PDBB 950

AGENCY FOR INTERNATIONAL DEVELOPMENT

PROJECT IDENTIFICATION DOCUMENT FACESHEET (PID)

1. TRANSACTION CODE: A (A = Add, C = Change, D = Delete) — Revision No. ____

DOCUMENT CODE: 1

2. COUNTRY/ENTITY: Mauritania

3. PROJECT NUMBER: 682-0237

4. BUREAU/OFFICE — A. Symbol: AFR — B. Code: 06

5. PROJECT TITLE (maximum 40 characters): MAURITANIA RIVER VALLEY DEVELOPMENT

6. ESTIMATED FY OF AUTHORIZATION/OBLIGATION/COMPLETION

A. Initial FY: 88

B. Final FY: 88

C. PACD: 93

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

FUNDING SOURCE		LIFE OF PROJECT
A. AID		2,000
B. Other U.S.	1.	
	2.	
C. Host Country		550
D. Other Donor(s)		
TOTAL		2,550

8. PROPOSED BUDGET AID FUNDS ($000)

A. APPROPRIATION	B. PRIMARY PURPOSE CODE	C. PRIMARY TECH. CODE 1. Grant	C. PRIMARY TECH. CODE 2. Loan	D. 1ST FY 1. Grant	D. 1ST FY 2. Loan	E. LIFE OF PROJECT 1. Grant	E. LIFE OF PROJECT 2. Loan
(1) SDP	100	070		2,000		2,000	
(2)							
(3)							
(4)							
TOTALS						2,000	

9. SECONDARY TECHNICAL CODES (maximum 6 codes of 3 positions each): 022 074

10. SECONDARY PURPOSE CODE

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

A. Code	BR	BS	TNG			
B. Amount						

12. PROJECT PURPOSE (maximum 480 characters)

To increase production of sorghum by establishing effective control and maximal use of water, land and human resources on and around the Dirol Plain.

13. RESOURCES REQUIRED FOR PROJECT DEVELOPMENT

Staff:

See Annex 7

Funds

14. ORIGINATING OFFICE CLEARANCE

Signature: Walter W. Cookson

Title: A/Director

Date Signed: MM 08 DD 01 YY 87

15. DATE DOCUMENT RECEIVED IN AID/W, OR FOR AID/W DOCUMENTS, DATE OF DISTRIBUTION — MM DD YY

16. PROJECT DOCUMENT ACTION TAKEN

S = Suspended
A = Approved
D = Disapproved
CA = Conditionally Approved
DD = Decision Deferred

17. COMMENTS

18. ACTION APPROVED BY

Signature: Charles L. Gladson

Title: Assistant Administrator Bureau for Africa

19. ACTION REFERENCE

20. ACTION DATE — MM 11 DD 03 YY 87

AID 1330-2 (8-79)

1x

INSTRUCTIONS

Block 1 - Enter the appropriate letter code in the box, if a change, indicate the revision number.

Block 2 - Enter the name of the Country, Regional, or other Entity.

Block 3 -Enter the Project Number assigned by the field mission or an AID/W bureau.

Block 4 - Enter the sponsoring Bureau/Office Symbol and Code. *(See Handbook 3, Appendix 3, Table 1, Page 1 for guidance.)*

Block 5 - Enter the Project Title *(stay within brackets; limit to 40 characters).*

Block 6 - Enter the estimated Initial (A) and Final (B) FY of the Authorization/Obligation, and Project Assistance Completion Date (PACD) (C).

Block 7 - Enter the information taken from the 'Estimated Cost Table' in the PID.

Block 8A. - Use the 'Alpha Code'. *(See Handbook 3, Appendix 5B, Table 2, Page 2 for guidance.)*
Block 8B. - See Handbook 3, Appendix 5B for guidance.
Blocks 8C., D., & E., - Enter all amounts in thousands of U.S. dollars.

Blocks 9 & 10 - See Handbook 3, Appendix 5B for guidance.

Block 11 - Enter the code and amounts attributable to each concern for 'Life of Project'. For coding see Handbook 3, Appendix 5B, Attachment C.

Block 12 - Enter the 'Project Purpose' from the PID. If more than one (1), list each one (1) in order of priority *(stay within brackets; limit to 480 characters).*

Block 13 - Summarize any planning resources needed to develop the project in terms of staff and funding required. For staff, indicate whether direct hire or contract staff. Indicate the established amount and source of funding required (operative expenses or Mission funds).

Block 14 - This block is to be signed and dated by the Authorizing Official of the originating office. The PID will not be reviewed if the PID Facesheet is not signed and dated. Do not initial.

Block 15 -This date is to be provided by the office or bureau responsible for the processing of the PID.

Block 16 - This block is to be completed by the authorized representative of the office or bureau responsible for the processing of the PID.

Block 17 - Enter any comments on the action taken.

Block 18 - This block is to be signed and dated by the Approving Official. Do not initial.

Block 19 - Identify the action document i.e., memorandum, cable.

Block 20 - Enter the data of the action document.

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MAURITANIA RIVER VALLEY DEVELOPMENT PROJECT (682-0237)
PROJECT IDENTIFICATION DOCUMENT

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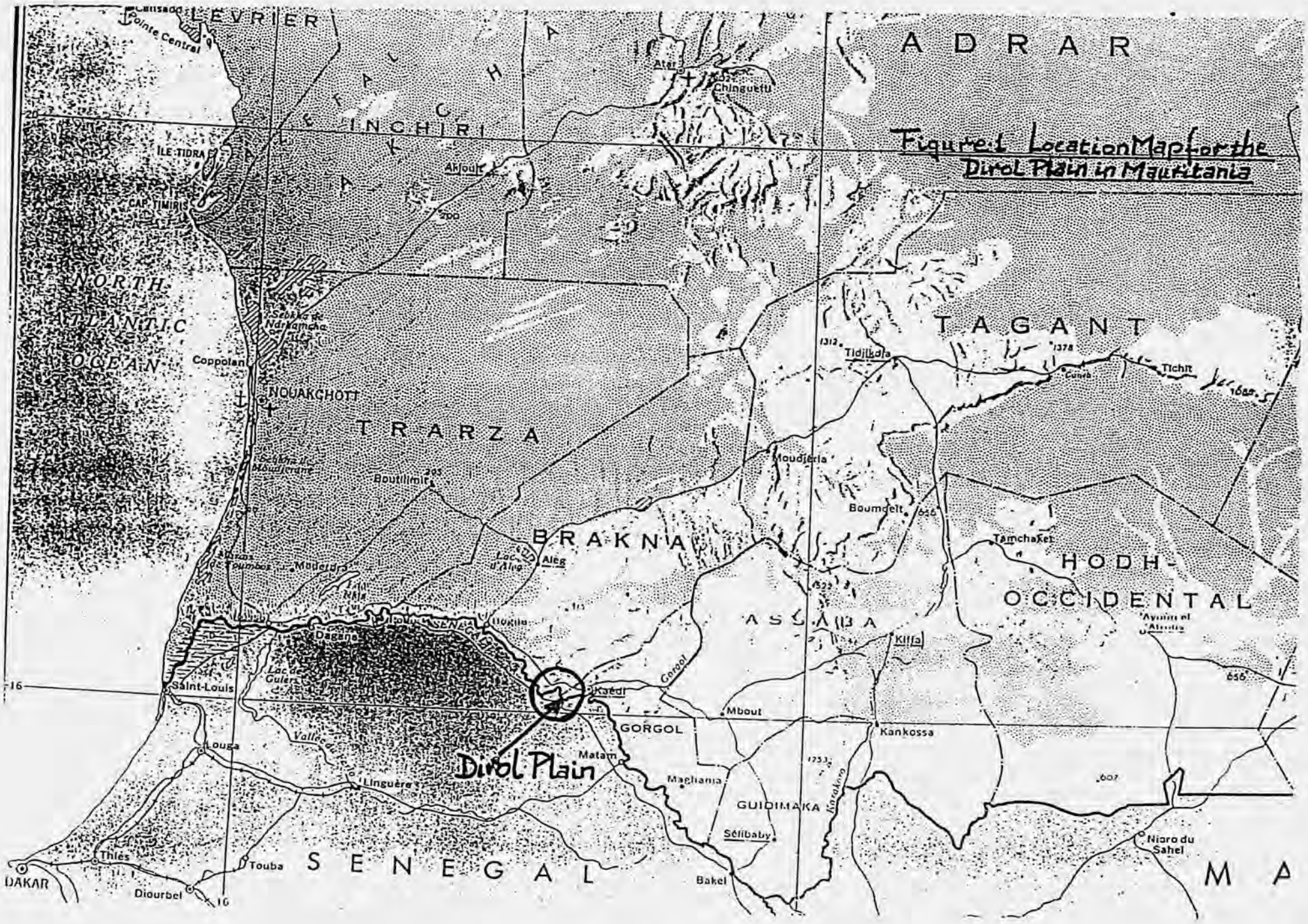
Figure.1 Location Map for the Dirol Plain in Mauritania
LEVRIER
ADRAR
INCHIRI
TAGANT
TRARZA
BRAKNA
HODH-OCCIDENTAL
ASSABA
GORGOL
GUIDIMAKA
SENEGAL
NORTH ATLANTIC OCEAN
Pointe Central
ILE TIDRA
CAP TIMIRIS
Ater
Chinguetti
Akjoujt
Coppolani
NOUAKCHOTT
Boutilimit
Moudjeria
Boumdeit
Tidjikdja
Tichit
Tamchakett
Aleg
Lac d'Aleg
Kiffa
Kaédi
Mbout
Kankossa
Matam
Maghama
Sélibaby
Bakel
Niaro du Sahel
Saint-Louis
Dagana
Lac de Guiers
Louga
Linguère
Thiès
Touba
Diourbel
DAKAR
Dirol Plain

LIST OF ACRONYMS

ADO	Agricultural Development Officer (USAID)
AGRESS II	Agricultural Research and Development Project II
CC	Coordinating Committee
CCCE	Caisse Centrale de Cooperation Economique
CDSS	Country Development Strategy Statement
CFC	Center for Cooperative Training
CGEM	General Confederation of Mauritanian Employers
CNRADA	National Agricultural Research Center
COP	Chief of Party
CSA	Food Security Agency (GIRM)
CTS	Technical Monitoring Committee
DirAg	Directorate of Agriculture (GIRM)
DPN	Directorate of Environmental Protection (GIRM)
DPWUA	Dirol Plain Water User Association
DRIG	Guidimaka Integrated Rural Development Project (USAID)
ENFVA	National Agricultural Training School
FAC	Fonds d'Aide et Cooperation (French Bilateral Aid)
FAO	Food and Agriculture Organization (UN)
FED	European Development Fund
FSR	Farming System Research
GIRM	Government of the Islamic Republic of Mauritania
IAG	Inspector of Agriculture/Gorgol Region
IBRD	World Bank
IEE	Initial Environmental Examination
IGN	International System for Measuring Height Above Sea Level
LOP	Life of Project
m	meter
m3	Cubic Meter
MDR	Ministry of Rural Development (GIRM)
MRVDP	Mauritania River Valley Development Project
ORSTOM	Overseas Scientific and Technical Research Organization
PACD	Project Assistance Completion Date
PEEG	Gorgol Animal Health and Production Extension Project
PID	Project Identification Document
PP	Project Paper
PREF	Economic and Financial Recovery Plan of Mauritania
REO	Regional Environmental Officer
PSC	Personal Services Contractor
RFP	Request for Proposal
SONADER	National Rural Development Company
SRB	Senegal River Basin
UM	Monetary Unit of Mauritania - Ouguiya
UNDP	United Nations Development Program
USAID	United States Agency for International Development

