between the existing alternative life styles, all of which are necessary to sustain a viable community.

Individual economic diversity is characterized by the need for each individual party to engage in a series of activities that will limit economic risk through avoiding excessive specialization, insure subsistance by auto-production, and provide essentially needed cash for required monetary expenses.

Individual and community diversity means that the alternative available lifestyles are inextricably composed of a combination of activities of which agriculture is and can only be a part.

no individual should be expected to devote full time to project or agriculturally centered activities. The project will have to work within the constraints of the annual work calendar. An attempt to impose a foreign stereotype of the "ideal" basically subsistance-oriented agriculturalist would be foolish and self-defeating.

Despite the generalized picture of under- or un-employment, the individualistic nature of Moor life and economic activities limits the amount of time that can be devoted to any particular activity. Enterprise cannot simply be expanded through the addition of new laborers since the basic work unit is the individual or a small nuclear family (average 5 people). In addition, since the prime participants in migratory economic activities are men, it is females and female labor potential that predominates in many rural communities and whose physical capacity must be realistically assessed. In practice this means that the investment of one's money, obtained from other activities such as commerce, rather than one's labor is the only way to increase rural production. (Thus many communities find it easier to pay the gas for a government bulldozer to come repair their earthen dam than to muster the needed laborers. Poorer communities that can't muster the money often just can't do the job.)

All implementation actions that will demand prolonged and intensive labor inputs must be carefully measured against the peoples' actual capacity.

Project activities such as fencing and watering should demonstrate a spectrum of possibilities from the more labor intense to the more capital intense, thereby offering people an opportunity to chose what best suits their situation (i.e. more capital-costly wire fencing or more labor-demanding living fences). Sole reliance on labor intensive methods may be as prejudicial to the interests of some needy parties (i.e. weaker elderly or women) as sole reliance on costly technologies would be to the poor.

This necessity for the project to offer a diverse portfolio of possibilities should extend to the very choice of communities to be worked with. A spectrum of communities has been chosen rather than an "ideal" type based on our self-imposed criteria.

Despite the fact that many people are deserting the nomadic life, nomadic cultural values continue to dominate Moor perspectives. These will not rapidly disappear during the lifetime of the project and must be dealt with rather than ignored.

Among the most important for the purposes of this project are:

1. The idea that quick gain is preferable to uncertain long-term investment.

2. Leisure (or commercial activities) are acceptable pastimes for high status people while manual work, including agriculture and laboring, for others is demeaning.

3. Cooperation is at best temporary and opportunistic. Self-reliance is wiser than long-term dependence on others, especially tenuous entities like "community" and "government."

   (Note: "Being dependent" should not be confused with "taking advantage of" which is acceptable and culturally recommended.)

4. There are only limited (sometimes just marginal) availabilities of resources and

wealth (pasture, water, money, etc.) Therefore, another's gain is very often your loss, and everyone is acting out of their own self-interest.

5. Wealth and power are themselves demonstrative of one's worth and favor in the eyes of Allah (Baraka). Therefore, the rich and powerful not only have more than the poor and weak but ipso facto deserve more. Therefore, to the Moor the idea of a program that only helps the poor and down trodden is absurd.

In implementing the project, present cultural values will be accepted and constructively accommodated even while working to eventually modify them. This means among other things:

1. Recognizing that the project will have to prove its value before people can be asked to prove their commitment.

2. Using people's inclination to jealousy constructively by working on their neighbor's plots rather than on some government or communal plot that they will ignore as irrelevant.

3. Assisting any and all members of the community since to do otherwise will: (a) threaten to give rise to destructive divisions and charges of favoritism; and (b) if only selective assistance is provided, in the end the powerful may wrestle it from the weak.

4. Recognizing that people will generally only be motivated by the possibility of fairly rapid, concrete rewards. Activities that are designed to bring long-term benefits will have to be instigated through the offering of some more tangible payoff, i.e. we give wire fencing now in return for planting brushes that will provide living fencing in the future.

5. Recognizing that peoples' reliance on themselves rather than on government is to be encouraged. Project components should be disigned to allow people to be as free from government assistance as possible. In a tough environment people must be tough themselves, and encouraging dependence may destroy their ultimate capacity to survive.

B. Past Innovation and Development Experiences

In regard to any or all of the proposed possibilities, certain past experiences with development projects should be born in mind in any new project designs:

1. The experience with cooperatives - such as that in Atar - has not been good. Such ventures seem to be easily controlled and manipulated for the benefit of a few powerful interests. Projects should be designed to permit each producer to operate as an independant agent. This is true also as regards the purchase of goods (i.e. pumps, fencing, etc.), and the ultimate economic feasibility of any innovation will be calculated based on what it will cost the individual producer to procure or maintain it, through private commercial outlets, after foreign assistance has ended.

2. To the extent food and other necessities can be provided to project participants (through GIRM distributions of WFP and other donor food aid), experience, both with drought relief and other projects, shows that government distribution to rural areas

cannot be depended upon; and transport and other support assistance may have to come from this project to serve the project oases.

3. The more elaborate a project or demonstration area, the less meaningful it is to the average person, who attributes any success there is to a vast investment of time and money. The best demonstration area is a neighbor's plot which, if successful, will be copied, if only out of jealousy. (In the IRFA "Ladybug" Project, people who were initially skeptical of the insects' efficacy against scale insects, ended up stealing them from their neighbors' groves.)

4. A somewhat ironic but serious hinderance to the success of some projects seems to be the phenomenon of temporary excess production within a specific area due to a lack of avenues to a wider market. Such has occurred vis-a-vis millet production around Nema and vegetable production at Atar. The result can be the discontinuance of what would otherwise be an ultimately profitable venture. This project, therefore, will address the problem of how long it will take for infrastructures to develop capable of marketing increased production which is greater than autoconsumption needs.

C. Project-Specific Analysis

The following is a more specifically focused resume of the situation in the Assaba area and the proposed target communities.

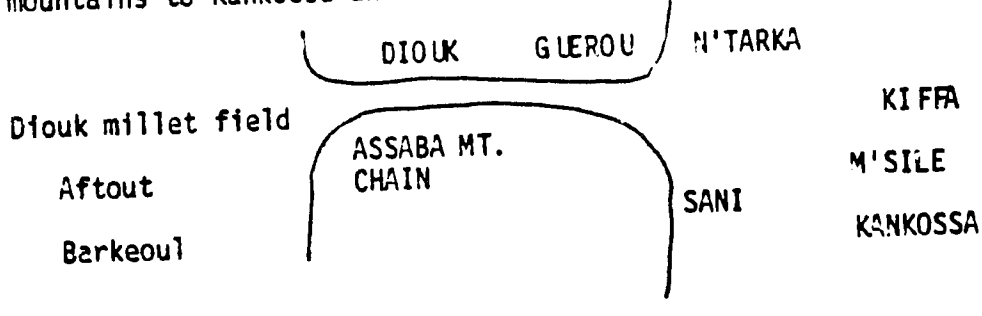
1. GENERAL TOPOGRAPHY

The occupied lands of the Assaba Region can be visualized as an "H", with the Assaba ("crown: in Hassaniya) mountain chain dividing the eastern and western halfs. It traditionally is divided into 5 out-regions:

(a) the north-east "Reguiba" - a vast sand plain;
(b) the south-east "M'Sile" - another sandy but more mobile dune area;
(c) the rocky "Idjam Affole" to the east;
(d) the western rocky "Aftout" plain of the "Gorgol Noir" and "Gorgol Blanc;" and
(e) the "Assaba" mountain chain itself.

The eastern and western divisions of the region are joined by a pass through the mountains near the village of Diouk. There is another pass, navigable only by foot or on animal back to the south.

At present the area of greatest concern to the project is the southern "U," the communities along the pass (Diouk, N'Taka, Guerou) and southward on each side of the mountains to Kankossa and Barkeoul, respectively.



2. GENERAL OBSERVATIONS

The southern "U" of the Assaba Region is relatively impressive from the standpoint of having:

(a) a viable mixed economy;
(b) a population that in numerous instances has already demonstrated its willingness to engage and invest in a broad spectrum of economic activities (millet, farming, dates, vegetables, herding, commerce);
(c) a favorable central location both in terms of east-west/north-south trade, population movements and accessibility to modern transport (paved road); and
(d) an apparently viable, dynamic, modest-sized urban area in which rural services and markets could concentrate.

3. GENERAL ECONOMICS

The area has a fairly well-established mixed economy of millet cultivation (Aftout and southern M'Sile), date palms (M'Sile and N'Taka-Diouk pass) and herding (especially the M'Sile). Many communities also receive infusions of money from the commercial activities of members in other areas and countries (Nouakchott, Nouadhibou, Senegal, Zaire, Cote d'Ivoire).

Significantly, many examples exist of both Moors and Peuhls who are personally engaged in mixed agriculture/herding activities. However, the interdependence of the economic activities, both present and potential, in the area presents a problem vis-a-vis attempted, limited, single-focused interventions, for the labor force that works the date groves also grows millet; and any populations that would settle the south-east area to cultivate would also surely herd and thereby tax the surrounding pasture and forest resources.

4. POPULATION PROFILES

Present day (1977 census) population figures for the entire Assaba Region are 128,778 of which 43,136 are nomadic and 85,642 sedentary. By department:

Guerou (Aftout):	47,865	-	14,528 nomadic 33,417 sedentary
Kiffa:	41,699	-	17,526 nomadic 24,143 sedentary
Kankossa:	26,599	-	6,441 nomadic 20,158 sedentary
Boumdeit:	12,565	-	4,641 nomadic 7,924 sedentary

(Present department of Guerou was formally split in two)

Guerou:	16,103	-	5,520 nomadic 10,663 sedentary
Aftout:	31,762	-	9,008 nomadic 22,754 sedentary

Estimated population density is:

Assaba Region	3.52 per km2
Guerou Department	5,78 per km2
Aftout Department	4.47 per km2
Kiffa Department	3.82 per km2
Kankossa Department	2.27 per km2
Boumdeit Department	2.79 per km2

No official figures are available on the area's ethnic composition. The vast majority are Moors (both Bidan and Haratin). There is a small but significant Peuhl (Foulabe) population in the southern area around Sani and Toucouleur presence in Kankossa and Kiffa.

5. ASSABA OASIS AREAS

In the past the Assaba was a border area between two often warring cultures - that of the arab-berber Moors and that of the black agriculturalists (Sarakölle, Toucouleur). While oasis date cultivation goes back centuries in Mauritania (Chinguetti, 8th century; Tichiit, 12th century; Tidjikja, 17th century), the first oasis in the Assaba Region was settled in 1925 after the clear establishment of French authority.

6. LAND TENURE AND TRIBAL POLITICS

Problems of land tenure and tribal politics are a thorny issue and potential stumbling block to development activities. Understanding the complexity of the issue is not helped by many western misconceptions as to what a "tribe" actually is. In brief, one can say that three major Moor tribes (Qabila) inhabit the areas of possible project intervention. They are the Sidi Mahmoud, the Chrattit and the Tadjakant. Also significantly present in project sites are the Messoum and Idovaich. Discussions were held with Mohamed Rathe, Chef General of the Ahel Sidi Mohamed, and Mokhtar Ould Boucef, Chef General of the Chiratti. Basically, tribal unity is an opportunistic response to outside threats - economic or political. Since the project intends to work with the populations already inhabiting specific areas and does not intend to make any efforts to either take over occupied land or move in new populations, there is no foreseen problem. Should the project prove successful, it can be predicted that increased spontaneous migration to the improved areas will occur in the form of other members of the tribe or their friends to establish areas and "strangers" to presently uncultivated locations.

The proposed project sites have been carefully analyzed as to their specific land tenure problems and were chosen partially because their situation seemed more open and flexible than many other technically feasible but less socially promising oases.

7. SOCIO-ECONOMICS

The basic socio-economic situation of direct relevance to project design and site selection can be summed up as follows:

(a) Virtually nobody (no family) exists on a subsistence level or is able to meet all their basic needs through the pursuit of a single economic activity. The average family is 5 persons. Estimated per capita annual needs are as follows:

Quantity/Per Capita/One Year:

Unit	Millet/Sorghum kg	Rice kg	Milk liter	Meat kg	Tea kg	Sugar kg	Cloth meter
Rural-sedentary	140	6	120	17.5	1	12.5	17
Nomad	75	7	234	24	1.5	16.5	14
City	95	55	100	41	3	37	31

When one adds to this other costs such as fuel, rent (urban), social expenses, transport, medicine, etc.,one can estimate that in monetary terms the average family needs are in the range of:

Rural-sedentary	-	5,000 UM/$110 per month
Nomad	-	6,000 UM/$124 per month
Urban	-	8,000 UM/$172 per month

For the urban dweller almost all of these needs are met with cash per se. For the rural-sedentary and nomad, probably between 50 and 75% are met through auto-production but leaving an actual cash need.

(b) The generally associated economic activities are: 1) millet farming and paid traditional labor; 2) mixed herding and farming (both millet and oasis); 3) herding-commerce (palm trees). The first, category "1",comprises the poorest elements, mainly Haratin (freed slaves). The second, category "2" is comprised of haratin, poorer Bidan and a few Peul (Fulbe). The third, category "3," is the best off (though not necessarily rich) and is mostly Bidan.

ANNUAL WORK CALENDAR FOR HERDER

MAR	APR	MAY	JUNE	JULY	AUGT	SEPT	OCT	NOV	DEC	JAN	FEB
.	.	.	.	.	.	.	.	.	.	.	.
Descent of herds to southern areas in search of pasture Kankossa-Selibaby-Mali-Senegal				Return of herds after 1st rains. Guetna (date harvest)			Recession agriculture (Kala) Herds feed in fields after harvest				

ANNUAL WORK CALENDAR FOR HARATINE CULTIVATION

MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
Take care palm groves: watering, fertilization, fencing. Sell charcoal, straw, manual labor to others.			Guetna (date harvest) rain fall agriculture (Dieri)				Recession Agriculture (Kala)	Vegetable gardening or manual labor for pay			

(c) Among the paid laboring groups both males and females work. Among the predominantly herding and commerce-oriented groups, the men travel frequently and are often absent for prolonged periods of time. This is also true among laboring groups as the numbers of workers seeking jobs in urban areas increases. The result is that in the villages and campments many women supervise their own and other family members' date groves, and some know more about oasis agriculture than many men.

(d) Oasis agriculture (meaning mainly date palm and henne) requires a certain amount of capital (to buy the land, pay helpers, or support oneself through non-productive years) and is not at present a viable alternative for the very poorest millet-growing paid laboring class who actually work the areas for others. It is viable for category "2" mixed farmer herders, but within the group it would be subserviant to herding needs. Category "3" commercants are the most able to support and initiate oasis agriculture but are dependent on available paid helpers to do the work.

(e) A livestock component to the project will be addressed. People cannot live without their animals. Note: People estimate a herd of 15-20 goats per family would suffice for milk, meat and sale if always kept nearby.

(f) There is a general loosening of the social structure in the sense that Haratin groups as they become more economically independant are becoming more assertive of their rights. Conversely, richer commerce-oriented elements are becoming increasingly aware of their dependence on the paid labor groups and the need to forestall these groups deserting them for the city, other countries or totally independent activities.

(g) When asked what help they needed most, people were universal in asking for fencing. They claimed damage to crops by animals was the primary detriment to gardening and that the situation has become more serious now that the government has forbidden them to cut trees. Therefore, assistance in fencing is a major component in the project.

(h) Regardless of its "ideological" attractiveness, the fact is that, excepting a few major government enterprises and actions (SNIM, roads, etc.), on the local level it is the commercants who are developing the country (in their own interest to be sure), and that this cultural force can either be harnessed as one of the country's great resources or ignored at the peril of its undercutting all efforts at sensible, balanced, equitable development.

8. BENEFICIARIES

If we look at AID development objectives, we see our primary target group, in terms of the desirable beneficiaries, as the "poorest of the poor." At the same time a project as designed is worthless unless capable of being successfully implemented. Unless the project is truly capable of being extended, its benefits, even if successful, are destined to be so limited as to be meaningless in terms of a Country Development Strategy which must make major changes beyond helping a small pilot group.

If we now match the social situation to our development objectives, we find the following: the most desirable beneficiary group, category "1" millet farmer - paid laborer cannot support the activities in question. The group most easy to work with, category "2" herder/agriculturalists,can physically implement as oasis project but will be limited in their ability to extend it independent of continued aid. If the idea is good, it is group "3", the commerce-oriented population, that is most likely to spread the model.

Two basic types of communities have been sought as participants in this project. The first, to help insure a viable technical model, will be a progress population of type "2" herder-oasis famers. The second, and certainly the more difficult but also the more challenging and far more valuable in terms of the country's actual development, would be a new mixed association between the laboring group and the capital-possessing group. It will have to be created out of the structure of some existing communities where the more powerful interests are already aware that their dependence on paid labor requires their offering new enticements to this element of the population. It would have to be counter-balanced by insuring that the laboring population was provided with sufficient independent economic rights to be able to break the association should it prove more exploitative than mutually profitable.

9. ACTUALLY SELECTED SITES

Sani: This is the most "open"option. Sani is composed of newly settled type "2" herder agriculturalists (Bidan, Haratin and Peuhl) (Fulbe). The Sani Agricultural Station and its agent Aziz Barrada provide a leadership resource of immense value.

N'Taka El Wasa: This is a most unusual community of combined Bidan, Haratin oasis farmer-herders. Presuming the project as designed interests the people, they are probably the most likely to succeed.

Lagran-Somoga: These are not particularily wealthy, Bidan-dominated communities where it should be possible to attempt to work out a new relation among the owners and workers. Of possible greater significance is the fact that these communities exist at the base of several footpaths to the Assaba escarpment. On the top of the escarpment are related communities where people produce extensive quantities of millet and sorghum among their date trees.

Bugara - Billaouare: These communities are very clearly dominated by powerful Bidan families. However, the families are very sophisticated and capable of clearly discerning their present and future interests. The area is along the route of the now-being-constructed Kiffa-Nema Road. This threatens them with a loss of their dependent labor population and the spector of an influx of strangers. They seem potentially open to readjusting their situation if only to adapt to changing circumstances they cannot control.

Moreover, this area would seem of great importance in that its potential for directed development may greatly diminish once the road is built and the in-migration becomes difficult to control. On the other hand, should the project prove attractive, one is assured of a constantly growing population along the road to participate in its expansion.

ANNEX C-5 B - SOCIAL ANALYSIS : BACKGROUND TO HASSANIYA MOORISH CULTURE

I. The following is a generalized description of Hassaniya culture and in no way reflects all the subtleties of Moorish society, nor its numerous regional variations.
This description does not differentiate between the situation vis-à-vis women and men. This is because the position of women in Moorish society is quite free, and largely determined by their class status. Apoor hartani (freedslave) woman will work in the fields as will her husband, either for herself or others.
A rich noble woman can own her own animals, be a property owner in her own right, and basically live a life of leisure while others work for her. Therefore, the situations and consequences which will be described as accruing to any particular class, fraction, or family should be understood as largely, or potentially, applicable to both men and women.

Because the history of the country is largely tied up with the southern expansion of caucasion Berber and Arab people into Black Africa, there is a strong correlation between skin color and social status, especially in that most former slaves are black. However, there has been much intermixing; there are many dark noble Moors and lighter skinned servants; and, therefore, skin color, while often an indication of group membership, is not a determinant of social position. Likewise, many Blacks are members of members of other ethnic groups (i.e., Toucouleur, Sarakolle, etc). who are not members of traditional Moorish society and who possess their own hierarchy ranging from noble to slave.

Slavery is no longer a legally enforced institution in Mauritania. However, some people remain as family slaves in that they have little other possibility of finding an alternative livelihood. Conversely, even if a former slave is no longer attached to a family, the social status of being a slave remains and greatly influences their position in the society and their opportunities for advancement.

The social analysis contained in this report centers on Moor life, and largely ignores the cultures of the Toucouleur, Sarakolle, Wolof, and Bambara populations that are found along the river and in the eastern region.

This is because date palm cultivation and the oasis complex is a phenomenon presently found in areas of Moor predominance. It is these areas, which cover the region traditionally know as Trab-el-Hajra (land of stone) located in the central portion of the country, stretching from around Atar in the north to Mbout in the south, and Aleg in the west to Aioun-el-Atrouss in the east- that formed the focus of this description.

HASSANIYA CULTURE

Traditional Moor society is often described as conservative and inwardly looking. While true as far as the peoples' attachment to their cultural institutions, this perspective tends to obscure the crucial role outside commercial relations have played in determining the immediate political,social, and demographic situation, and the means of exploitation of the country's somewhat meager natural resources. The vectors of commerce have varied in intensity and direction depending on immediate circumstances. They include the traditional trans-Saharan traffic between the Maghrib and Black Africa, now greatly diminished; the coastal trade with Europeans (Dutch, Portuguese, English and French, at Arguin and Portendick) in the 17th-18th centuries; the dominance of trade with the French along the Senegal River and at St. Louis during the 19th and 20th centuries; and the present resurgence of a coastal orientation towards the cities of Nouadhibou and Nouakchott, based on the exploitation of iron deposits in the north, and the new realities of being a nation with a capital city and growing foreign community in the south.

TRADITIONAL SOCIAL STRUCTURE

Moor social structure was, and is, largely a reflection of a continual attempt by various groups to acquire and guard access to both limited economic resources, such as water, pasture, and productive land, and the trade routes and contacts that are a source of enrichment both as outlets for local production and as services to be offered to others. As shall be seen, however, in this land of apparent hardship, power and wealth was to be achieved not through the intensive development of scant resources, but rather through the extensive exploitation and expropriation of the productive labor of others. This theme that extensity of economic rights is more important than the intensity of ones own labor is still an important factor in present thinking and was clearly relected in traditional social structure. That structure can be understood best from the two perspectives of "social status" and "organizational units."