MAURITANIA RIVER VALLEY DEVELOPMENT PROJECT
MRVDP
(682-0237)

PROJECT IDENTIFICATION DOCUMENT

Introduction

Is Mauritania an agricultural basket case? Three quarters of the country's one million square kilometers of territory is in the Sahara Desert. The rest is Sahelian waste land, where rainfall rarely exceeds 400mm/year. Agriculture, including herding, employs nearly 75% of the national work force, but even in a good year, the sector provides less than one third of the country's cereals needs. During the colonial era, the French made no effort at agricultural development in Mauritania beyond periodic vaccination campaigns to combat endemic cattle diseases. As a result of the drought years and subsequent loss of grasslands and livestock populations, the Mauritanians have initiated alternative efforts to develop the agricultural lands bordering the Senegal River. There is potential for increasing agricultural production in the Senegal River Basin with improved management and control of available water resources.

With such a slim resource base, Mauritania may never entirely satisfy its own cereals requirements. But should nothing be done to take advantage of the country's not insignificant agricultural potential? For centuries, Mauritania has produced cereals in a belt of land of varying width across the southern border of the country. A complex symbiosis linked the farmers and herders of what are now Mali, Mauritania and Senegal into a self-sufficient unit. Milk, meat, and cereals went freely from one area to another. Water, land and pasture resources were exploited wherever plentiful. But this efficient mutual dependency has eroded in recent years. Drought, nationalism, environmental degradation, pressure on land resources and population growth have broken the links forged over centuries and left today's nation-states dependent each on its own internal resources.

Those resources are not insignificant in Mauritania. The Senegal River's annual flood can cover up to 70,000 ha of heavy clay "walo" land, soaking it with sufficient water to permit the harvest of a crop of sorghum large enough to permit population densities of more than 2 inhabitants per hectare of arable land. (200 people per square kilometer). In addition, even under adverse condition, rainfed agriculture contributes heavily to national cereals production.

Mauritania's riverine peoples are farmers. They like to farm, work hard at farming, and readily adopt crops and techniques that prove beneficial to their interests. Mauritania's burgeoning urban population needs cereals. The heavily indebted national government (GIRM = Government of the Islamic Republic of Mauritania) can ill afford the foreign exchange now allotted to the commercial import of around 75,000 tons of cereals each year. Donated levels of international food aid may not continue forever at the current level of 100,000 tons per year.

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To survive as a nation, as a viable economic and political entity, Mauritania must become self-reliant in cereals. The country can produce enough food to fill the gap between needs and affordable imports. The national Economic and Financial Recovery Plan (PREF) Plan de Redressement Economique et Financier) calls for the nation's farmers to produce 40% of the country's cereals needs by 1988. While much of the proposed increase in production will spring from new or rehabilitated irrigation projects, the PREF recognizes the importance of traditional agriculture in meeting the country's goals.

Irrigated agriculture provides complete control of water, which is the primary constraint on production in every agricultural enterprise in Mauritania. Irrigation is, in theory, the country's chief source of hope for significant increases in food production. However, past experience with irrigated perimeters has frustrated planners and implementers alike. Difficult terrain, high capital costs, pump and dike maintenance problems, recalcitrant farmers, poor management, settlement problems, and inadequate engineering design have all taken their turn at increasing costs and lowering production on irrigated projects from one end of the Senegal River Basin to the other.

Recently, the GIRM and the donor community began wondering if there were not an alternative approach to increasing the agricultural performance of the Mauritanian side of the Senegal River Basin (SRB). Traditionally, much of Mauritania has depended on rainfed agriculture for its food supply. But the dramatic overall decline in rainfall over the last 30 years compromises any hopes for significant increases of pluvial production in the Middle Valley.

However, the annual floods of the Senegal River, fed by more dependable rainfall in upland Guinea, do offer such hope. Improved flood recession agriculture offers a more economical opportunity for rapid increases in cereals production with lower capital development and recurrent costs, as well as fewer management and maintenance problems. If farmers can better control and manage the floodwaters, keeping them on larger areas of good land for optimal periods of time, they can hope for significant increases in production, income and well-being. The Mauritania River Valley Project (MRVDP) will help farmers in the Diroi Plain area of the SRB establish such control and achieve such increases.

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I. A. Program Factors:

Conformity with Recipient Country Strategy and Programs. In 1985, following the first meeting of the World Bank Consultative Group for Mauritania, the GIRM produced a National Recovery Plan (PREF) which stated the country's problems in clear language and presented a plan for solving them. The GIRM refers to the PREF as the most definitive current statement of its strategy and program for development. The PREF places heavy emphasis on agriculture, allocating more than 30% of public investment monies to agricultural projects for the period 1985-88.

Although irrigated agriculture remains the main priority and hope for food self-reliance of the GIRM, the PREF recognizes the problems that irrigated agriculture has faced in the past and calls for investments in improved traditional agriculture, particularly recessional cropping. The PREF calls for investment in at least four recessional agriculture schemes, which will contribute to achieving the goal of improving 2000ha of floodgate-controlled fields per year. In addition to this project which will be based in Kaedi, Lake R'kiz, Maghama and the Karakoro are also targeted for major investment in recessional agriculture. The PREF expects to flood and control up to 25,000ha annually before the end of the century.

The second of the two documents which define the GIRM's development plans for the SRB is the Terms of Reference for the "Post-Manantali" studies which the IBRD and the FED have commissioned. The first page of this analytical strategy statement is very unambiguous: "During a transition phase, the duration of which could reach the end of the century, annual demand for Manantali water will be noticeably inferior to the capacity of the reservoir. This excess water capacity will permit the maintenance of an artificial flood after the completion of the dam through controlled releases. Thus, during this period the government of Mauritania will carry out a program of recessional agricultural improvement along the Senegal River".

The PID team's meetings with GIRM, parastatal and other donor officials revealed significant frustration with irrigation schemes in Mauritania. These schemes are expensive to build, expensive to operate, and difficult to organize and exploit. By contrast, the French FAC (Fonds d'Aide et Cooperation - official bilateral assistance agency) and CCCE (Caisse Centrale de Cooperation Economique - official bilateral lending agency) have funded a recessional agricultural development project near Lake R'kiz in the Trarza Region, which has achieved excellent results in its first year of operations. Farmers will harvest nearly 3 tons per hectare on 1500 hectares from this year's flood. Other donors including the FED and the FAO/UNDP have indicated interest in working with recessional projects.

While counting on irrigated agriculture to solve Mauritania's cereals production problems in the long-run, the GIRM has clearly indicated that improvement of recessional agriculture is an important short and medium-term goal. The MRVDP thus fits within the GIRM's priorities for investment in the agricultural sector and the agricultural sector is the GIRM's highest priority for development during the foreseeable future.

I. B. Relationship to the CDSS

One of the major goals of USAID/Mauritania as set forth in the FY 1986 CDSS and the FY 1989 Program Statement, is to help the country improve its food security. The MRVDP directly addresses the issue of food security, concentrating on increasing area cultivated and yields for cereal agriculture in one of the most promising cropping zones of the Mauritanian bank of the SRB. Although the MRVDP will not suffice to end Mauritania's cereals deficit, it will permit the country to move toward diminished dependence on imported coarse grains, which make up a significant portion of its food aid. The project will also contribute to increased employment, income and well-being in previously neglected rural areas.

The GIRM has generally asked donors to concentrate their agricultural development programs in specific areas of the SRB. The French work in the Delta, the Dutch and Chinese in the lower valley, the Germans and the European Development Fund (FED) in the middle valley, and the IBRD in the upper valley (eastern Gorgol and Guidimaka). Mauritania has reserved the Dirol Plain for USAID.

The AID program in Mauritania is already active in the Kaedi area where the MRVDP will base its operations. The proposed project is complementary to other USAID assisted activities based at Kaedi such as the AGRES II project. The AgRes II Project supports the CNRADA with management and farming systems inputs. The Human Resources Development Project has sent Mauritanian technicians from two Kaedi institutions, the National Agricultural Research Center (CNRADA) and the Agricultural Training School (ENFVA) to the US for bachelor's and master's level courses. Peace Corps agricultural and health projects operate on and around the Dirol Plain. In addition, USAID helps maintain the Boghe-Kaedi road, which runs along the Northern edge of the Plain.

In the long run, the MRVDP's output will be enhanced by the results of other USAID assisted agricultural activities. Innovations flowing from CNRADA/AGRES II, for example, will contribute materially to increases in small farmer productivity.

The MRVDP will be one of the first attempts to manage the floodwaters of the SRB. It will provide vital information on the agronomic, economic and social feasibility of maintaining recessional agriculture on a long term basis after the completion of the Manantali Dam. It will help determine optimal methods for the eventual transformation of traditional agricultural systems into modern ones. This will

contribute to improved food production, incomes, and well-being as Mauritania moves toward increased food self-reliance over the coming decade.

II. Project Description

A. The Perceived Problem

Mauritania needs cereals to feed its people. The devastating droughts that began in 1968 have driven hordes of Mauritanians from the rural areas that could no longer feed them. As a consequence, the nation's urban population has grown rapidly to include more than 30% of all Mauritanians. Nouakchott alone holds nearly a quarter of the country's people. These people do not farm but must eat. Their needs have led to Mauritania's present exaggerated dependence on international food aid for its basic survival.

To begin to solve the problem of dramatic cereals deficits, Mauritania needs a strategy to increase agricultural production and make life in rural areas more prosperous and thus attractive. Farmers must produce more and must earn fair prices for what they do produce.

Traditional agriculture in Mauritania is constrained by the lack of water, and the abundance of birds, locusts, rats, wandering herds of animals, smut, and other dangers which affect harvests. However, water is the key to production. Traditionally, farmers have used water in three ways:

- rain directly on fields
- run-off from seasonal watersheds, collected behind temporary dikes or floodgates
- floodwaters from the annual rise of the Senegal River

From the early 1960's, after Mauritania became independent, agricultural planners have sought to avoid the risks inherent in all three traditional water management systems by establishing irrigated perimeters along the Senegal River. Irrigation provides total control of available water and thus should ensure high production at low risk. Unfortunately, as colonial planners predicted, the construction of irrigated perimeters in Mauritania has proven costly, operations and maintenance have been difficult and expensive, and adapting traditional land tenure systems and agronomic practices to the needs of irrigated agriculture has met surprising resistance from local farmers.