Moor "social status categories" can be stereotypically understood as a reflection of occupationally defined roles. (see table). At the top of the hierarchy are the two categories of "warrior" (Hassani) and marabout (Zawiya). Traditionally specific hassani groups protected economic and political interest of specific zawiya groups in return for being financially provided for. The zawiya, while often categorized as religious leaders, were equally important as the "commercial managers" of specific resource networks. They organized and commercialized local production, (i.e. cattle, sheep, gum arabic, dates, etc.) as middlemen, received "tribute" from subservient groups, and in the 20th century, became small retailers in neighboring countries. Subservient groups included the zenagha (non-noble Berber groups), haratine (freed slaves and their descendants) and abid (actual slaves). It is members of these last two groups that have traditionally performed most manual, especially agricultural, labor. The actual living and production units were conglomerates of people of different statuses. (see table 2). Traditionally, in nomadic society, a Bidan (white Maure) belongs to one of a large number of tribes or clans (Qabila)whose members theoretically descend from

a common ancestor. These, however, generally are large and ancient to the point of having little meaning in terms of the management of everyday life. As a result they break down into smaller factions called (Fakhdh) or "fractions In theory, members of the same Fakhdh also descend from a common descendent of the original founder of the Qabila. In reality, however, membership in both a Quabila and Fakhdh can change and are as much an alliance of people of similar social status as they are actual kin groups. Moreover it is usually the Fakhdh that is the functioning alliance and in fact members of different Fakhdh of the same Qabila may be actually allied against each other. The Fakhdh themwelves are composed of patrilineal extended families (father and sons) called Ahel and which are the most fundamentally important kin units, especially since divorce is quite frequent in many areas and the nuclear family of husband, wife and children is therefore unstable.

TABLE I

SIMPLIFIED OUTLINE OF MOOR SOCIAL STRUCTURE[1]

ZWAIYA (religious leaders) — HASSAN (warriors)

ZWAIYA 2° (dependent on more powerful Hassans) — HASSAN 2°

ZENAGA (Tributary Moor Groups, usually herders)

MU'ALLAMIN (Artisans) 3

HARATIN (Descendent Freed Slaves) (cultivators, herders) — IGHYWN[3] (entertainers, "griots")

'ABID (slaves)

Comments:

1/None of this structure is legally enforced in Mauritania, but it still has major social significance.

2/The relative position of Zenaga and Haratin varies by region.

3/These groups have an ambiguous position as attached to but not part of Moor groups, and as both despised for earning their living working for others, admired for their skills, and feared for supposed magic.

TABLE II

TRADITIONAL MOOR SOCIAL ORGANIZATION

EMIRATE
(Confederation)

TRIBE
(Qabila)

Known as Wuld (son of), Ahel (peopleof) or other term

FRACTION
(Fakhdh)

(known as Wuld... or Ahel...)

URBAN CENTER
Ksar

ATTACHED AGRICULTURAL VILLAGES
(Abdaye)

ENCAMPMENT
(Frig)
(Living, travelling unit)

EXTENDED FAMILY
('Ail)
(to grandparents, not necessarily living togeth

Large
(Massa)

Medium
(Nazla)
(10-20 tents)

Small
(Khyam)
(1-10 tents)

Neighborhoods
(Halgay)

Tent
(Khaime)

House
(Dar)

R & D Office, USAID/NOUAKCHOTT

In the rural areas the basic living unit is the Khayma or tent, which generally is anonymous with the nuclear family. The Frig is the encampment of which three different categories are generally recognized: (a) small frig from 1 - 15 tents, generally referred to as a khyam ; (b) frig of 10 - 20 tents called Nazla : and very large encampments, called Massa. The Massa, where the chief of the Qabila has his tent, is referred to as Helle or El Kariya (the tribal center). Such a settlement may be divided into sections or "neighborhoods" referred to as Halagaiz, Halgay or Halagal (circles).

Between individuals, especially within the same fraction, rights were recognized and protected b y another crucial cultural institution, that of Islamic jurisprudence know as figh. The figh should not be confused with the somewhat vague oral traditions of rights found in many sub-Sahara societies. It is a highly complex and sophisticated written jurisprudence that has provided a mechanism whereby very specific and often complex contractual arrangements can be entered into by different parties, each of whose legal rights are clearly defined. While often made in private, such contracts might also be witnessed, and, in case of later conflict, judget by either the Cadi (local Muslim Judge) or the Djem'a (the council of elders from the fraction's most important families).

LAND RIGHTS AND OASIS OWNERSHIP

Traditionally, rights in land were valuable in that they provided access to pature. water sources, and cultivatable land. Large expanses of land were claimed by groups by dint of their presence and political power. Individual rights to land were intially obtained by putting it to use in a way that demanded an investment of labor or of money (i.e., digging a well, cultivating a crop, or buildings a house.) Such action gave the individual not only a right to the immediate area used but also to a certain amount of adjoining property know as the harim.

Once such a private claim on property was established, it continued. even if the land later fell into disuse. Either the property itself or a specific right in it (i.e. usufruit - the right to use of the land but not the land itself - called habous) could thereafter be sold, given away, or passed on as an inheritance.

Technically, there was apparently no legal constraint as to whom such rights could be passed on to. In reality, however, land was rarely sold to members of other fractions without the prodominate fractions consent, and few people would attempt to settle in the territory of others without their permission. However, regardless of who legally owned property, it was rarely the owner who worked it. Rather it would be cared for by either a slave of the houschold or a hartani (a member of the freedslave class - haratin). A slave worked for his master in return for being provided for. A freeman usually worked under one of numerous types of arrangements (called cherika) which called for the owner to provide the well, the seeds (or, in the case of date trees, the shoots), and food to support the worker till the harvest. The harvest itself would be divided ; the precise percentage going to each party was determined by the original agreement.

What is important to realize to realize therefore is that agriculture was largely a secondary activity of the propertied class. This was especially true of date palms which require a significant intial investment of time and money without yielding a return for several years. For the property owner the gain was not only

a small amount of exports to Mali and Senegal. Most date consumption occurs during the time of year know as the Guetna, when people gather at the oases to eat the ripe dates. While some dates are sold (a family may by the produce of a tree), many are eaten free by people socially attached to the owner. What remains after the guetna, is sold. However, it seems that except for owners of large parcels, the actual profit to be obtained is often small. (The actual price of "a tree for the guetna" varies considerably with the general supply available and the quality of the dates. Last year in Tidjikja good grees sold for 3000 UM each, but owners claim 30-50% of dates are consumed by non-paying people.).

In fact, many of the apparent "technical" problems of traditional date production seem traceable to the actual economics of date cultivation, on which little really accurate data seems to exist. (For example, if price falls as supply mounts, at what point does the incentive to increase production per tree stop?).

Other problems seem traceable to absentee ownership, and the specific, and sometimes conflicting, interests of the owner and this worker.
Thus the concern of the owner may be as much in establishing his control over the land (at as limited a cost as possible) as in increasing production.
Likewise, while an absentee owner of a palm grove may theoretically favor the cultivation of crops under his trees-since this helps insure their being adequately watered -if part of the worke's pay is food, in the absence of an established market, there is little benefit to be gained by such labors. (Not to mention the difficulty of protecting such cultivation from destruction by goats, cows, etc. usually owned by people against whom the worker cannot complain.).

THE PRESENT SITUATION

In the last half century the above characterized system has undergone substantially transformations caused largely by the following series of events.

1. The pacification and colonialization of the country which destroyed the system of tribute for protection that characterized inter-group relations.

2. The introduction of new commercial relations - such as the expanded opportunities for local "business-men" (commercants), both in Mauritania and surrounding countries - and, most importantly, the introduction in the north of a mining complex, based on the region's rich iron resources, which has served as the basis for the creation of a new class of salaried workers independent of traditional ties.

3. Political independence that has created a new political structure, a new capital city, ended slavery as a legal institution, and more closely tied the future of Moor society with that of the river and eastern non-Moor populations.

4. The prolonged drought that has severely affected the country and decimated herds and palm groves.
All the above have combined to produce the following situation:
there has been a mass exodus from the rural areas and a general sedentarization of the population around the major urban centers - especially.

Accompanying this has been a breakdown in many of the old established economic relations, the creation of a large landless class with no established means of livelihood, and a growing emphasis on the seeking and use of temporary wage labor not only in the cities but also for such traditional tasks as cultivation and herding. One result has been a reinforcing of a basic commercial, capitalistic, private property orientation. People who can are now investing within the urban milieux, though not necessarily relinquishing their claims to property in rural areas. In line with this, it should be mentioned that "fraction" interests are now apparently an important element in modern national and regional politics. Regional interests seem to often take precedence over national interests,

Conversely, the central government is far from all-powerful, and must take cognizance of regional and fractional interests.

In light of all the above, the government seems to be maintaining a somewhat ambiguous position where questions of private property rights conflict with possibilities for national development; an ambiguity reflected in the 1960 Loi Domaniale (60-132), which seems to recognize traditional rights to land as private property (article 3) at the same time as saying that private property rights will be compromised, if necessary, in cases where the owner is unwilling or unable to put the land to use, but that owners have preferences in terms of participating in proposed projects, and that land is never confiscated solely to achieve a more equitable distribution of wealth.

In cases of disputes over land, the Cadi and Djem'a are still important means of adjudication but ultimate authority lies with governmental officials (i.e.; the prefets and governors.)

ANNEX D

INITIAL ENVIRONMENTAL EXAMINATION (IEE)

Project Location: The Assaba Region of South Central Mauritania

Project Title: Oasis Development Project

Funding (Fiscal Year and Amount): 1980 $1.142 million

Life of Project: $5.991 million

IEE Prepared by: J. Rowland Illick Date: November 10, 1979

Environmental Action Recommended: Negative Determination

Concurrence: Mission Director Date: December 19, 1979

Assistant Administrator's Decision: Date:

I. Examination of Nature, Scope and Magnitude of Environmental Impacts

A. Description of Project

Owing to the continuation of the Sahelian drought which began in 1968 and the deterioration of the environment in much of Mauritania the viability of many oases has been threatened. This is particularly true in the drier northern part of the country in the region of the Adrar. Here lowered water tables and increasing salinity have become increasingly serious.

Water resources are much better in the oases around the margin of the Assaba plateau located in the south-central tier of Mauritania and it is for this region that a five-year project of oasis improvement has been designed. Its objectives include the introduction of measures to improve the productivity of oases, enhance living standards, and slow the current out-migration of people to urban centers -- at low risk and cost to the inhabitants.

Initial activities will be undertaken at the four oases of Sani, N'Takat el Ouassa, El Grahan, and Samoga in the Assaba region. These locations have the typical oasis production mix of date palm and grain cultivation, livestoc herding, and some specialty crops, and also appear to be receptive to self-help and innovations. They will be assisted in selected demonstrations involving more efficient water use, improved varieties and techniques of date grain, fruit, and vegetable production. Animal husbandry improvement will be included. "Living" fences and windbreaks to protect cultivations, livestock, and soil, as well as woodlot cultivations for environmental protection, fuel, and emergency browse are additional facets of the project. Commodities, technical assistance, and appropriate training are other important elements o the effort. Particular emphasis will be devoted to the developmental role of women in the oasis economy, with special recognition of health, nutrition, and the administration of agricultural productions.

USAID will finance technical assistance teams to conduct the initial activitie and supervise the technological introductions at the participating oases in conjunction with the GIRM rural service cadre.

The project is designed to be simple in techniques and activities and modest in intervention costs in order to enhance prospects for success and replication. The overall test of project success will be demonstrable improvements in the living condition of oasis people as measured in productio health, and environment. The project also will have collected data on the development potential of a substantial number of other Mauritanian oases for involvement in a subsequent more extensive program.

B. Identification and Evaluation of Environmental Impacts

The Oasis Development project will select four oases and utilize no more than 2, 4, or 6 hectares per oasis. Owing to the minimum amount of generally level land involved, the crops grown will not cause much erosion. Tree crops (dates and fruit) will help shield the vegetables, henna, grain, and forage crops from wind blown sand and dust and from severe precipitation.

By keeping the animal corrals and drinking wells at the terminal margins of the oases gardens, pollution of the domestic water supplies will be minimal. The hard hooves of livestock can pulverize the surface soil, particularly when the animals cluster around wells or corrals. This is an additional reason for keeping the livestock outside the oasis proper. Where dunes border the wadis occupied by oases soil slumpage can be extensive if livestock are permitted to graze or travel over them. Protecting dune slopes from livestock by live fences could prove effective. It would permit also the regeneration of grass, shrubs, and trees on the protected dunes.

Water supplies may be overutilized or become saline in certain periods, particularly in drought years. Occasional flash floods in wadis may result in shifting sand deposits, the undercutting of palms or gardens, and possibly periodic shallow flooding in the wadis. Plantings of gonakier forests in the wadis would aid considerably in stabilizing soil and water. The sandy soils bordering each oasis will prove invaluable in absorbing precipitation and in reducing runoff.

Intensive cropping of the land with date palms, henna, fruit, vegetables, grains, and forage crops, in conjunction with the thinning or removal of some wild doum palms and some grasses, will alter slightly the existing plant and animal habitats but create new ones. The smallness of the proposed plots and the random siting of the gardens will minimize the effect of the environmental alteration.

Wherever groups of palms and plants are grown in close proximity there is always the possibility of plant diseases occuring. Biological controls, such as the use of lady bugs to combat palm afflictions, offer viable solutions.

Discussion of Attached Impact Identification and Evaluation Form Ratings

The following comments explain the evaluation charted in the accompanying form. All notations under the heading N exert no negative impacts and will require no explanations. All other columns (L - little, M - moderate, H - high, and U - unknown), where checked, will be commented on below:

Land Use Owing to the prospect of crop improvement, more efficient water use and the introduction of environmental protection systems, it is believed that the plant and animal habitats and the general land-use will be changed for the better. This situation should result in stabilization of or a moderate increase in the population of each oasis.

Water-Related Impacts The planting of trees in the wadi channels and on wadi margins should assist in controlling occasional flood waters with their accompanying sediment loads. The water table may be lowered slightly by increased use for new crops, nurseries, living fences, and wind-breaks, but with the

establishment of additional trees in the wadi channel, the micro-climate should be altered to slow evapotranspiration and thereby aid in maintaining groundwater.

Natural Resources The project should improve the overall balance between the natural resource base and human occupance through more efficient land-use and watering techniques.

Cultural It is anticipated that the improvements described earlier will so materially improve and diversify the crop and livestock quality that the human occupants will alter their traditional methods and thus revise their cultural values.

Socioeconomic Every aspect of the socioeconomic spectrum may be altered. The oases improvements should improve land values and may cause some changes in land ownership as new owners may appear as tenure patterns change. Yield betterment will probably increase demands for education and health services, and perhaps stimulate greater frequency of transport service to the market place. It is hoped that the several culture groups living in the oases will develop greater cooperation and interdependence than in the past.

Health An important improvement in diet is anticipated through the vegetable trials. A covered, and therefore cleaner well system, (Tysen type) should improve the general health of the people, as will the simple water filtration system proposed (see Part III A 2). Periodic testing of the drinking in the project sites will be conducted by the GIRM National Hygine Center.

Pesticides Before any pesticides are procured for or used in the project, a risk/benefit analysis will be done. Pesticides will also be purchased in accordance with A.I.D. pesticide procurement regulations current at the time.

General If date yields improve sufficiently and if date management techniques are widely emulated, it is possible that greater exports of dates to neighboring countries will occur. Henna and gum arabic may also find increasing foreign buyers. A major objective of the oasis project is to win widespread approval and, therefore, adoption of new methodologies by other oases. This is the larger program impact.

II. Recommendation for Environmental Action: Negative Determination

The total impact of the proposed changes in the oases appear to result in almost no adverse environmental consequences. Rather, the project activities should have a positive effect.

INITIAL ENVIRONMENTAL EXAMINATION

Impact Areas and Sub-areas - See Explanatory Notes for this form.

Impact Identification and Evaluation - Use the following symbols:

N - No environmental impact
L - Little environmental impact
M - Moderate environmental impact
H - High environmental impact
U - Unknown environmental impact

	N	L	M	H	U
A. LAND USE					
1. Does the project change the character of the land through:					
a. Erosion	X				
b. Excavation and/or grading	X				
c. Change in animal or plant habitats				X	
d. Modification of land use				X	
e. Increasing concentration/population		X			
2. Potential natural disasters	X				
3. Unplanned roadside activity (e.g. overgrazing)	X				
4. Other factors					
B. WATER RELATED IMPACTS					
1. Does the project change the quality of water resources through:					
a. Drainage pattern	X				
b. Modification of flood patterns		X			
c. Water table change		X			
d. Salinity modification		X			
e. Pollution of adjacent waters	X				
f. Induce sedimentation of adjacent waters	X				
g. Ecological balance			X		
h. Other factors					
C. ATMOSPHERIC					
1. Does the project induce atmospheric changes through:					
a. Pollution (during construction e.g. dust)	X				
b. Pollution (vehicle generated e.g. dust, exhaust)	X				
c. Air pollution (cargo generated e.g. chemical asbestos, phosphates, etc.)	X				
d. Noise pollution	X				
e. Other factors					
D. NATURAL RESOURCES					
1. Does the project change the natural resource balance through:					
a. Planned and unplanned exploitation			X		
b. Utilization of limited resources for construction	X				
c. Other factors					

	N	L	M	H	U
E. CULTURAL					
1. Does the project affect the culture through:					
a. Changes in traditional cultural values		X			
b. Alter physical symbols	X				
c. Alter traditional modes of transportation	X				
d. Alter traditional living patterns through increased mobility changes in family structure	X				
e. Other factors					
F. SOCIOECONOMIC					
1. Does the project affect socioeconomic conditions through:					
a. Changes in ownership/land values/tenure			X		
b. Changes in market patterns (local, natural, regional		X			
c. Increase demand of services (e.g. public and private automative, water supplies, health, etc.)		X			
d. Change in transportation pattern (cost; cargo)		X			
e. Changes in economic/employment patterns		X			
f. Other factors					
G. HEALTH					
1. Does the project affect health standards through:					
a. The creation of stagnant water which may result in increased disease vectors	X				
b. Increased carrier mobility (human and/or animal)	X				
c. Dietary changes (introduction of new food products)			X		
d. Increased traffic accidents (human and animal)	X				
e. Other factors					
H. GENERAL					
1. Does the project have:					
a. International impacts		X			
b. Controversial impacts	X				
c. Larger program impacts		X			
d. Other factors					
I. OTHER POSSIBLE IMPACTS (not listed above)					

5C(1) - COUNTRY CHECKLIST

Listed below are, first, statutory criteria applicable generally to FAA funds, and then criteria applicable to individual fund sources: Development Asistance and Economic Support Fund.

A. GENERAL CRITERIA FOR COUNTRY ELIGIBILITY

1. FAA Sec. 116. Can it be demonstrated that contemplated assistance will directly benefit the needy? If not, has the Department of State determined that this government has engaged in a consistent pattern of gross violations of internationally recognized human rights?	Yes
2. FAA Sec. 481. Has it been determined that the government of recipient country has failed to take adequate steps to prevent narcotics drugs and other controlled substances (as defined by the Comprehensive Drug Abuse Prevention and Control Act of 1970) produced or processed, in whole or in part, in such country, or transported through such country, from being sold illegally within the jurisdiction of such country to U.S. Government personnel or their dependents, or from entering the United States unlawfully?	No
3. FAA Sec. 620(b). If assistance is to a government, has the Secretary of State determined that it is not controlled by the international Communist movement?	Yes
4. FAA Sec. 620(c). If assistance is to government, is the government liable as debtor or unconditional guarantor on any debt to a U.S. citizen for goods or services furnished or ordered where (a) such citizen has exhausted available legal remedies and (b) debt is not denied or contested bv such government?	No
5. FAA Sec. 620(e)(1). If assistance is to a government, has it (including government agencies or subdivisions) taken any action which has the effect of nationalizing, expropriating, or otherwise seizing ownership or control of property of U.S. citizens or entities beneficially owned by them without taking steps to discharge its obligations toward such citizens or entities?	No

A.

6. FAA Sec. 620(a), 620(f), 620(d) App. Act, Sec. 108, 114 and 606. Is recipient country a Communist country? Will assistance be provided to the Socialist Republic of Vietnam, Cambodia, Laos, Cuba, Uganda, Mozambique, or Angola? Will assistance be provided to Afganistan or Mozambique without a waiver? — No

7. FAA Sec. 620(i). Is recipient country in any way involved in (a) subversion of, or military aggression against, the United States or any country receiving U.S. assistance, or (b) the planning of such subversion or aggression? — No

8. FAA Sec. 620 (j). Has the country permitted, or failed to take adequate measures to prevent, the damage or destruction, by mob action, of U.S. property? — No

9. FAA Sec. 620(l). If the country has failed to institute the investment guaranty program for the specific risks of expropriation, inconvertibility or confiscation, has the AID Administrator within the past year considered denying assistance to such government for this reason? — NO

10. FAA Sec. 620(o); Fishermen's Protective Act of 196 , as amended, Sec. 5. If country has seized, or imposed any penalty or sanction against, any U.S. fishing activities in international waters: — No

a. has any deduction required by the Fishermen's Protective Act been made?

b. has complete denial of assistance been considered by AID Administrator?

11. FAA Sec. 620; FY 80 App. Act, Sec. 603. (a) Is the government of the recipient country in default for more than 6 months on interest or principal of any AID loan to the country? (b) Is country in default exceeding one year on interest or principal on U.S. loan under program for which App. Act appropriates funds? — No

12. FAA Sec. 620(s). If contemplated assistance is development loan or from Economic Support Fund, has the Administrator taken into account the percentage of the country's budget which is for military expenditures, the amount of foreign exchange spent on military equipment and the — N/A

A.12.

amount spent for the purchase of sophisticated weapons systems? (An affirmative answer may refer to the record of the annual "Taking Into Consideration" memo: "Yes, as reported in annual report on implementation of Sec. 620(s)." This report is prepared at time of approval by the Administrator of the Operational Year Budget and can be the basis for an affirmative answer during the fiscal year unless significant changes in circumstances occur.)