Irrigation is probably a necessary component of any long-term solution to Mauritania's agricultural production problems, but the GIRM and the donor community have begun to look elsewhere for short and medium-term interim approaches that will provide increased production and rural income. They looked first at rainfed agriculture, led by USAID's Integrated Rural Development Project in the Guidimaka (DRIG). Although the DRIG obtained positive results, the unique conditions of the Guidimaka limited the application of lessons learned there to other areas of the SRB. You cannot do rainfed agriculture where there is no rain.

The GIRM and the donors next turned to "walo" agriculture. The Senegal River can potentially flood up to 70,000 hectares in Mauritania each year. However, the waters rarely reach even a small proportion of this area. But where the floods cover the land for an optimal period of 45 to 60 days, farmers obtain good crops of sorghum. The future of recessional agriculture depends largely on plans for the use of water controlled by the Manantali Dam on a major tributary of the Senegal River. During the next ten to fifteen years, while the OMVS countries decide on priorities for the use of this water, recessional agriculture will provide significant potential for increasing cereals production in Mauritania.

Recessional agriculture requires a specific set of topographical and pedological conditions which severely limit the areas available for improving its performance. This improvement depends primarily on improved water control and management. In Mauritania, the plains of R'Kiz, Maghama, the Gorgol and the Dirol are the primary walo zones large enough to justify the construction of water management infrastructure.

The Dirol Plain, an area of about 11,000 hectares, lies about 15 kilometers west of Kaedi. About a quarter of the Plain is in the Gorgol Region, the rest in the Brakna. The plain is quite flat, with elevations ranging from about 6m to about 13m. It contains soils well suited to recessional crops, and is nearly entirely denuded of vegetation, except in and around the villages that dot its landscape and on uncultivated lands at elevations above 11m. The Dirol is very densely populated. It is one of the few areas in Mauritania where you can see several villages from one spot.

Farmers on the plain have practiced recessional agriculture for centuries. However, they suffer from the irregularity of the uncontrolled floods, which limits available arable area and changes that area from year to year. Irregular water supply also limits yields from what area they do manage to plant. This irregularity has kept harvests and thus incomes and food security low, driving many of the most dynamic members of the Dirol villages to seek their fortune elsewhere. During good years, with high floods, many of these emigres return for the recessional season (September - April).

The MRVDP should increase the area annually available for maximally effective walo cultivation on the Dirol Plain and return sorghum yields to what they were in the pre-drought era. This should increase the incomes and security of the people of the Dirol Plain.

II.B. Project Goal and Purpose

The <u>Project Goal</u> is to increase production of staple food crops, particularly sorghum on the Dirol Plain in South-Central Mauritania. This goal supports GIRM sector goals as well as USAID country development strategy goals. In attaining this goal, the MRVDP will contribute to food self-reliance for Mauritania.

The Purpose of the project is to increase sorghum yields by establishing effective control and maximal use of water on the Dirol Plain. Through the retention of water on the flood plain for optimal periods of 45 to 60 days, farmers will be able to harvest a mature crop of sorghum, with yields of up to 450 kgs/hectare. It is also expected that growing of other basic foodstuffs will be stimulated by the farmers increased ability to retain the water on their fields.

The MRVDP will thus serve as a pilot effort to identify alternative production systems to supplement irrigated agriculture in Mauritania.

II.C. EXPECTED ACHIEVEMENTS/ACCOMPLISHMENTS

During the life of Project (LOP), the MRVDP will have:

- o completed the construction of a 12m high floodgate near the mouth of the Dirol Creek;
- o increased annual sorghum production on the Plain by 1,000 tons;
- o trained villagers to operate and maintain the floodgate;
- o trained farmers to manage efficiently the water resources controlled by the floodgate.

These projected achievements will be elaborated on during the PP Phase.

II.D. Project Outline and How It Will Work

The setting:

The MRVDP will construct a floodgate to benefit the people earning their living from recessional agriculture on the Dirol Plain. These people have evolved a farming system which has enabled them to survive in a harsh and irregular environment. The MRVDP will introduce no innovative methods to transform their agriculture. It will rather give them the opportunity to better manage their water resources as a means of reducing risk and variability in their present system.

The land tenure system of the Pulaar and Haratine farmers who work the plain is remarkably well adapted to the current conditions of recessional agriculture. Traditional political structures can adapt themselves to meet the needs of both water management and floodgate maintenance. Farmers are used to paying traditional taxes which are used to meet community expenses - hospitality, public buildings (e.g. mosques), or charity. The farmers of the eighteen principal villages which exploit the plain are not willing to devote the traditional 'assakal' tax, which is used for charity and religious works to floodgate maintenence. But they have stated that they are prepared to

levy a supplementary tax similar to the 'assakal' uniquely to pay for the maintenance of water control structures built by the project.

There is good traditional appreciation of the importance of water management. Several villages have attempted to build handmade seasonal dams in the Dirol Watershed in order to keep rainwater from running off too quickly. These have all failed to achieve their purpose.

The human milieu in which the project will work presents significant potential for successful and sustainable implementation. Initially, labor availability was expected to present a major potential constraint to project success. Many people have left the Dirol Plain during the past years because of harsh and irregular agricultural conditions there. But most of these people (nearly 70%) are in nearby cities - Dakar, Kaedi, Nouakchott. Many return regularly for the agricultural season. Thus, there are serious reasons to believe that sufficient labor will be at hand when needed. Land availability seems to present a more serious problem. The MRVDP will attack this problem directly by ensuring that larger quantities of good land can be exploited effectively every year through effective water management.

The natural milieu in which the MRVDP will work is also propitious. The Plain itself is flat and relatively free of natural vegetation. No land clearing is needed to exploit the entire walo area. The construction of a water retention floodgate near the mouth of the Dirol Creek will ensure annual flooding of about 4500 ha of prime walo land for the optimal period of 45-60 days. The current and predicted flood pattern of the Senegal River indicates that the marginal benefits from constructing a dike on the plain to allow water retention beyond what the natural 10-12m IGN levee retains would be minimal. These additional benefits would not come close to justifying the additional costs of dike construction and maintenance (see annexes for the details of this argument).

Low-lying soils (6.5-10m) on the plain are well suited to recessional agriculture. If and when villages are ready to begin the transition to pump-irrigated agriculture, suitable land is available for perimeter development at higher elevations (10-13m). There should be no conflict between recessional/traditional and irrigated systems because pump-irrigation will be used only on higher land, which cannot be used for recessional cropping.

The institutional setting of the Dirol Plain also offers significant advantages to the MRVDP. Kaedi is the home of one of the GIRM's most important agricultural institutions, the CNRADA (Centre National de Recherche Agronomique et Developpement Agricole), which is assisted by the USAID-funded AGRES II Project. Under AGRES II, USAID will place an agronomist in the CNRADA to conduct farming systems research, with on-farm trials and demonstrations to improve recessional agriculture in Mauritania. This expert will concentrate his research on the Dirol Plain.

Core Project Activities:

The MRVDP is a straightforward construction and water management project. USAID will finance the construction of a strongly built 12m high flood-gate near the mouth of the Dirol Creek. As stated above, the floodgate will retain water on the Dirol Plain for an optimal period, thus enabling the farmer to significantly increase his yields. If engineering and hydrological analyses during implementation call for additional structures (e.g. a weir upstream on the Creek itself, drainage channels in the Southern Plain, or riverbank protection measures), these will also be considered for financing.

The Project will help organize and train Dirol Plain farmer groups to manage the water that is retained by the floodgate and to maintain the works themselves. The PID team has worked closely with farmers in the Plain and has elicited their agreement to participate in planning the organization of water management activities and in generating sufficient finance to ensure sustainable maintenance of the floodgate.

The MRVDP will finance long and short term technical assistance to ensure effective implementation of these core activities but will avoid the establishment of any new institutions that are not entirely under the control of the farmers who work the Plain.

Sustainability:

To ensure that project benefits accrue to the villagers of the Dirol Plain and thus to Mauritania permanently, the MRVDP must do everything possible to institutionalize maintenance and water management among the farmers who work on the Plain. At the same time, it must do everything possible to avoid institutionalizing anything within the Project itself. For this reason, project personnel and administrative infrastructure must be kept to an absolute minimum. No GIRM personnel need be assigned to the MRVDP. Thus no one will have an interest in empire building within the project structure.

MRVDP's emphasis will aim squarely at beneficiary sustainability. It will assist participating farmers to create long-term institutions to collect maintenance fees and to manage the water activities. Project activities will contribute to reinforcing the capacities of the people of the Plain to effectively manage flood water and infrastructure maintenance. Although related research activities will be intense during the first few years of the project, that research will be conducted entirely by the CNRADA/AGRES II and will not burden farmer organizations or the MRVDP budget or personnel.

Technical Assistance:

The MRVDP will require expatriate technical assistance to supervise the construction of the Dirol Creek Floodgate and to show the people of the Plain how to maintain and operate the structure to ensure optimal management of water resources. This implies the presence of a Civil/Structural Engineer for approximately 18 months at the start of the project. Once the floodgate is near completion an agricultural engineer should join the project for approximately two years. Both

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should return for two visits per year of approximately one month for the LOP after they finish their tours of duty in Kaedi.

The MVRDP will make use of other short term specialists for specific tasks related to the analysis of the need for further water management structures and monitoring and evaluation. It is also envisioned that the project will finance short-term consultants to undertake various baseline studies in collaboration with the National Agricultural Research Center (CNRADA).

Coordination and Supervision:

To ensure GIRM support for the project and coordination with Mauritanian national policy goals, the MRVDP USAID Project Officer will establish a close working and coordinating relationship with the Ministry of Rural Development (MDR), Directorate of Planning, for coordination of project implementation activities amongst:

USAID
CNRADA
SONADER
Directorate of Planning
Directorate of Agriculture Engineering

The MRVDP, Directorate of Agriculture Engineering (DGR) will take primary responsibility for project implementation and supervision.

In Kaedi, the MRVDP Project Engineer will ensure regular and constant contact to help the project run smoothly among:

- CNRADA
- AGRES II
- SONADER
- ENFVA
- Environmental Protection Inspector
- Inspector of Agricultural Engineering
- Inspector of Agriculture

III. FACTORS AFECTING PROJECT SELECTION AND FURTHER DEVELOPMENT

A. SOCIAL CONSIDERATIONS:

Two principal social issues have influenced the development of modern agriculture along the Mauritanian river basin. These are land tenure and social organization for operations and maintenence of water-control infrastructure. By choosing to work with a traditional, locally known and approved production system, the MRVDP should be able to avoid problems in these domains.