13. FAA Sec. 620(t). Has the country severed diplomatic relations with the United States? If so, have they been resumed and have new bilateral assistance agreements been negotiated and entered into since such resumption?

The IRM has diplomatic relations with the U.S. at the Ambassadorial level. A bilateral assistance agreeement is currently being drafted.

14. FAA Sec. 620(u). What is the payment status of the country's U.N obligations? If the country is in arrears, were such arrearages taken into account by the AID Administrator in determining the current AID Operational Year Budget?

Mauritania regularly meets its U.N. obligations.

15. FAA Sec. 620A, FY App. Act, Sec. . Has the country granted sanctuary from prosecution to any individual or group which has committed an act of international terrorism /or a war crime?

No

16. FAA Sec. 666. Does the country object, on basis of race, religion, national origin or sex, to the presence of any officer or employee of the U.S. there to carry out economic development program under FAA?

No

17. FAA Sec. 669, 670. Has the country, after August 3, 1977, delivered or received nuclear enrichment or reprocessing equipment, materials, or technology, without specified arrangements or safeguards? Has it detonated a nuclear device after August 3, 1977, although not a "nuclear-weapon State" under the nonproliferation treaty?

No

B. FUNDING CRITERIA FOR COUNTRY ELIGIBILITY

1. Development Assistance Country Criteria

a. FAA Sec. 102(b)(4). Have criteria been established and taken into account to assess commitment progress of country in effectively involving the poor in development, on such indexes as: (1) increase in agricultural productivity through small-farm labor intensive agriculture, (2) reduced infant mortality, (3) control of population growth, (4) equality of income distribution, (5) reduction of unemployment, and (6) increased literacy?

Yes

B.1.

b. FAA Sec. 104(d)(1). If appropriate, is this development (including Sahel) activity designed to build motivation for smaller families through modification of economic and social conditions supportive of the desire for large families in programs such as education in and out of school, nutrition, disease control, maternal and child health services, agricultural production, rural development, and assistance to urban poor through community-based development programs.	Yes agricultural production will be improved through this project and the improvement of nutritional conditions will also be addressed
2. Economic Support Fund Country Criteria	
a. FAA Sec. 502B. Has the country engaged in a consistent pattern of gross violations of internationally recognized human rights?	N/A
b. FAA Sec. 533(b). Will assistance under the Southern Africa program be provided to Mozambique, Angola, Tanzania, or Zambia? If so, has President determined (and reported to the Congress) that such assistance will further U.S. foreign policy interests?	N/A
c. 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
d. FY App. Act, Sec. 113. Will assistance be provided for the purpose of aiding directly 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?	N/A
e. FAA Sec. 620B. Will ESF be furnished to Argentina or Chile?	N/A

5C(2) - PROJECT CHECKLIST

Listed below are statutory criteria applicable generally to projects with FAA funds and project criteria applicable to individual fund sources: Development Assistance (with a subcategory for criteria applicable only to loans); and Economic Support Fund.

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

A. GENERAL CRITERIA FOR PROJECT

1. FY 79 App. Act Unnumbered; FAA Sec. 653 (b); Sec. 634A. (a) Describe how Committees on Appropriations of Senate and House have been or will be notified concerning the project; (b) is assistance within (Operational Year Budget) country or international organization allocation reported to Congress (or not more than $1 million over that figure)?	(a) advice of Program Change will be submitted. (b) Yes
2. FAA Sec. 611(a)(1). Prior to obligation in excess of $100,000, will there be (a) engineering, financial, and other plans necessary to carry out the assistance and (b) a reasonably firm estimate of the cost to the U.S. of the assistance?	(a) Yes Construction of buildings will follow plans and specifications which will have been approved by REDSO/WA Engineering (b) 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?	N/A.
4. FAA Sec. 611(b); FY 79 App. Act Sec. 101. If for water or water-related land resource construction, has project met the standards and criteria as per the Principles and Standards for Planning Water and Related Land Resources dated October 25, 1973?	Yes Individual technology trials and extensions subject to this requirement will be subjected to the appropriate analysis prior to implementation.
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?	This is not a Capital Assistance project
6. FAA Sec. 209. Is project susceptible of 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

B.1.b.(4).

(v) for special development problem, and to enable proper utilization of earlier U.S. infrastructure, etc., assistance;

(vi) for programs of urban development, especially small labor-intensive enterprises, marketing systems, and financial or other institutions to help urban poor participate in economic and social development.

c. [107] Is appropriate effort placed on use of appropriate technology? — N/A

d. FAA Sec. 110(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 has the latter cost-sharing requirement been waived for a "relatively least-developed" country)? — Strict adherence to the 25 percent rule is not required of SDP-funded projects.

e. FAA Sec. 110(b). Will grant capital assistance be disbursed for project over more than 3 years? If so, has justification satisfactory to the Congress been made, and efforts for other financing, or is the recipient country "relatively least developed"? — N/A

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 governmental and political processes essential to self-government. — Mauritanian oasis agricultural production is characteriyed as low-yielding with inadequate extension service this project will test and introduce techniques which will increase yields and out put in addition to upgrading skill the existing extension service.

g. FAA Sec. 122(b). Does the activity give reasonable promise of contributing to the development of economic resources, or to the increase or productive capacities and self-sustaining economic growth? — Yes

2. Development Assistance Project Criteria (Loans Only)

a. FAA Sec. 122(b). Information and conclusion on capacity of the country to repay the loan, including reasonableness of repayment prospects. — N/A

b. FAA Sec. 620(d). If assistance is for any productive enterprise which will compete in the U.S. with U.S. enterprise, 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?

B.1.a.

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?

(c) self-help will be encomaged throug the provision of technical services an agricultural commodities to oasis farmers on their own land (d) women producers will be targetted for participati in the project.

b. FAA Sec. 103, 103A, 104, 105, 106, 107. Is assistance being made available: (include only applicable paragraph which corresponds to source of funds used. If more than one fund source is used for project, include relevant paragraph for each fund source.)

(1) [103] for agriculture, rural development or nutrition; if so, extent to which activity is specifically designed to increase productivity and income of rural poor; [103A] if for agricultural research, is full account taken of needs of small farmers; N/A

(2) [104] for population planning under sec. 104(b) or health under sec. 104(c); if so, extent to which activity emphasizes low-cost, integrated delivery systems for health, nutrition and family planning for the poorest people, with particular attention to the needs of mothers and young children, using paramedical and auxiliary medical personnel, clinics and health posts, commercial distribution systems and other modes of community research. N/A

(3) [105] for education, public administration, or human resources development; if so, extent to which activity strengthens nonformal education, makes formal education more relevant, especially for rural families and urban poor, or strengthens management capability of institutions enabling the poor to participate in development; N/A

(4) [106] for technical assistance, energy, research, reconstruction, and selected development problems; if so, extent activity is: N/A

(i) technical cooperation and development, especially with U.S. private and voluntary, or regional and international development, organizations;

(ii) to help alleviate energy problems;

(iii) research into, and evaluation of, economic development processes and techniques;

(iv) reconstruction after natural or manmade disaster;

A.

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; (c) encourage development and use of cooperatives, 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.	(c) Project will improve the technical efficiency of agriculture through the use of improved crop varieties and new techniques in oasis agriculture.
8. FAA Sec. 601(b). Information and conclusion on how project will encourage U.S. private trade 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).	Project will finance technical assistance services and project commodities from private firms in U.S.
9. FAA Sec. 612(b); Sec. 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 to meet the cost of contractual and other services.	Mauritania's contribution represents the maximum that it can manage, given that it is one of the poorest countries in Africa.
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?	No
11. FAA Sec. 601(e). Will the project utilize competitive selection procedures for the awarding of contracts, except where applicable procurement rules allow otherwise?	Yes
12. FY 79 App. Act Sec. 608. 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?	No

B. FUNDING CRITERIA FOR PROJECT

1. Development Assistance Project Criteria

a. FAA Sec. 102(b); 111; 113; 281a. Extent to which activity will (a) effectively involve the poor in development, by 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	(a) This activity will improve productic in oases in the rural area through the improvement of appropriate technologies encourage investments in the area, and increase employment opportunitées.

B.

3. Project Criteria Solely for Economic Support Fund

N/A

a. FAA Sec. 531(a). Will this assistance support promote economic or political stability? To the extent possible, does it reflect the policy directions of section 102?

b. FAA Sec. 533. Will assistance under this chapter be used for military, or paramilitary activities?

MINISTERE D'ETAT
[redacted] ANNEX F - GIRM REQUEST FOR ASSISTANCE
CHARGE DU DEVELOPPEMENT RURAL

وزارة الدولة
للترقية الريفية

F 1

Nouakchott le 31 AOUT 1977

انواكشوط في

351

le Ministre d'Etat

وزير الدولة

à Monsieur le Directeur de l'USAID

الى

OBJET: Projet de développement rural intégré dans les oasis

Monsieur le Directeur,

Il ressort des entretiens que mon Département a eus récemment avec diverses personnalités de votre Ambassade, de l'USAID en particulier, que cette dernière serait désireuse d'apporter sa contribution au financement de projets de développement rural intégré susceptibles d'être réalisés dans la zone des oasis.

Qu'il me soit permis à cette occasion, au nom de mon Gouvernement et à celui du Département que je dirige, de remercier les responsables de l'USAID pour leur souci de voir améliorer le sort des populations que ces projets peuvent concerner.

Semblable contribution qui renforce les liens d'amitié existant entre nos deux Pays ne peut de ce fait qu'être vivement appréciée.

Dans cet ordre d'idées il serait alors souhaitable que les modalité d'exécution des différentes interventions envisagées fassent au préalable l'objet d'une étude in situ.

A cet égard j'ai l'honneur de solliciter de l'USAID l'envoi en Mauritanie d'une mission chargée de formuler les projets qui, dans ce cadre, pourraient être réalisés.

Pensant pouvoir compter à nouveau sur le concours de votre Agence, dans cette attente, je vous prie d'agréer, Monsieur le Directeur, l'expression de ma haute considération./.

LE MINISTRE

ABDOULAYE SEBAHO

الجمهوريـــة الاسلامية الموريتانيـــة
REPUBLIQUE ISLAMIQUE DE MAURITANIE

F 2

Ministère du développement Rural

وزارة التنمية الريفية

شرف - اخاء - عدالة

Honneur-Fraternité-Justice

N° 897 /M D R

Nouakchott, Le 17 DEC. 1979 انواكشوط في

Le Ministre الوزيـــر

à Monsieur le Directeur de l'USAID الى

Nouakchott

OBJET : Projet de Développement des Oasis

Monsieur le Directeur,

Dans votre lettre en date du 4 Decembre 1979 vous me presentiez l'avant projet "Developpement des Oasis" que votre Agence va executer en Mauritanie. Ce projet rentre parfaitement dans le cadre de nos objectifs de développement dans le secteur rural à savoir :

- auto-suffisance alimentaire
- Regeneration du milieu naturel (environnement)
- fixation et retour des populations rurales dans leur terroir

Tous les efforts entrepris et à entreprendre dans le secteur rural et même dans les autres secteurs sont menacés par l'envahissement des sables(recouvrement des terrains de cultures, ensevelissement des villages et villages et villes etc..). C'est pour cela que nous attachons une importance particuliere à la regeneration du milieu naturel et à la protection de l'environnement pour mieux assoir notre politique d'autosuffisance alimentaire.

Pour cette raison il est trés important pour nous que ce projet reduise et même arrete si possible la menace d'ensablement des oasis, ceci par une action de reboisement;

... / ...

En ce qui concerne le volet elevage il ya lieu de prévoir en plus de la gestion de l'élevage et des paturages les cultures fourragéres pour améliorer l'alimentation du petit élevage des agriculteurs.

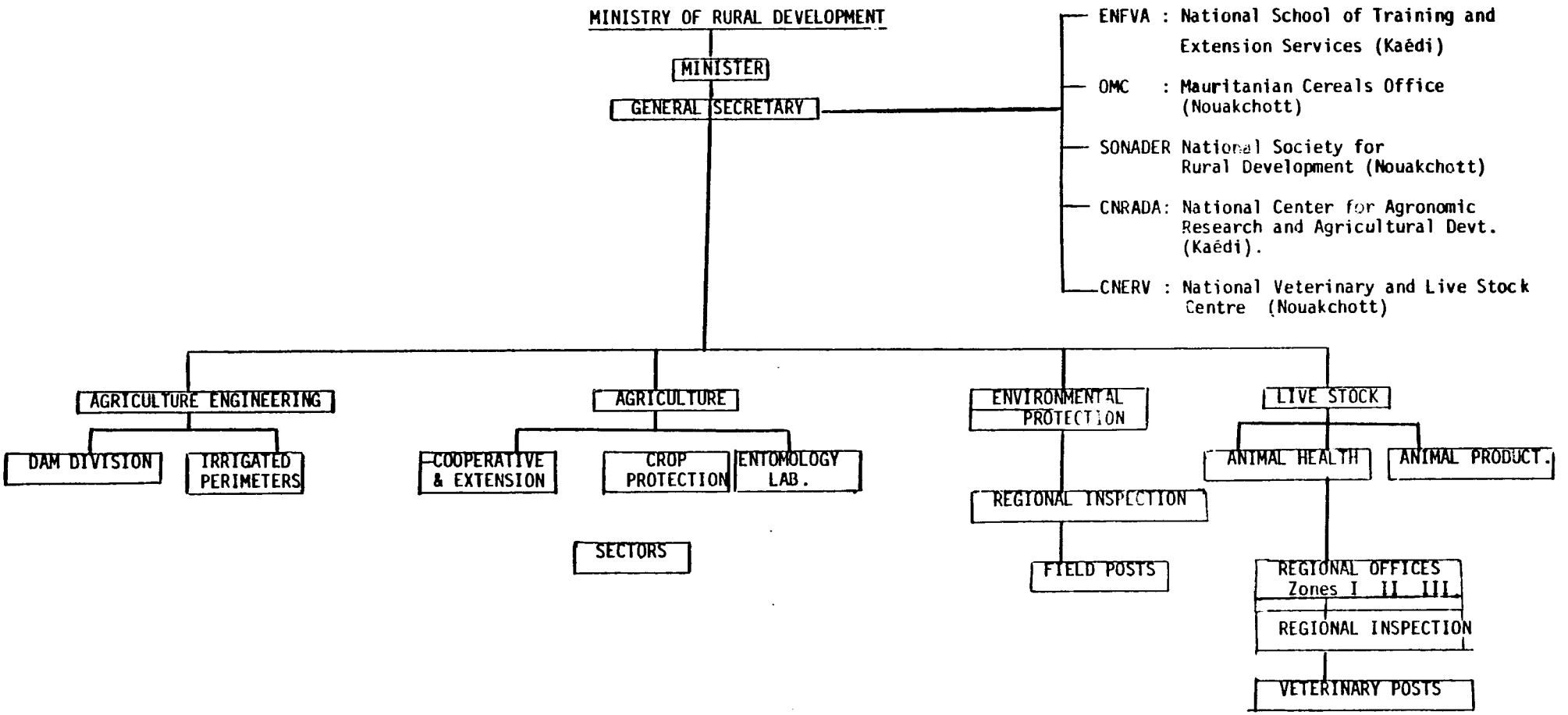
Avec ces points nous esperons mieux integrer ce projet et nous garantir de l'appui et de la participation des populations concernées conditions indispensables pour la reussite de tout projet.

Nous vous donnons ainsi notre accord pour le dit projet et souhaitons sa mise en place rapide. Tout en vous renouvelant notre disposition à la collaboration etroite et dinamique, veuillez croire, monsieur le Directeur l'assurance de ma trés haute consideration./.

Dr. OUMAR BA

LE MINISTRE

ANNEX G - GIRM ORGANIZATION SUPPORTING STRUCTURE



ANNEX H

DETAILED BUDGET - OASIS DEVELOPMENT PROJECT, U.S. INPUTS BY YEAR (at 1979 prices)

	(LC) or (FX)	Year 1	Year 2	Year 3	Year 4	Year 5	LC	FX	TOTAL
PERSONNEL									
Long-term, expatriates									
Team leader, salary & allow. (4 person years)		-	60,000	90,000	30,000	60,000			240,000
Admin. Officer, salary & allow. (5 p. yrs)		45,000	45,000	67,500	27,500	45,000			225,000
Contractor overhead (100% sal.)		-	60,000	90,000	30,000	60,000			240,000
Post assignment travel, R&R, HL		15,000	18,600	18,900	6,300	22,600			81,400
Housing and utilities	(LC)	25,500	51,000	76,500	25,500	51,000	229,500		229,500
(subtotal)		(85,500)	(234,600)	(342,900)	(114,300)	(238,600)	229,500	786,400	(1,015,900)
(108 person months)									
Short-term, expatriates		-- M O N T H S --							
Oasis Agric. specialist		4	2	2	1	1			10
Date specialist		1	1 + 1		1				4
Irrigation specialist		3	2	2	1	1			9
Approp. Technology specialist		1	3	2	1	1			8
Animal traction specialist			2		2				4
Hydrogeologist				4					4
Agric. Economist				4		1			5
Forestry specialist			1	1					2
Horticulture specialist		1	2	2	2	2			9
Other		1	1	1	1	1			5
total person months		11	15	18	9	7			60
$000's at $3,500/month		38,500	52,500	78,750	15,750	24,500			210,000
Contractor overhead		38,500	52,500	78,750	15,750	24,500			210,000
Per diem & misc. @ $3,000/month		33,000	45,000	54,000	27,000	21,000			180,000
Travel		11,000	16,000	14,000	12,000	10,000			63,000
(60 person months) (subtotal)		(121,000)	(166,000)	(225,500)	(70,500)	(80,000)		663,000	(663,000)

	(LC) or (FX)	Year 1	Year 2	Year 3	Year 4	Year 5	LC	FX	TOTAL
Local Personnel									
Training & Extension Coord. support		2,500	7,500	8,250	2,750	6,000			27,000
Nutritionist		5,000	5,000	-	-	-			10,000
Admin. Asst./ Clerk		2,500	7,500	7,800	2,600	5,200			25,600
Rural works mechanic		2,250	6,750	7,500	2,500	5,000			24,000
Asst. mechanic		2,000	6,000	6,300	2,100	4,400			20,800
Oasis Devt, Workers (ODWs)		8,000(4)	24,000	39,000(6)	13,000	26,000			110,000
ODW Assistant		4,000(4)	12,000	19,000(6)	7,000	14,000			56,000
Drivers		6,000(4)	18,000	19,000	7,000	14,000			64,000
Laborers		10,000(10)	30,000	30,000	10,000	20,000			100,000
Others		5,000(5)	15,000	15,000	5,000	10,000			50,000
(subtotal)		47,250	131,750	151,850	51,950	104,600	487,400		487,400
(1896 person months)									
Local Travel and Support									
Team leader (housed in Kiffa)		-	2,500	3,750	1,250	2,500			10,000
Admin. Officer (Nouakchott/Kiffa)		1,500	4,000	3,000	1,000	2,000			11,500
Nutritionist (Nouakchott/Kiffa)		1,250	-	-	-	-			2,500
Admin. Asst/Clerk (Sani)		400	1,200	1,200	400	800			4,000
Training & Extension Coordinator (Sani)		1,500	4,500	4,500	1,500	3,000			15,000
Rural Works Mech. (Sani)		450	1,350	1,500	1,500	1,000			4,800
Oasis Devt. Workers (4 ea/yr)		800	2,400	3,600	1,200	2,400			10,400
Drivers (2.0 ea/yr)		4,000	12,000	12,000	4,000	8,000			40,000
Moniteurs (2.5 ea./yr)		3,750	11,250	11,250	3,750	7,500			37,500
Other		2,000	6,000	6,000	2,000	4,000			20,000
(subtotal)		15,650	46,450	46,800	15,600	31,200			155,700

	(LC) or (FX)	Year 1	Year 2	Year 3	Year 4	Year 5	LC	FX	TOTAL
Commodities									
U.S. Procurement									
Long-term pers. furniture&appliances		27,500	27,500						55,000
Office furniture & supplies		20,000	-						20,000
Seeds & plant materials		1,200	2,500	3,000					6,700
Chemicals, fungicides, fertilizer		900	4,200	6,700					11,800
Agric. equipment & supplies		2,600	700	100					3,400
Fencing		20,000	-						20,000
Vaccines		1,000	1,000	200					2,200
Sulpher dusters		5,000	-						5,000
Sulpher		1,000	-						1,000
Pollination dusters		2,500	-						2,500
Tolls		3,300	-						3,300
Water lifting & irrig. supplies		44,000	14,000	14,000					72,000
SSB radio transformers/rec.		3,400	-						3,400
12 KVA generators		6,000	-						6,000
Gas refrigerators		1,000	-						1,000
Training supplies		4,700	4,700	1,200					10,600
Other		-	5,000	7,500	2,800				15,000
subtotal		144,100	59,600	32,700	2,500				238,900
O.T., I.F. & ins. 80%		115,280	47,680	26,160	2,000				191,120
PSA 7%		10,087	4,172	2,289	175				16,723
(subtotal)		(269,467)	(111,452)	(61,149)	(4,675)			446,743	(446,743)
Procurement - Local									
Local tools & project supplies		11,300	6,000	6,400	1,300				25,000
Traction animals		2,200							2,200
Sani furnishings & appliances		40,000							40,000
Vehicle PO. & maintenance		40,000	40,000	60,000	20,000	40,000			200,000
Rents (Kiffa)		8,000	8,000	12,000	4,000	8,000			40,000
Utilities & communications		2,000	2,000	3,000	1,000	2,000			10,000
Additional services & support		10,000	10,000	15,000	5,000	10,000			50,000
(subtotal)		(113,500)	(66,000)	(96,400)	(31,300)	(60,000)	367,200		(367,200)