LAND TENURE SYSTEM

The land tenure system and the social organization of the societies of the Dirol Plain, Pulaars and Haratine, are appropriate for ensuring land distribution and effective exploitation of the agricultural resources of the Plain.

Through a complex system of ownership and access rights to land, Pulaar society controls both land and agricultural labor. The control of labor derives from the use of different types of tenure arrangements which the Pulaar use to ensure both productivity and equity. Onerous sharecropping (with payments of up to one half of the crop) occurs when there is a dire shortage of land as during a very low flood year (10% probability). Various mechanisms also exist to ensure that all the fields are cultivated, even in a high flood year when there might be a labor constraint. In the latter situation, the farmers use devices such as making temporary gifts of land (Dokal) and loans of land (Loubal).

A certain amount of flexibility is built into the land tenure system to reduce farmers' risks during high and low flood years. The dispersion of the fields farmed by any individual and the annual redistribution of land through the traditional tenure system permits all farmers, even those with lesser ownership rights, to cultivate some recessional land. In this region, as the majority of the lands are commonly owned at the lineage or the extended family level, the oldest person of the family or lineage plays an important role in allocating land to the different members of the family.

Almost 80% of the total population have primary or secondary ownership rights on the land they cultivate. One's relation to the land he cultivates might change according to seasonal flood levels. For example, a farmer may become "land-short" if his field is not flooded or if the flood remains too long and he misses the right planting season. If either situation occurs, the farmer is then forced to rent a field suitable for planting. The MRVDP will reduce the risks associated with either occurrence through an improved water management strategy.

The MRVDP will improve recessional agriculture by retaining water and increasing the inundation time for walo lands on the Dirol plain. Thus, it will work hand in hand with the traditional land tenure system. The MRVDP is less a water control project than an agricultural risk aversion project, which means that it has to have flexibility in its approach to water and land management. The traditional land tenure system already contains such flexibility and should present no obstacles to project implementation.

ORGANIZATION FOR FLOODGATE MAINTENANCE

The population of the Dirol Plain already has a complex system of land and production management authorities. These authorities, at the clan or family level, define rights in land and the taxes that are to be

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paid for such rights. Land rents differ depending on the type of right and the caste of the farmer, but in general, the entire population pays the Assakal (one tenth of the production). This is used as social security for the poor and to help unfortunate farmers during periods of grain shortage. The Assakal is also used to help needy families on occasions such as relgious feasts, marriages, and deaths.

Pulaar and Haratine elders play an important role in decision making, both at the lineage and the family levels. The head of an extended family collects all the Assakal payments from his brothers, even though the brothers have full ownership rights on their land. This same type of organization is appropriate for levying local taxes for floodgate maintenance. The head of the extended household, who knows the capacity of the different fields he has distributed in any given year, will collect the taxes for the proposed Dirol Plain Water Users Association (DPWUA). He will be observed by other heads of extended households to see if what he reported was right.

The taxes collected in kind (presumably in sorghum) from each village will be recorded and eventually sold to CSA at its support price of 21 UM/kg. The PID team estimates that even during the worst years, the taxes levied through this Assakal-type system will be enough to cover more than the cost of maintaining the floodgate. The villages interested in the project will set up a Resource Center Association where each extended family will have a representative. Once all the taxes are collected, the DPWUA will sell all the grain and the money received will be put into an Association bank account in Kaedi.

The taxes will not serve only for floodgate maintenance but also as a resource base to which all participating villages can have access if they have a viable project to carry out.

The organization of the farmers and the design of the tax structure similar to that of the Assakal will provide a good testing ground for future projects in the SRB and serve as a good transitional mechanism if irrigated perimeters are to be implemented in the future.

Beneficiaries

A recent demographic survey reveals that there are more than 25,000 inhabitants on and within the immediate vicinity of the Dirol plain that will be assisted by the proposed project. This population is aggregated into 24 villages and the town of M'Bagne where 11 percent of the population resides. The population represents 3,855 households of which 2960 (77 percent) indicated that agriculture was their principal activity. This project will reduce risk and provide more security for the farmer households that cultivate on Walo. It is also estimated that the project will increase cereals production by up to 10 percent at a development cost of at least 20 times lower per hectare than for pump irrigated projects.

WOMEN AND THE MRVDP

More and more, women are playing an important roles in the development of the SRB. The males are going away and much of the decision making within households is being transferred to women who sustain their families and help their migrant husbands.

In many Pulaar areas, women rarely have access to land. On the Dirol Plain, however, numerous people claim ownership of land through inheritance from their mother (Yuman-ndewmi). Women among the Hebbiyabe, Nerenabe, Irlabe, and Tmoudek inherit land and can farm their own share if they want to.

These fields inherited from the mother pose certain problems because they tend to be fragmented into small plots that are not economically viable. To avoid this fragmentation, the different rights holders use the fields in a system of one year rotations. These fields are important. For example, all the Irlabe people living in the village of Niabina have inherited their land rights through their mothers.

In recent years, women in this region have become involved in village gardening projects, which provide a useful complement to their family diet as well as a source of income. By and large village garden projects are run by women and tend to be well-managed.

While the scope of this project does not permit a concentrated focus on the roles of women on the Dirol Plain, the project will encourage greater participation by women in agricultural production by better managing water for the fields they cultivate.

III.B. ECONOMIC CONSIDERATIONS

SUMMARY OF ECONOMIC ANALYSIS

Flood patterns and the elevation of future irrigated perimeters are the two key determinants of economic feasibility of specific water retention structures proposed for the Dirol Plain.

CONSTRUCTION COMPONENTS IN THE NORTHERN DIROL PLAIN

LeBloas (1986) and Smith (1984) have assumed high future flood patterns and that irrigated perimeters will be constructed at elevations below 10 meters IGN. Under these assumptions a 9.5-10 meter (effective level) retention system provides $38,675 of direct and indirect benefits annually from flood retention and minimal flood protection for irrigated perimeters. An 11 meter retention/protection system provides $63,285 of direct and indirect recessional cropping benefits plus flood protection for irrigated perimeters below 10 meters elevation. If flood protection for irrigated perimeters has a significant value then the clear choice is the higher 11 meter dike system.

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The PID team has assumed low future flood patterns (based on Gannett Fleming) and that irrigated perimeters will be constructed at elevations above 11 meters due to soil characteristics. Under these assumptions a 9.5-10 meter retention system (effective level) provides $143,596 of direct and indirect benefits annually from recessional agriculture. An 11 meter retention/protection system provides no additional recessional agricultural benefits and minimal flood protection for irrigated agriculture. In this scenario the flood retention benefits for recessional agriculture alone make the 9.5-10 meter retention system economically viable and optimal. Under these assumptions the clear choice for the northern Dirol Plain is a low elevation retention system involving exclusively a structure at the mouth of the Dirol Creek. This structure is expected to provide a net present value of $708,135 with a benefit/cost ratio of 1.77 and an internal rate of return of 18%. This economic rate of return is based on very conservative estimates of benefits including minimal sorghum yield increases due to increased inundation, negligible additions to cropped hectarage, no improved agronomic practices, no value placed no additional forage produced, no benefits to the livestock sector from increased water availability, no new crops, and labor opportunity costs that minimize project benefits.

CONSTRUCTION COMPONENTS IN THE SOUTHERN DIROL PLAIN

Under high floods and low elevation irrigation, the management problem in the southern plain is drainage and flood protection. Under low floods and high elevation irrigation the management problem is to provide access channels for floodwater to enter the southern plain. Again differences in these two fundamental assumptions led the PID team to different conclusions from LeBloas and WMSII. Initially, development should focus on channel deepening to provide floodwater access to depressions in the southern plain. At a later date, it is possible that a very small water retention gate should be built in the access channel that is deepened. Limited field time and topographical information make a detailed analysis of southern plain development net benefits impossible at this time. However, aggregate gross benefits are substantial.

AGRONOMIC COMPONENTS

All other agronomic components reviewed were deemed economically viable development strategies for specific (but not all) villages in the Dirol Plain. Small irrigated perimeters, improved agronomic practices in recession agriculture, agroforestry, fishing, and introduction of new crops could all be included in the Dirol Plain Development Project. If improved agronomic practices are adopted for recessional agriculture, then the annual crop benefits from the proposed structure at the mouth of the Dirol Creek (in a year like 1986/87) would increase by $322,000/year from an annual average cropping benefit of $110,451.

The economic analysis at the PID stage clearly concludes that the project is viable, even with minimal agronomic interventions. The potential benefits would be even greater if improved Agronomic practices from CNRADA's research were included as part of this project. USAID/Mauritania has purposefully decided to minimize its initial investment in this pilot scheme. The key to improved yields during this phase lies in training the villagers to control the water and to maintain the flood-gate structure. The project will collaborate with the government extension agency already operating in the Dirol Plain and with the USAID AGRES II project. The fundamental assumption, however, is that by being able to retain water on their lands for an optimal period of 45-60 days, farmers will be able to reap a mature crop of sorghum, thus significantly increasing their yields. With the assistance of short-term technical assistance and periodic evaluations, project progress will be monitored to determine if and when modification are needed.

III.C. RELEVANT EXPERIENCE WITH SIMILAR PROJECTS

For many years after Mauritania became independent, the GIRM and the donor community expended very little time, money or effort on the improvement of traditional agriculture. Investments in pump-irrigated perimeters, large and small, seemed to promise far higher returns than did any possible improvements to traditional rain-fed or recessional farming systems. However, pump-irrigated agriculture has not fulfilled its potential. Construction costs have been astronomical; operations and maintenance have proved beyond the means of cereal growers, the GIRM and the donors themselves. Traditional land tenure systems and socio-political organization have found themselves in profound contradiction with the needs of irrigated perimeters.

Thus, over the last few years, the GIRM and the donors have begun thinking about alternative solutions to the problem of increasing cereals production. USAID led the way with the Guidimaka Integrated Rural Development project, which had good success increasing yields and area cultivated in parts of Southeastern Mauritania. However, few other parts of the country receive as much rain as the Guidimaka, limiting the replicability of the project. Still, USAID learned that modest agricultural projects which work with farming systems understood and appreciated by the local population can achieve substantial results.

USAID has also achieved good results in Mauritania introducing innovative agricultural techniques. The Guidimaka project had good success with animal traction, and the Vegetable Production Project, with significant assistance from the Peace Corps, established numerous self-sustaining market gardens along the river valley and in the Assaba. The Peace Corps has continued this program on its own and continues to achieve solid results.

Through all this, recessional agriculture remained apart. Mauritanian and expatriate agronomists assumed that most recessional areas would eventually be "improved" with pump-irrigated perimeters, as has happened in the Gorgol and Boghe areas. However, in the past five

years, the GIRM and the donors have begun thinking of improved recessional agriculture as a real alternative to or useful transitional phase leading to pump-irrigated perimeters. In 1985, the French began the construction of water management structures on Lake R'Kiz in the Trarza. During their first season (1986-87) they achieved remarkable results, with average yields of 2.2T/hectare of sorghum on approximately 2000 hectares of soils similar to those of the Dirol Plain. The R'Kiz project must be counted a success to date.