	(LC) or (FX)	Year 1	Year 2	Year 3	Year 4	Year 5	LC	FX	TOTAL
Procurement - Third Country									
Tysen's well		8,000		2,000	2,000				12,000
Other hand pump		1,600		400	400				2,400
Vergnet pumps		3,200		800	800				4,800
Vehicles		60,000		60,000					120,000
Date shoots			22,500						22,500
subtotal		72,800	22,500	63,200	3,200				161,700
Transport & handling (75%)		54,600	16,875	47,400	2,400				121,300
(subtotal)		(127,400)	(39,375)	(110,600)	(5,600)			282,975	(282,975)
Other Requirements									
Construction at Sani	(LC)	150,000							150,000(LC)
Geophysical Studies	(LC)	16,000		24,000					40,000(LC)
Third Country Training visits	(FX)		40,000	40,000					80,000(FX)
Participant Training (US or 3rd C)	(FX)			100,000					100,000(FX)
Evaluations				40,000		40,000			80,000
(subtotal)		(166,000)	(40,000)	(204,000)		(40,000)	190,000	260,000	(450,000)
TOTALS		945,676	835,627	1,239,199	293,925	554,400			3,868,918
Contingencies 5%		47,288	41,781	61,960	14,696	27,720			193,445
subtotal		993,055	877,408	1,301,159	308,621	582,120			4,062,363
Inflation, 15%, compounded		141,958	282,964	677,741	231,157	587,941			1,928,761
Total A.I.D. Contribution		1,142,013	1,160,372	1,978,900	539,778	1,170,061	2,210,725	3,780,399	5,991,124
Rounded to		$1,142,000	1,160,000	1,979,000	540,000	1,170,000			$5,991,000

ORIGIN AID-00

INFO OCT-01 EB-03 AF-10 OES-09 /113 R

DRAFTED BY AFR/SFWA:LMSMITH/HGRAY:MM
APPROVED BY AA/AFR:GTBUTCHER
DAA/AFR:WHNORTH
AFR/SFWA:JKELLY
AFR/SFWA:HFARNHAM
AFR/SFWA/SDP:PSTEFFEN (DRAFT)
AFR/DR/SFWAP:JMC CABE
AFR/DR/SFWAP:DMASON (DRAFT)
AFR/DR/AGR:DFERGUSON (DRAFT)
AFR/SFWA:DMILLER
AFR/DR/ENGR:JMORGAN
AFR/DR/H:MKIRBY
AFR/DR/H:ABRAUNSTEIN
AFR/DP:WTATE
AFR/DP:EMCKOY
AFR/DR/SDP:JNIXON
AFR/SFWA/DPS:JOWEN
DESIRED DISTRIBUTION
7F ACTION AFR 15 CHRON 2 3 8 INFO PPC 11A AA/DS CMGT DS/HEA DS/N DS/S T
ENGR ES SER AGRIC CDC HEW 90P
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R 061557Z FEB 79
FM SECSTATE WASHDC
TO AMEMBASSY NOUAKCHOTT
INFO AMEMBASSY ABIDJAN

UNCLAS STATE 031463

AIDAC

E.O. 12065: N/A

TAGS:

SUBJECT: REVIEW REVISED PID - MAURITANIA INTEGRATED DEVELOPMENT OF OASES (682-0207)

1. SUBJECT REVISED PID REVIEW ON 10/24 BY PROJECT COMMITTEE AND NOW APPROVED BY AA/AFR AS BASIS FOR PP DESIGN. OAR/NOUAKCHOTT WAS REPRESENTED BY PROGRAM OFFICER IM ANDERSON. RESULTS OF REVIEW FOLLOW.

2. OAR REPRESENTATIVE NOTED THIS REVISED PID REFLECTED CHANGE IN OAR'S APPROACH WHICH NOW CONSIDERED STABILIZATION OF PEOPLE IN THE INTERIOR AS ANOTHER IMPORTANT PROGRAM ELEMENT. THIS IS ALSO PRESENTED AS A PILOT ACTIVITY WITH PART OF ITS FOCUS TO GATHER INFORMATION; SUBSEQUENT ACTIVITIES COULD BE MORE PRODUCTION-ORIENTED. PP DESIGN SHOULD REFLECT TOTAL INTEGRATED DEVELOPMENT OF OASES WITH ACCENT ON IMPROVED NUTRITION, INCLUDING VARIOUS FOOD CROPS AS WELL AS DATE PALM PRODUCTION. PROJECT PURPOSE AND GOAL STATEMENTS SHOULD BE REWRITTEN TO CLARIFY THIS. ALSO, BECAUSE IMPROVED DATE PALM CULTURE IS SEEN AS A KEY COMPONENT OF THE PROJECT, THE FEASIBILITY OF PROVIDING TECHNICAL ASSISTANCE THIS COMPONENT MORE GENERALLY SHOULD BE EXAMINED BY THE DESIGN TEAM. OAR REPRESENTATIVE ALSO NOTED PROJECT CONSISTED OF TWO SEPARATE ASPECTS, WITH ONE FOCUSING ON DEMONSTRATION PLOTS ON EXISTING OASES AND THE SECOND INVOLVING ESTABLISHMENT OF NEW OASES.

3. IN LIGHT OF ABOVE, COMMITTEE AGREED THAT NUMBER OF PROJECT SITES SHOULD BE LIMITED TO NO MORE THAN SIX, AND THEY SHOULD REPRESENT BEST OVERALL SOCIAL, ECONOMIC AND WATER USE POTENTIAL. PROJECTS SHOULD BE KEPT SMALL, MANAGEABLE AND IMPLEMENTABLE.

4. COMMITTEE EXPRESSED CONCERN REGARDING LAND OWNERSHIP ISSUES AND ALSO POSSIBILITY OF WEALTHY OASES OWNERS EXPLOITING LABORERS OR GAINING MAJORITY OF BENEFITS. OAR REPRESENTATIVE STATED MISSION WAS SENSITIVE TO THIS AND HOPED TO AVOID THESE SOCIOLOGICAL PROBLEMS BY ESTABLISHING NEW OASES, WHILE ALSO DETERMINING WHAT WOULD BE DONE ON EXISTING OASES.

5. COMMITTEE RECOMMENDS FOLLOWING DIRECTIONS FOR PP DESIGN: A. PROJECT SHOULD BE DESIGNED SO THAT INCREASED DEMAND ON EXISTING AQUIFERS SHOULD BE MET BY IMPROVING THE EFFICIENCY OF THE SYSTEM (I.E. INCREASING THE DIAMETER AND/OR DEEPENING WELLS) RATHER THAN INTRODUCTION OF ADDITIONAL SYSTEMS. ALONG THIS LINE, THE DESIGN MUST ENSURE THAT THE RATE OF WATER EXTRACTION AT EACH OASIS DOES NOT EXCEED RATE OF RECHARGE. ONLY THE USE OF WATER FROM RECHARGEABLE AQUIFERS SHOULD BE PLANNED. FOSSIL WATER SHOULD BE SAVED FOR TIMES OF REAL EMERGENCY, E.G., DROUGHT. IN ADDITION, PP TEAM SHOULD CONSIDER THE APPLICATION OF MANUAL OR ANIMAL-POWERED PUMPING DEVICES (SUCH AS PERSIAN WATER WHEEL AND SHADOUF) RATHER THAN ENGINE DRAWN PUMPS.

B. PP TEAM SHOULD BE AWARE OF COMMITTEE'S INTEREST IN TRAINING OF AGRICULTURAL AGENTS AND SMALL FARMERS. COMMITTEE NOTED THAT TRAINING SHOULD BE CONDUCTED ON IN-COUNTRY BASIS AS MUCH AS POSSIBLE. IMPACT OF PROJECT ON WOMEN MUST BE EXAMINED, ESPECIALLY REGARDING THE ROLE OF WOMEN AS PRODUCERS, CONSUMERS AND PROVIDERS OF FOOD.

C. HEALTH AND NUTRITION ASPECT OF PROJECT SHOULD BE PROVIDED PARTICULAR ATTENTION, ESPECIALLY IN AREAS OF FOOD CONSUMPTION HABITS AND DISEASES IN THE OASES (I.E. SCHISTOSOMIASIS, MALARIA, ETC.). SPECIFIC QUESTIONS SHOULD BE ADDRESSED -- WHO IS EATING WHAT, WHEN AND HOW -- IN TERMS OF BOTH BASELINE DATA AND EXPECTED OUTPUT.
D. PP TEAM MUST SATISFY REQUIREMENTS OF SECTION 611 (A) AND (B) OF THE FAA.

6. INDIVIDUAL MEMBERS OF THE COMMITTEE ADDRESSED SPECIFIC AREAS NOT COVERED IN THE PID WHICH THEY FELT SHOULD BE DEALT WITH IN PP DESIGN AS FOLLOWS: A. PID IS NOT SPECIFIC AS TO THE TYPES OF ACTIVITIES TO BE UNDERTAKEN. THE AGRONOMIC POSSIBILITIES (BEYOND DATE PALM CULTURE) ARE NOT CLEAR. RATHER THAN A MODEL FARMER APPROACH, IT WOULD APPEAR TO BE MORE ENVIRONMENTALLY SOUND TO ESTABLISH THE TOTAL WATER SUPPLY FOR EACH SITE AND DESIGN AN IRRIGATION SYSTEM TO USE THE WATER INCLUDING THE WATER LIFTING AND DISTRIBUTION SYSTEM, AND CROPS TO BE GROWN. THE PP TEAM, THEREFORE, MUST HAVE SUFFICIENT TECHNICAL KNOWLEDGE TO DETERMINE THE EXTENT OF AGRICULTURE DEVELOPMENT POSSIBLE FOR EACH OASIS SELECTED. AGRICULTURAL DEVELOPMENT WILL BE DETERMINED BY THE AVERAGE YIELD OF WELLS, NUMBER OF WELLS AT EACH OASIS, THE RECHARGE RATE OF THE AQUIFER AT EACH SITE, THE EXTENT OF ARABLE LAND AVAILABLE AND THE AREA IN WHICH EACH CROP IS TO BE GROWN (BECAUSE SOME CROPS REQUIRE MORE WATER THAN OTHERS).

B. IN DEVELOPING OASES, CARE MUST BE EXERCISED TO ENSURE THAT THE RATE OF WATER CONSUMPTION AT EACH OASIS DOES NOT EXCEED THE RATE OF RECHARGE TO PREVENT THE DATE PALMS FROM DYING DUE TO THE WATER TABLE BEING DRAWN DOWN BELOW THEIR ROOT SYSTEM.

7. IEE CAN BE DEFERRED UNTIL SITE SELECTION IS MADE. IF OAR/MAURITANIA PREFERS TO DEFER IEE IT SHOULD AMEND PID IMMEDIATELY IN ACCORDANCE WITH SECTION 216.3 (A) (1) OF REGULATION 16 (COPY OF REG. 16 PROVIDED ANDERSON FOR HIS

REFERENCE.)

8. IN SUMMARY, COMMITTEE RECOMMENDED COMBINING PHASE I (SOCIOLOGICAL STUDY AND HYDRO-GEOLOGICAL INVENTORY) WITH THE PP DESIGN.

THEREFORE, THE COMMITTEE SUGGESTED THAT AN AGRONOMIST, GROUNDWATER HYDROLOGIST, IRRIGATION ENGINEER AND SOCIOLOGIST CONDUCT A SURVEY OF POTENTIAL SITES FOR APPROXIMATELY THREE MONTHS PRIOR TO BEING JOINED BY AN ECONOMIST, DATE PALM EXPERT (AMERICAN DATE EXPERTS ARE AVAILABLE WITH CANELIAN EXPERIENCE), HORTICULTURALIST, NUTRITION PLANNER/PROGRAMMER, DESIGN OFFICER AND SECRETARY. THE DESIGN TEAM WILL THEN MAKE FINAL SELECTION OF UP TO SIX OASES TO BE DEVELOPED AS PILOT DEMONSTRATION OASES AND, ASSISTED BY REDSO WATER RESOURCES ENGINEER, WILL ENSURE THAT 611 REQUIREMENTS ARE MET. COMMITTEE AGREED THAT INDIVIDUALS FROM FRENCH GOVERNMENT INSTITUT DE RECHERCHES SUR LES FRUITS ET AGRUMES (IRFA) COULD BE USED AS RESOURCE PERSONNEL DURING PROJECT DESIGN AND IMPLEMENTATION.

9. FOLLOWING COMMENTS WERE MADE AT THE 30 JAN AA/AFR COUCH SESSION:

A) PROJECT'S PURPOSE MUST BE RESTATED TO INCLUDE NOT ONLY CONCEPT STATED PARA 2 ABOVE, BUT ALSO MORE ACCURATELY REFLECT THE PILOT NATUFE OF THIS ACTIVITY WHICH IS DESIGNED TO PROVIDE AN INFORMATION BASE FOR FUTURE PROJECT DEVELOPMENT AND INTRODUCE NEW TECHNOLOGY. PURPOSE AS STATED NOW REFLECTS MORE PROJECT GOAL THAN PURPOSE. ALONG THIS LINE IT WAS FELT THAT THE GOAL SHOULD ALSO BE MORE REALISTICALLY STATED AND NOT CONTAIN PRESUMING PHRASES SUCH AS QUOTE FULLY EXPLOITED UNQUOTE.

B) PP SHOULD IDENTIFY MISSION AND GIRM'S ROLE, PARTICULARLY HIGHLIGHTING OAR PERSONNEL REQUIREMENTS AND RESPONSIBILITIES DURING IMPLEMENTATION PHASE. FOR EXAMPLE, IS PROJECT MANAGER ON BOARD AND IS HE DEALING WITH GIRM ON A REGULAR BASIS CONCERNING THIS PROJECT? IF NOT, WHAT ACTIONS NEED TO BE TAKEN TO BRING ON BOARD? HAS GIRM IDENTIFIED RESPONSIBLE MINISTRY/OFFICERS TO LIAISE WITH AID ON PROJECT AND, IF NOT, WHAT ACTIONS NEED TO BE TAKEN IN ORDER TO RECTIFY SITUATION? CONCERN WAS EXPRESSED THAT PID LACKS AN ADEQUATE DESCRIPTION OF HOW THE PROJECT WORK IS TO BE ORGANIZED. ALTERNATIVE MODELS WILL NEED TO BE EXPLORED BY PP TEAM TAKING ACCOUNT OF THE UNIQUE ASPECTS OF THE OASES IN MAURITANIAN SOCIETY AND THEIR RELATIONSHIP TO THE CENTRAL GOVERNMENT FOR ANY SERVICES OR SUPPORT REQUIRED. VANCE

ANNEX J

PROCUREMENT

Much of the commodity requirements for this project will become clear only as initial introductions are tried and evaluated. For this reason, the procurement plan for agricultural and water-technology activities can be considered firm only as regards initial procurement. Specific commodity requirements for the remainder of the project (see Part IV Implementation Plan) will have to be adjusted according to which agricultural or water-technology interventions are selected for extension introductions to the oases and the particular requirements for the selected activities.

For this reason the procurement plan details those requirements for project start-up and includes funding which is estimated to be sufficient in total for the remaining years. As indicated in Parts III D and V, the project Administrative Officer will initiate the first procurement actions, working with the USAID Project Manager. This will include the procurement of those items not needed for first-year activities and local procurement of the more urgent needs. Some in the latter category may have to be procured in Senegal if they are unavailable in Nouakchott. Later procurement, after the team leader is in country, will be in accordance with needs and specifications which are identified by the team leader and concurred in by the USAID Project Manager. Procurement from U.S. will be through AAPC or other U.S. purchasing agency.

Title to the commodities procured for this project will be with the host government, subject to provision in the Pro Ag that they will be controlled and utilized by USAID, through its implementing contractor, during the life of the project.

The Geographic Source Code for procurement wunder the project will be 941 and the cooperating country. A waiver of the source and origin requirement will be necessary to permit Code 935 procurement of eight vehicles. As indicated elsewhere in the PP, all procurement and other contracting will be performed by the technical assistance team in collaboration with USAID.

Commodity Procurement List

A. U.S. Procurement

	First Year	All Years
Long-term pers.furniture & appliances	27,500	55,000
Office furniture & supplies	20,000	20,000
Seeds & plant materials	1,200	6,700
Chemicals, fungicides, fertilizer	900	11,800
Agric. equipment & supplies	2,600	3,400
Fencing	20,000	20,000
Vaccines	1,000	2,200
Sulpher dusters	5,000	5,000
Sulpher	1,000	1,000
Pollination dusters	2,500	2,500
Tools	3,300	3,300
Water lifting & irrigation supplies	44,000	72,000
SSB radio transformers/rec.	3,400	3,400
12 KVA generators	6,000	6,000

		First Year	All Years
A.	**U.S. Procurement (cont'd)**		
	Gas refrigerators	1,000	1,000
	Training supplies	4,700	10,600
	Other	-	15,000
	subtotal	144,000	238,000
	O.T.,I.F. & ins. 80%	115,280	191,120
	PSA 7%	10,087	16,723
	(subtotal)	(269,467)	(446,743)
B.	**Local Procurement**		
	Local tools & project supplies	11,300	25,000
	Traction animals	2,200	2,200
	Sani furnishings & appliances	40,000	40,000
	Vehicle PO & maintenance	40,000	200,000
	Rents (Kiffa)	8,000	40,000
	Utilities & communications	2,000	10,000
	Additional services & support	10,000	50,000
	(subtotal)	(113,500)	(367,200)
C.	**Procurement - Third Country**		
	Tysen's well	8,000	12,000
	Other hand pump	1,600	2,400
	Vergnet pumps	3,200	4,800
	Vehicles	60,000	120,000
	Date shoots	22,500	22,500
	subtotal	95,300	161,700
	Transport & handling (75%)	71,500	121,300
	(subtotal)	(166,800)	(283,000)
D.	**Other Requirements**		
	Construction at Sani	150,000	150,000
	Geophysical Studies	16,000	40,000
	Third Country Training visits		80,000
	Participant Training (U.S. or 3rd C)		42,000
	(subtotal)	(166,000)	(312,000)

Construction at Sani

A. Requirements

	Size in sq. meters
-	
- 10 rooms 25m^2 each for technicians and agents:	250
- 2 offices	50
- 1 warehouse	50
- 1 shop	50
- 1 dormitory	50
- 1 kitchen	25
- 1 recreation room	50
- showers and latrines	100
Total	625
Estimated cost	$150,000

B. Basis of cost estimates: SOCOGIM 1978 study of construction costs in adobe block at Rosso indicated costs of building at 36 UM ($80) per square meter, excluding contractor costs. Including inflation since 1978, the osolation factor and estimated contractor costs, the PP design team estimates requirements for this project at $160/m^2. $50,000 additional is for site improvement, plumbing, wiring, and fencing.

The above general listing is illustrative only. There will be other activities identified and added during the project implementation. (See below, Part II-A for elaboration)

b. Coordination between GIRM and USAID

At the inception of the project GIRM and USAID will hold discussions with the proposed oases to reach agreements regarding participation in the project. The Project Grant Agreement will contain a condition precedent requiring that the GIRM execute an agreement with participating oasis communities providing that the communities will (a) accept an Oasis Development Worker who will live and work in the community; (b) make land available for project activities; and (c) cooperate with project technicians. There will also be a condition precedent requiring that the GIRM make the Sani research station available to the project. The Grant Agreement will also contain covenants providing in substance as follows: (a) training opportunities provided through the project should be made available to women and to all social groups in the project area, and that such individuals should also be considered as candidates for Oasis Development Worker, or assistant, on an equitable basis; and (b) before any project interventions will be extended to participating oasis farmers, appropriate environmental analyses will be done; and (c) the GIRM will indicate its commitment to expanding the oasis development activities to other Mauritanian oases through the development of a plan to do so by the time of the evaluation during the third year. The GIRM will also provide for organizational arrangements to involve the GIRM regional extension personnel with continuing monitoring responsibilities in the extension of these trials; for assignment to the project of a Training and Extension Coordinator as well as three agents of the Mauritanian Agricultural Service who will work primarily with the initial introductions at Sani and receive on-the-job training; and agreement to collaborate and participate with USAID in scheduled project evaluations and periodic informal reviews. These conditions have been discussed with the GIRM and have been agreed to in principle.

The Project Agreement will also contain the USAID commitments to provide a technical assistance package which will include specified long and short-term specialists; construction of certain essential but modest facilities; commodity assistance in tools, seeds, fertilizers, variety plant stocks, wire and fencing, project vehicles, pumps and irrigation supplies and other required items as listed in Annex H; salaries and/or support costs for designated full-time Mauritanian project personnel; support to the agricultural agents working and training on the project; transportation support to GIRM extension personnel when they are assisting in installing extension demonstrations in the oases; training costs; and other operating costs associated with implementing the project.

ANNEX K

Legislative Criteria

FAA Sec. 611(a)

Detailed planning and cost estimates which are reasonably firm have been developed in preparation of the PP. No major construction is included in the project, and buildings will be of simple adobe block construction utilizing clay found on site. Only the buildings for the Sani activities will be erected under construction contract. Detailed design and specifications will be secured through local engineering services and will be approved by REDSO engineers prior to solicitation for contract award. Buildings erected at other locations will be small shelters of traditional construction costing less than $2,000. Buildings planned for construction for this project are to facilitate the trials, demonstration and training conducted by the technical assistance team during the project.

FAA Sec. 611(b)

This is not a large capital project. The interventions will be small and simple shallow wells, retention dikes and water channeling. Wells to be constructed will be for improved manual water lifting or simple mechanical devices. Technology will be appropriate to the physical and financial capabilities and the level of expertise of the oasis farmers. Innovations will be extended to these oases only after they have been proved appropriate through trials at Sani.

To the extent applicable, the extent of Section 611(b) has been met in the economic, social and environmental analyses included in the project paper.