Previous experience with improvement of traditional farming systems, introducting modest innovations to these systems, and working with improved recessional agriculture indicate that the MRVDP has good potential to improve agricultural production and increase rural prosperity on the Dirol Plain.

III.D. PROPOSED GRANTEE IMPLEMENTING AGENCY

The MRVDP design intends to maximize the participation of small farmer beneficiaries in the planning and implementation of the project. Requirements for GIRM financial and managerial support for the project will thus be minimized. Nonetheless, GIRM oversight is appropriate and necessary. It is proposed that the implementation of the MRVDP fall under the supervisory mantle of the Ministry of Rural Development (MDR). The MDR will assign responsibility for regular monitoring and control of the project to one of its constituent elements, which is represented both in Nouakchott and in Kaedi. As the MRVDP is primarily a construction and water management project, it is suggested that this responsibility fall within the Directorate of Rural Engineering (DGR) of the MDR. The DGR will in turn report to the Planning Cell of the MDR, which has oversight responsibility to ensure that all rural projects are carried out in accord with GIRM priorities and intentions.

The project implementing team will include a prime contractor, selected through open competitive bidding. This contractor will provide long term advisers and short term technical assistance as needed. The long term positions are: Civil/Structural Engineer, and agricultural/water management engineer. If a single individual can cover both of these skill areas, it will be preferable to bring only the one long term adviser to the field. The prime contractor will also take charge of procuring necessary commodities for the activity, both overseas and in Mauritania.

The Long and short term experts will meet regularly with the recessional agriculture adviser to the CNRADA/AGRES II to coordinate their activities.

III.E. AID SUPPORT REQUIREMENTS AND CAPABILITY

At the field level, the MRVDP will be managed by the contractor engineer with headquarters in Kaedi. He will oversee the construction of the floodgate, and prepare villagers for maintenance and operation of the structure. He will maintain working relationships with the

CNRADA/AGRES II staff. The engineer will report to the USAID Project Officer based in Nouakchott. The Project Officer will be the USAID Mission Agriculture Development Officer assisted by the Mission Engineer.

In addition to the field level Technical Committee (CTS), which will meet on a regular basis in Kaedi, the project proposes to form a senior level Coordinating Committee (CC) which will meet once a year to discuss program direction and any policy issues which may arise. The composition of this committee is presented in section II.D. of the PID.

Although no additional USAID logistical support requirements are anticipated beyond those normally required for a project of this size and complexity, it will be determined at the Project Paper stage if the services of a local assistant project manager will be needed. This person would be based in Kaedi and would be responsible for much of the coordination with farmer organization, the extension agency and the Peace Corps.

USAID will take the prime role in ensuring that policy implications which emerge from project operations are transmitted to and negotiated with the appropriate GIRM agencies.

III.F. ESTIMATED COSTS AND METHODS OF FINANCING

The preliminary MRVDP budget presented below shows the estimated costs of the activity over a five year LOP. All costs are to be grant-funded. To the extent that counterpart funds are available, they will be used to finance local currency requirements. The extent of future availability of these funds is not presently known, but needs are estimated at approximately $1,500,000 over the LOP. The modalities of local cost financing will be worked out at the PP phase and during project implementation.

It is proposed that the contractor supplying technical assistance to the project also be responsible for procuring all project-related commodities. USAID/Mauritania will be responsible for assigning the contract for floodgate construction to a qualified firm which will implement that contract. Supervision of the work will be provided by the contractor, the MDR Directorate of Agricultural Engineering (DGR), and the USAID/Mauritania Mission Engineer.

Mauritanian contributions to the project will take the form of salaries and benefits of GIRM officials from the CNRADA working on recessional agricultural research, village financing of floodgate maintenence, proportional depreciation of CNRADA facilities placed at the disposition of the MRVDP and tax exemptions granted project personnel and commodities. These contributions will represent approximately 25% of the value of investment in the project.

A preliminary estimate of project costs includes:

Floodgate construction:	$750,000
Technical assistance:	
civil structural engineer x 18 mos	225,000
agricultural/water management eng x 2 years	300,000
Short Term TA	
20 person months x $15,000/month	300,000
Procurement:	
3 4WD vehicles x 25,000	75,000
spares at 10,000 over 5 years	50,000
2 computer sets at $5,000	10,000
spares, supplies	5,000
office equipment/supplies	20,000
CONTINGENCY	265,000
TOTAL:	$2,000,000

This is a preliminary estimate of costs that will be refined and made more precise at the PP stage.

III.G. DESIGN STRATEGY

The main thrust of the PP design strategy for the MRVDP will be to refine, broaden and focus the preliminary analyses made during the preparation of the PID. To achieve optimal results and to ensure that construction and hydrology assessments furnish the implementation plan with the most accurate possible estimations of water flow patterns, levels and quantities, it is essential that the PP design team observe both the rainfall runoff from the Dirol Creek Watershed and the Senegal River flood on the plain during 1987.

Thus, design work should begin, ideally in July or August. This will permit observation of nearly a full rain fed and recessional planting cycle as well as the hydrological events mentioned above during the six month period allocated for PP preparation by the RFP for the Dirol Plains Studies Project (OS/AFR)86)0004).

The PP team should be composed of a team of experts similar to those who contributed to the PID:

- o design officer 2 x 5 weeks
- o local hire sociologist 6 months
- o engineer (agricultural/civil)) 5 months
- o agricultural economist) 4 months
- o hydrologist) 2 x 6 weeks
- o agronomist) 1 month
- o engineering geologist) 6 weeks

- o expatriate social scientist) 2 x 1 month
- o cost estimator) 2 x 2 weeks
- o procurement analyst) 1 month
- o secretary) 6 weeks

Terms of reference for the principal members of the team are presented in an annex to this PID.

The team will present a PP outline during the first week of work in country and offer bi-monthly interim briefings to the USAID mission and GIRM officials. At that time, the official interlocutor of the project design process named by the GIRM will assign an engineer to the design team.

The final draft report on construction feasibility will be submitted at the end of the second month after a review by USAID/Mauritania's PSC engineer. It will be completed by the end of the third month. The final engineering design will be completed by the end of month four and the final cost estimates by the end of month five. At that time, a draft PP will be submitted for USAID review.

As USAID/Mauritania does not now have a PDO on its staff and does not expect to have one until January, 1988, it will be necessary to request one from REDSO/WCA or from AID/W to assist the mission with the PP design.

III.H. ENVIRONMENTAL THRESHOLD DECISION

An IEE has been prepared for the MRVD Project and is appended as an Attachment 2 to this PID. That IEE recommends a negative determination for the engineering works component, the TA sub-components directly affecting the environment, and the commodity procurement components. All other components are recommended for categorical exclusion pursuant to the provision of 22 CFR 216.2(C).

III.I. AID POLICY ISSUES

The MRVDP aims to increase agricultural production. Although it is not a policy advisory project, experience has shown that successful production projects can profit from favorable policy environments and often provide the best arguments for needed policy changes. The MRVDP should not neglect the important potential impact of the GIRM's agricultural policies on cereals production on the Dirol Plain. It should also remain constantly aware of the impact that project success or failure will have on decisions about policies that will govern the establishment of priorities for the use of the water of the Senegal River after the Manantali Dam begins operations.

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Currently, the agricultural policy climate in Mauritania is relatively favorable to small farmers. Cereals marketing is completely free and numerous small merchants and entrepreneurs participate in the market. The Commissariat @ la Securite Alimentaire acts as a buyer of last resort for certain crops, including sorghum, and sets a floor price which is close to the import parity price. For the last several years, in spite of mountainous annual cereals deficits, free market sorghum prices have stayed below the CSA floor price for most of the year. Exceptions are at periods between harvests when stocks are low. In 1986, for example, sorghum prices shot up to over 25UM/kg or before the harvest. The apparent anomoly of huge cereals deficits and low free-market cereals prices may be related to imports of sorghum and other grains provided as food aid by donor nations.

On the other hand, GIRM land tenure policy puts recessional agriculture at a disadvantage. By declaring that all land must be owned by private individuals, in conformity with Islamic Law, the GIRM has tried to facilitate the adaptation of traditional land-holding practices (see annex) to irrigated agriculture. If applied to the Dirol Plain, the current land tenure law would probably paralyze agricultural production. If the MRVDP's water management interventions are wholly successful and the amount of flooded acreage stabilized, such application may eventually become feasible. For now, the GIRM has not sought to apply the official land tenure rules to floodplains.

When the Manantali dam becomes fully operational at the end of the century, a conflict will inevitably arise between competing requirements for the limited supply of available water in the reservoir. While Mali is unlikely to take a strong stand on such issues, Senegal and Mauritania may differ dramatically in their positions. Both countries now place very high priority on the availability of water for pump-irrigated agriculture along the SRB. The Senegalese very badly want Manantali to generate as much electricity as possible to fuel the mines and industries in their Eastern regions and to service the Manantali & Diama debt. Mauritania has very little need for electricity from Manantali, but badly needs a continued controlled flood for recessional agriculture. Senegal has expressed little or no interest in a controlled, "artificial" flood.

Since the water management requirements for a constant flow of hydroelectricity are incompatible with those of the "artificial" flood, Mauritania is going to have to bring very strong arguments to bear to carry the day, even if optimal artificial flood levels are lower than currently anticipated. The MRVDP should provide a major part of the arguments in favor of recessional agriculture. for this reason, careful monitoring and evaluation of the cost and benefits of all project activities will be exceptionally important if they are to contribute effectively to policy formation.

III.J. WAIVER REQUIREMENTS

The only specific waiver currently anticipated is for motor vehicles. Experience has shown clearly that such US-made vehicles do not perform

adequately and are extremely difficult to maintain under local conditions. Although no additional waivers from normal procurement procedures seem warranted at this time, any such requirements will be brought to AID/W's attention as they are identified.

III.K. GRAY AMENDMENT

The Mauritania River Valley Development Project is a construction and water management project. It will a) construct a 12 meter floodgate near the mouth of the Dirol Creek and b) train Dirol Plain farmer groups to operate and maintain this floodgate. This will improve the potential for effective water management on the plain and improve crop yields.

The Project base will be in Kaedi, a rural town in Southern Mauritania. It is anticipated that a modest amount of technical assistance will be procured under this project.

While the nature and technical difficulty of the project does not exclude all of the firms covered by the Gray Amendment, USAID/Mauritania places a premium on selecting the most capable firm to execute the project. At a minimum the firm selected should have significant experience in successfully implementing projects in similarly harsh, desert like environments and any proposed experts should be seasoned specialists in their fields.

For these reasons, therefore, USAID/Mauritania believes that the contract to implement this project should be subject to open competition. Open competition would open up the bidding to interested, qualified firms covered by the Gray Amendment, while permitting all other interested and qualified firms to compete.

ATTACHMENT I

PRELIMINARY LOGICAL FRAMEWORK MATRIX
FOR MAURITANIA RIVER VALLEY DEVELOPMENT PROJECT
(682-0237)

NARRATIVE SUMMARY	OBJ'LY VERIFIABLE INDICATORS	MEANS OF VERIFICATION	ASSUMPTIONS
GOAL: INCREASE PRODUCTION OF STAPLE FOOD CROPS ON DIROL PLAIN IN MAURITANIA	INCREASED STAPLE CROP PRODUCTION AND SALES ON DIROL PLAIN	A. OFFICIAL PRODUCTION STATS B. FARMER SURVEYS C. STRUCTURE ANALYSIS OF SORGHUM MARKET USING SAMPLE DATA AND COMPARISONS FROM ALL SOURCES D. SORGHUM PURCHASES OF CSA	A. GIRM POLICY REMAINS FAVORABLE TO RECESSIONAL AGRICULTURE B. NO LABOR CONSTRAINT C. CORRELATION BETWEEN AGRICULTURAL PRODUCTION AND WATER RETENTION WITHOUT OTHER INTERVENTIONS IS STRONG
PURPOSE: TO INCREASE SORGHUM YIELDS THROUGH MAXIMAL USE OF WATER, LAND AND HUMAN RESOURCES	FLOODGATE CONSTRUCTED AND BEING OPERATED FOR INTENDED BENEFICIARIES AT REASONABLE COST	VISUAL INSPECTION AND REPORTS OF CONTRACT BY MISSION ENGINEERS	FLOODGATE CAN BE BUILT IN ONE YEAR
OUTPUTS A. INCREASED SORGHUM PRODUCTION B. TRAINED FARMERS CAPABLE OF MAINTAINING GATES AND OPERATING THEM C. OPERATION FLOODGATE		A. OFFICIAL STATISTICS B. FARMER SURVEYS C. CSA PURCHASES D. ANALYSIS OF SORGHUM MARKET	A. FARMERS APPRECIATE UTILITY OF GATES B. GIRM POLICIES REMAIN FAVORABLE TO AGRICULTURE IN GENERAL AND RECESSIONAL AGRICULTURE IN PARTICULAR
INPUTS A. LONG AND SHORT TERM TECHNICAL ASSISTANCE 825,000 B. COMMODITIES 35,000 C. VEHICLES 80,000 D. CONSTRUCTION 750,000 E. CONTINGENCY 310,000		A. QUARTERLY FINANCIAL, ADMINISTRATIVE, AND IMPLEMENTATION REPORTS B. VISUAL INSPECTIONS	A. COMPETENT CONSTRUCTION COMPANY AVAILABLE TO DO FLOODGATE IN ONE YEAR B. INPUTS AVAILABLE ON TIMELY BASIS

INITIAL ENVIRONMENTAL EXAMINATION

OR

CATEGORICAL EXCLUSION

Project Country: Mauritania

Project Title: Mauritania River Valley Development (682-0237)

Funding: FY(s) _____ US$ _____

IEE Prepared By: J. Wiley Goodson
Regional Environmental Officer
REDSO/WCA

Date: 18 May 1987

Environmental Action Recommended:

Positive Determination _____

Negative Determination ___X___

The engineering works component and TA subcomponents involving activities directly affecting the environment are recommended for negative determination. No significant adverse effect on the environment is expected to result from implementation of any engineering infrastructural or other MRVD Project intervention, but significant positive impact is expected to accrue to the fisheries, pastoral, health and agricultural sectors. The commodity procurement component is also recommended for negative determination since no pesticides will be "procured" or "used" under the project pursuant to 22 CFR 216.3(b)(1). It is recommended that river transport, erosion, Manantali discharge and health issues, as described in sections 2.2, 2.5, 2.6 and 2.10 of this IEE, respectively, be addressed in writing during the PP design stage.

Categorical Exclusion:

The farmer training, agricultural training and extension, and TA components of the project which do not include activities directly affecting the environment are categorically excludable under the provisions of 22 CFR 216.2(c)(2)(i) and should be so excluded.

Clearance:

Mission Director, USAID/Mauritania: _____

DATE: _____

Concurrence:

Bureau Environmental Officer:

APPROVED: _____

DISAPPROVED: _____

DATE: _____

Clearance:

GC/AFR: _____

DATE: _____

Pursuant to 87 State 18297, and as a Class A USAID Mission, USAID/Nouakchott requests that under Delegation of Authority 551 authority for approval of the Initial Environmental Examination (IEE) for the Mauritania River Valley Development Project be delegated to the Regional Environmental Officer (REO), REDSO/WCA, with clearance authority delegated to the REDSO/WCA Regional Legal Advisor (RLA).

INITIAL ENVIRONMENTAL EXAMINATION

1.0. PROJECT DESCRIPTION

The Mauritania River Valley Development (MRVD) Project (682-0929) is a five year, US$--million activity designed to help farmers in the Dirol Plain area of the Senegal River Basin (SRB) establish control over floodwaters from Dirol Creek and the Senegal River, and thereby increase agricultural production, income and welfare. The project goal is to improve the quality of rural life in the SRB and the project purpose is to maximize use of water, land and human resources on and around the Dirol Plain to increase agricultural production, augment farmer income and reverse rural exclus.

Farmers have evolved a traditional system of recessional agriculture on the 11,000 ha Dirol Plain which relies on planting sorghum and other crops in lowlying areas after recession of peak seasonal floodwaters from Dirol Creek (August) and the Senegal River (September). Planting only occurs where depth and duration of flooding were sufficient during the August-September period to have left a soil moisture regime conducive to good sorghum plant growth. Both hectarage planted and crop yields on the Dirol Plain therefore fluctuate with the depth and duration of inundation on the plain, and thus vary considerably between years as a function of precipitational and runoff patterns in the upper Dirol Creek and SRB watersheds. Dirol Plain farmers are well aware of the potential benefits which would accrue to this traditional recessional system if the floodwaters of Dirol Creek and/or the Senegal River could be retained on the plain: this would both increase and stabilize the hectarage which could effectively be planted, and reduce interannual uncertainty and variation in crop harvests. Indeed, local efforts have been made to sandbag Dirol Creek near its mouth so as to retain floodwaters, but these efforts have been and are likely to remain unsuccessful.

The MRVD Project is designed principally to permit retention of floodwaters from both Dirol Creek and the Senegal River through construction of a two-way floodgate structure near the mouth of Dirol Creek, and through minor ancillary engineering works designed to maximize floodwater retention on the plain. These engineering works will not result in flooding of more hectarage than currantly is flooded, but rather they will extend water retention time on flooded land and thereby increase the hectarage with a sufficient residual moisture regime to produce a good sorghum crop.

Basically an advanced recession agriculture project, the MRVD is expected to serve as an effective transition stage to help farmers shift from traditional recessional methods, well adapted to existing social, economic and political structures, to

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irrigated agriculture which requires major adaptations of those structures. The project is expected to increase national cereals production by up to 10% per year, contribute to the achievement of food self-reliance, and provide significant income to a beneficiary population of more than 25,000 people at development costs at least 20 times lower per hectare than for pump irrigation projects.

The MRVD Project can, for environmental review purposes, be broken down into five relatively discrete components: engineering works, farmer training, agricultural training and extension, technical assistance (TA) and commodity procurement. A range of secondary ancillary activities may also be undertaken, as appropriate, during project implementation.

The engineering component of the MRVD Project will include construction of a 10-12 meter AMSL floodgate structure near the mouth of Dirol Creek with about seven two-way floodgates. This structure will retain the peak discharge waters of Dirol Creek in seasonally inundated portions of the Dirol Plain until the floodwaters of the Senegal River can be captured approximately one month later. Both Dirol Creek and Senegal River floodwaters will be held for a total of approximately 45-60 days, or 30-45 days over "no project" conditions, and will be released about mid-November so that planting on moist but drained soils can be completed by the second week in December. If engineering and hydrological analyses during PP design call for additional structural improvements, e.g., an upstream weir on Dirol Creek, drainage channels on the southern plain, or riverbank protection measures, then these secondary engineering works will also be implemented with project funds.

The farmer training component of the project will organize and train Dirol Plain farmer groups to manage the water that is retained by the floodegate structure and to maintain the engineering infrastructure. Two elegant aspects of this project are: 1) the engineering infrastructural improvements required to effect significant production increases are simple, limited in scope and easily maintained, and 2) the water management system realized will fully complement the traditional water management systems employed by Dirol Plain farmers and thereby require only minor adjustments to the introduction of new floodwater retention techniques.

The agricultural training and extension component of the project will complement the newly introduced water control interventions. It will use long and short term TA for such potential activities as improving seed stock, introducing better crop genetic varieties, improving planting and harvesting techniques and improving crop production through better use of fertilizers and compost materials, and agroforestry activities.

The TA component will include provision of both long and short term TA. Long term TA is currently expected to include a chief

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of party (COP), administrative assistant, agricultural or civil engineer, agronomist and farmer organization specialist. Short term TA is expected to include a soils specialist, cereals agronomist, altermative crops specialist, cooperative management expert, training specialist, hydrologist, monitoring and evaluation specialist, and/or data processing specialist.

The commodity procurement component of the project will include procurement of floodgates and associated engineering infrastructural materials, vehicles, motorcycles, computers, and miscellaneous equipment, tools and household goods. No pesticides will, pursuant to 22 CFR 216.3(b) (1), be either "procured" or "used" under the MRVD Project, nor will any housing or similar construction be undertaken.

As the project develops, extension agents, Peace Corps Volunteers (PCV's) and/or village groups may express a desire to undertake project-related ancillary activities. These may include improving animal husbandry, crop protection, establishment of small ateliers or shops, animal traction, fisheries, agroforestry, cereals marketing support, village infrastructure development, market gardening, development of fruit orchards, poultry or milk production and/or similar activities. To the extent that these activities appear viable during project implementation and do not distract agents from the main project tasks of water management and cereals production, project TA personnel wll establish contacts with competent local organizations to assist with their implementation and the MRVD project may program local currency to meet a share of the costs of those operations.

2.0 ISSUES AND IMPACTS

Due to it's water management focus, a number of "environmental" issues are associated with the MRVD Project. Because it is a recession as opposed to an irrigation project, however, and is designed merely to retain floodwaters on the Dirol Plain for an additional 30-45 days over no project conditions, most of these issues are minor in comparison to, e.g., typical irrigation projects in the arid and semi-arid regions of Africa.

2.1 FISHERIES

An "Assessment of Environmental Effects of Proposed Developments in the Senegal River Basin" (Gannett Fleming, n.d.) concluded that the construction of the Diama and Manantali dams on the Senegal River, in conjunction with intensive irrigated agricultural development, would result in a permanent reduction of annual riverine fish harvests. This predicted impact was attributed to the fact that non-estuarine SRB fisheries rely substantially on inundated floodplains to replenish fish stocks since these floodplains provide both breeding habitat and nursery areas important to a variety of riverine-associated fish

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species. Specifically in association with the floodplain fisheries of the middle SRB valley, the assessment predicted under a maximum agricultural development scenario a loss of 360,000 ha of floodplain habitat by 2028, resulting in a net annual loss of 21,600 metric tons of harvestable fish from the Senegal River by 2028.

In contrast to irrigated agricultural development which excludes fish stocks from the floodplains, however, the MRVD Project will both continue and improve the Dirol Plain floodplain as a fish breeding and nursery area by 1) permitting movement of stocks onto the floodplain during the Senegal River flood stage; 2) increasing water retention and fish accessibility to the floodplain for an additional 30-45 days per year over no project conditions; 3) increasing retention of detrital and non-detrital nutrients on the floodplain, originating from both Dirol Creek and Senegal River transport from the upper watersheds; and 4) increasing primary (both phytoplanktonic and vascular) and secondary production on the floodplain over no project conditions. The MRVD Project is therefore expected to improve breeding and nursery habitat quality, result in a significant increase in fishery productivity in the Dirol Plain area over no project conditions, and there by counterbalance to some extent the adverse fisheries impacts expected as a result of major SRB dam construction and irrigated agricultural development. It should, moreover, improve fisheries offtake by local villages by increasing the fish biomass available on the plain for an additional 30-45 days and by improving water retention in the plain's seasonal lakes which are a source of fish protein throughout all or most of the year.

2.2. RIVER TRANSPORT

An issue raised during PID design related to the effect that construction of a floodgate structure near the mouth of Dirol Creek would have on river transport. During the flood season, one of the principal means of transport for people and goods between the Senegal River and the Dirol Plain is by pirogue (i.e., dugout canoe) via the Dirol Creek channel. Construction of the MRVD structure will constrain but not preclude such transport. It is expected that transfer of people and goods will occur either from pirogues below the structure to pirogues above the structure, or that the pirogues themselves will be manually transported across the structure prior to journey continuation. Since the floodgate is designed to be only a 10-12 meter structure, and since floodwaters will reduce the effective vertical distance between upstream and downstream areas of the creek at the site to only a few meters, construction of this floodgate is expected to represent only a minor transport constraint for a short period of time during the flood season. It is recommended, however, that the PP team further consider this issue and determine what if any realistic mitigation measure(s) could be undertaken to minimize the effects of floodgate construction on river transport between the Dirol Plain and the Senegal River via Dirol Creek.

2.3 DOWNSTREAM WATER USERS

Water management projects almost always affect, to a greater or lesser degree, downstream water quantity water quanty and timing. The MRVD Project will have an extremely minimal effect on all three parameters. Water quantity will be reduced only insofar as the increased retention time for Dirol Creek and Senegal River floodwaters reduces the mass water balance of the Senegal River through increased evapotranspiration (ET) and soil profile percolation of retained water over no project conditions. The overwhelming percentage of retained water will be released, however, to the Senegal River during the month of November.

The effect of Dirol Plain water retention on the timing of water availability will be to slightly reduce the Senegal River discharge pulse deriving from peak discharge of Dirol Creel in August; slightly reduce the peak discharge of the Senegal River during September; and slightly increase the Senegal River discharge during November over no project conditions. This effect should largely benefit downstream users. The actual quantity of water retained by the Dirol Creek floodgate structure, however, is minor in relation to total Senegal River discharge; peak Dirol Creek discharge, for example, is less than 10% of peak Senegal River discharge.

Significant water quality impacts are also not expected to result from project implementation. If anything, the increased Dirol Plain biotic productivity resulting from improved water retention should improve the nutrient budget of the Senegal River after release of waters in November, concomitantly increasing riverine fisheries productivity. The net suspended sediment load of the Senegal River downstream of the Dirol Plain, conversely, is expected to be somewhat reduced over no project conditions due to the settling out of suspended particles onto the Dirol Plain during water retention as a function of reduced water velocity. While water quantity, quality and timing impacts are expected for the most part to be neutral or beneficial in relation to downstream water users, none of the effects are likely to be significant since the quantity of retention waters is extremely minor in relation to Senegal River discharge and mass nutrient balance.

2.4 VILLAGE WELL IMPACTS

Water management activities typically result in some degree of village well impact, associated with either water quality, water quantity or both. The MRVD Project is not expected to result in any water quality impact, either positive or adverse, but it is expected to improve water quantity conditions through shallow aquifer recharge by virtue of improved water retention on the Dirol Plain. Village wells on the plain currently tap water at depths of about 5-15 meters during the dry season, depending on well elevation and shallow aquifer stratigraphic

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perturbations, and increased surface water retention and percolation through the soil profiles and subsoils can be expected to somewhat reduce these depths. This can in turn be expected to reduce well water acquisition time and absolute well drawdown over no project conditions, but beneficial impacts will undoubtedly be slight due to the limited increase in depth and duration of water on the plain over preexisting conditions.

2.5 EROSION

The Dirol Plain is a geographical feature characterized by very slight topographical relief and erosion on the plain proper is not considered an issue here. Lateral erosion by both Dirol Creek and the Senegal River is, however, a potentially important issue and should be more carefully assessed during PP design. It is clear that the current mouth of Dirol Creek will be stranded in the near to short run when the creek erodes through a narrow spit currently separating it from the Senegal River at a point well below the proposed floodgate structure, but this will affect neither dams stability nor floodwater ingress nor egress due to the site's lower topographical location. Of greater concern is the lateral (northward) migration of the Senegal River at a point upstream of the structure which threatens the eastern tributary of Dirol Creek. While this tributary drains only about 25% of the plain, northward migration of the Senegal River at this point will eventually capture this tributary and divert flow from this 25% of the plain directly into the Senegal River. The issue is how fast the Senegal River is actually migrating at this point and how rapid the approximately 450 meter wide spit separating the two hydrological features can be expected to continue to channel outflow through the proposed floodgate structure. This issue takes on somewhat greater importance if it is determined that construction of a dike off the east side of the structure would improve water retention, since the spit width between the potential dike and the Senegal River would be reduced to about 300 meters.

The environmental survey conducted in May 1987 suggests that while Senegal River erosion at this point appears significant at the vertical level of the upper and middle north bank, the river channel proper appears to be migrating northward at a much slower rate as a function of differential stratigraphic erosional resistance. Continued flood stage erosion should therefore continue to reduce the slope of the north bank and, because such a reduction in slope would reduce water velocity at the upper degrading edge of the slope due to drag, actual reduction in the width of the spit should slow over time. While eventual loss of 25% of the drainage area of the Dirol Plain directly into the Senegal River would reduce project benefits, it is not anticipated that such a loss would occur during the anticipated 20 year period required for project payoff. This issue should, nonetheless, be considered in somewhat greater detail during PP design.

2.6 MANANTALI DISCHARGE MANAGEMENT

The effect of discharge from the Manantali Dam upstream of the project area in Mali will ultimately be to reduce peak Senegal River discharges and increase current dry season discharges. A very important issue remains as to the effect that Manantali discharge will have on the MRVD Project, particularly given current uncertainty about the discharge management option which will ultimately be selected for that facility and the effect of reservoir filling on downstream discharges during the first few years after dam closure. Preliminary indications suggest that 1) reservoir filling will significantly reduce peak Senegal River discharge for a period of a few years; 2) peak discharges from the dam after filling will be on the order of 8.0-10.0 meters AMSL (IGN); and 3) artificial flooding will be maintained for at least 10-15 years to permit gradual shifting from recessional to irrigation agriculture in the middle SRB. The effect of peak discharges on project benefits are of course significant since capture of Senegal River floodwaters is a major objective of the project. This issue has been considered in detail during PID design and all indications are that even under a worst-case, no Senegal River flood scenario, the increased agricultural productivity which would accrue solely from retention of Dirol Creek floodwaters would be sufficient to render the project economically feasible. It is recommended that this issue be more carefully considered during PP design, however, when additional information is expected to be available regarding Manantali discharges and the implications of those discharges can be more carefully evaluated with respect to design and construction of the Dirol Creek floodgate structure.

2.7 SALINIZATION

The potential for salinization to result from project implementation is extremely minimal. The Dirol Plain is an externally-drained, high-lying geographical feature occuring in immediate proximity to a major river. While the precipitation: pan evaporation ratio is undoubtedly less than 1:2, groundwater depth is greater than 3.o meters, groundwater gradient is greater than 0.005, 24 laboratory soil analyses all gave soil infiltration rates of greater than 1.0 mm/hour, and late dry season conductivity of Senegal River water from near the mouth of Dirol Creek was measured during the environmental survey at only 115 micromhos/cm. In addition, the clay content of the soil is generally low except in seasonal lakes, and even late dry season conductivity of lake water measured during the current survey did not exceed 420 micromhos/cm. All of these factors, in conjunction with the improved annual flushing which will occur under the project, strongly suggest that salinization potential on the Dirol Plain with this type of intervention is virtually nonexistent.

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2.8 WOODY VEGETATIONAL RESOURCES

The natural vegetation of the Dirol Plain would normally vary according to topography and the depth and duration of annual flooding. Most of the natural vegetation, however, has been removed or modified under the considerable historical agricultural and grazing pressure associated with population densities currently averaging over 200/km2. The most important woody vegetational resources occur in a "foret classee" on the northern portion of the Dirol Plain, a degraded association which will not be directly affected by project implementation. Indirectly, the project may serve to increase the amount of woody biomass by increasing soil moisture and fertility and somewhat increasing groundwater levels. Limited agroforestry interventions may also be undertaken as ancillary project components during project implementation if such activities are found to be appropriate. The project is not, in any case, likely to increase existing pressure on woody vegetational resources either directly of through indirect population impact and no significant adverse project impacts on such resources are therefore anticipated.

2.9 PASTORAL IMPACTS

Two issue typically arise with respect to astoralism in association with water management projects in arid and semi-arid regions of Africa: impacts on the quantity of forage and water and impacts on access to forage and water resources. The MRVD Project will improve both water and forage quantity over no project conditions by retaining a greater amount of water on the Dirol Plain for a longer period of time during the year and thereby increasing both natural vegetational productivity and the pastorally critical post-harvest crop stubble biomass. Access to forage and water resources is not expected to be significantly affected either positively or negatively due to project implementation, since a traditional system has long been in place to regualte such access. Most livestock, including principally sheep, goats, camels and some cattle, are locally owned although there are occasional transmigrations of regional livestock through the Dirol Plain. In any case, existing access conditions should not significantly change since the existing system to regulate that access is considered sufficiently resilient to accomodate any spatial or temporal change in forage and water resource distribution which may ultimately result from project implementation.

2.10 HEALTH IMPACTS

Water management interventions have the potential to result in significant adverse human health impacts by exacerbating water-related disease incidence rates, at the same time that they are designed to reduce malnutrition or starvation through increased agricultural productivity. Water-related disease incidence rates are sometimes increased over no action conditions

when water management interventions 1) increase the area of surface water, 2) prolong surface water avalability later into the dry season, and/or 3) increase human exposure to surface waters. The most common diseases associated with water management projects in arid regions of Africa are malaria, schistosomiasis, onchocerciasis, yellow fever, filariases, dracunculiasis, diarrhea/dysentery and cholera. During the course of the current environmental survey, interviews were held with two medical doctors with considerable experience in water-related diseases in Mauritania. The first, who has been with the hospital at Kaedi on the Dirol Plain for approximately two years, summarized existing indicence rates in the Dirol Plain region qualitatively as follows:

Malaria: There is greater incidence in irrigated regions along the Senegal River than in the Dirol Plain area. Cases in the Dirol Plain area occur year around but are greater during the period October-April and peak from about Deember-January in association with maximum mosquito breeding habitat availability. Hospital treatment consists primarily of prescribing Nivaquine, of which there has so far been a sufficient supply.

Schistosomiasis: There are currently few cases. Previously the hospital saw about one case every two weeks but this has recently increased to about one case per week. Infection is primarily found in children and is about evenly distributed between sexes. There are currently sufficient supplies of drugs to treat schistosomiasis, although a seven day treatment period is required and the hospital typically has to keep the patient on the premises throughout this period.

Onchocerciasis: None has been reported at Kaedi in the last two years.

Yellow Fever: None has been reported at Kaedi during the last two years, and it is considered generally to be quite rare.

Filariases: Some incidence has been reported in areas to the east of Kaedi but no cases have been reported in the last two years from the Dirol Plain.

Dracunculiasis: Reported to be very uncommon in the Dirol Plain area.

Diarrhea/Dysentery: Reported to be extremely common and to be associated with contaminated drinking water and poor hygienic practices.

Cholera: There are a few (ca. 20) cases reported every year, usually occurring before the onset of the rains in July.

Malnutrition: This is not a water-related disease as such but it is critical to evaluating tradeoffs in water management project health impacts. Malnutrition is reported to be very common throughout the year, especially among pastoralistes.

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After describing the salient water management features of the proposed project, and the effects the project would have one water surface area, surface water prologation and human exposure to surface water, it was the opinion of the medical doctor at Kaedi that the incidence of malaria would increase, the incidence of schistosomiasis might increase, but that no other incidence rates were likely to be affected. This doctor pointed out that malnutrition would likely decrease, that Dirol Plain develcpment was extremely important ("one must develop") and that in his opinion there was no doubt that the net human health tradeoffs of the project would result in beneficial impact.

Another medical doctor, Dr. Jean-François Etard, was interviewed in Nouakchott regarding possible project impacts on schistosomiasis rates. Dr. Etard is a Mauritania schistosomiasis specialist and currently works on the USAID/Mauritania Rural Health Services Project. After review of anticipated, project-induced water regime impacts, it was Dr. Etard's opinion that schistosomiasis rates would probably increase to some extent. His rational was that 1) incidence rates associated with the Senegal River proper in this area are extremely low under existing conditions; 2) schistosomiasis on the Dirol Plain is probably currently restricted to those people who are exposed to the plain's ephemeral lakes, since the snail vector probably cannot survive the 10-11 month dessication in other portions of the plain; 3) increased water retention on the plain should permit expansion of infected areas to sites topographically removed from but aquatically connected to infected lakes during inundation; and 4) increased numbers of people would be exposed to those infected areas during the water retention period, by virtue of the greater area involved, even though drainage of retained water in November should help minimize impact.

It is the opinion of the Regional Environmental Officer (REO), based on these two interviews and an on-site survey, that the project will likely increase malaria incidence rates, may or may not actually increase schistomiasis rates, and is not likely to significantly affect any other water-related disease incidence rates. On balance, these potential impacts should be weighed against improved nutrition and food availability as a result of projected increases in agriculture productivity. It is recommended, however, based on 1) General Council direction that positive and adverse project impacts cannot be weighed against each other and 2) the intent of the provisions of 22 CFR 216 (specifically 22 CFR 216.1(b)(1)), that the USAID/Mauritania Health Officer review this opinion during PP design and determine whether mitigation of anticipated and/or ambiguous impacts makes realistic and good development sense. This review should, at a minimum, consider two factors. First, there are four basic alternative ways to mitigate adverse health impacts resulting from water management interventions: 1) accept a no projet scenario, which makes little sense given the prevailing food grain deficit and malnutrition problems currently observed in

Mauritania; 2) control mosquito and/or snail vectors with pesticides and molluscicides, which is expensive, only marginally effective, is probably not continuable after projet EOP, and has its own inherent health risks; 3) implement an education, training and health infrastructure (e.g., latrine and well) component, which is also expensive and not particularly effective in moslem-dominated cultural areas of north Africa; and 4) provide drugs for treating the target diseases through existing health care facilities. The last mitigation measure is almost invariably associated with the lowest costs and least management burden, but whether or not it makes realistic development sense is dependent upon the need for the drugs in relation to prevailing supply.

3.0 RECOMMENDED ENVIRONMENTAL ACTION

The farmer training, agricultural training and extension, and TA components of this project which do not include activities directly affecting the environment are categorically excludable under the provisions of 22 CFR 216.2 (c) (2) (i) and should be so excluded. The engineering works component and other TA subcomponents involving activities directly affecting the environment are recommended for negative determination. No significant adverse effect on the environment per 22 CFR 216.1 (c) (11) is expected to result from implementation of any engineering infrastructural or other MRVD Project intervention. Significant positive impact is, conversely, expected to accrue to the fisheries, pastoral, health and agricultural sectors. The commodity procurement component is also recommended for negative determination since no pesticides will either be "procured" or "used" under the project pursuant to the provisions of 22 CFR 216.3 (b) (1).

It is recommended that during PP design, the river transport, erosion, Manantali discharge Management and health issues described in sections 2.2, 2.5, 2.6 and 2.10, respectively, of this IEE be addressed in writing.

ACTION MEMORANDUM TO THE ASSISTANT ADMINISTRATOR FOR AFRICA

DATE

FROM : USAID, Mauritania

SUBJECT: Mauritania River Valley Development Project (682-0237) Source/Origin Procurement Waiver for Vehicles

A. Problem

Your approval is requested for Source/Origin Waiver from AID Geographic Code 000 to Code 935 to permit the purchase of 3 four-wheel drive vehicles and spare parts of non- U.S. manufacture.

1.	Cooperating Country:	Mauritania
2.	Authorizing Document:	Project Paper
3.	Project:	Mauritania River Valley Development Project (682-0237)
4.	Nature of Funding:	Grant
5.	Description of Commodities:	3 Four-wheel Drive All Terrain Vehicles Plus Spare Parts
6.	Approximate Value:	$125,000
7.	Probable Source:	Mauritania
8.	Probable Origin:	Japan or Germany

B. Background

Section 636 (i) of the Foreign Assistance Act of 1961, as amended, requires that vehicles for development assistance projects be manufactured in the U.S. unless there are "special circumstances: justifying a waiver. One of the special circumstances listed in AID Handbook 1, Supp. B, Chapter 4C2a (3) is the inability of U.S. manufacturers to provide a particular type of necessary vehicle, or the lack of adequate repair facilities and spare parts for U.S. Manufactured vehicles. Handbook 1, Supplement B, Chapter 5b4a sets forth an additional requirement that a change in the geographic code cannot be authorized unless one of 7 criteria for granting a waiver is met. One of these criteria is that the particular commodity required is unavailable. Under DOA 140, Revised, the Mission Director has authority only up to $50,000 for granting source/origin procurement waivers for motor vehicles.

C. Discussion:

The Mauritanian River Valley Development project will assist the farmers of the Dirol Plain to increase agricultural production. The

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project will construct a floodgate on the Dirol creek to and will assist farmers to manage and control the water retained by the floodgate. Technical assistance will be provided to supervise the construction. Successful project implementation will require extensive off road travel over the rough Mauritanian terrain. USAID/ Mauritania's experience has shown that U.S. manufactured vehicles are not well suited to this type of terrain. In addition, there is no service facility or supply of spare parts for U.S. manufactured vehicles in Mauritania . A ready supply of spare parts are available in Dakar, Senegal, for the Japanese manufactured which will be purchased for this project.

Because of the difficulty experienced in maintaining U.S. manufactured vehicles, USAID/Mauritania has requested and obtained AID/W approval to use Mercedes trucks as the standard Mission vehicle (Nouakchott 0983). Vehicles of the durability required which can be adequately serviced and maintained in Mauritania is not available from the U.S.

D. Recommendation

Based on the justification above, it is recommended that you sign below and thereby:

1. Determine that special circumstances exist to justify waiving the requirement to procure U.S. manufactured vehicles under FAA section 636(i);

2. certify that exclusion of procurement of motor vehicles from free world countries, other than the cooperating country and countries included in AID Geographic Code 941, would seriously impede the attainment of U.s. foreign policy objectives of the Foreign Assistance Program; and

3. waive the source/origin requirements set forth in Handbook 1, Supplement B, to permit the procurement of 3 four-wheel drive all terrain vehicles and spare parts from countries included in Geographic code 935.

4. Waive the source/origin requirements set forth in Handbook 1, Supplement B, to permit the procurement of 130 motorbikes and spare parts from countries included in Geographic code 935.

Approved : _____

Disapproved : _____

Date : _____

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COPIES OF ANNEXES ARE AVAILABLE FROM AFR/PD

ANNEXES TO PROJECT IDENTIFICATION DOCUMENT

MAURITANIA RIVER VALLEY DEVELOPMENT PROJECT
682-0237

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3. Analyzis
4. Technical Summary
5. Appendices

B. Hydrology

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2. Inventories
3. Analysis

C. Soils and Agronomy

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3. Agricultural Policy Implications
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8. Preliminary Results of Soils Tests

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4. Economic Viability of Sub-Components
5. Sensitivity Analysis
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7. Secondary Non-Farm Income
8. Flood Patterns for Economic Analysis

E. Social Soundness

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2. Social Organization
3. The Land Tenure System
4. The MRVDP and Land Tenure
5. Organization for maintenance and Operations
6. Women and the MRVDP
7. Inventories
8. Sample Village Profile

F. Institutional Analysis

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2. Inventory
3. Analysis and Institutional Descriptions

G. Terms of Reference for PP Preparation

1. Agricultural Economist
2. Engineer
3. Hydrologist
4. Agronomist
5. Social Scientist
6. Institutional Analyst

H. List of Persons Contacted

I. Bibliography

MAURITANIA RIVER VALLEY DEVELOPMENT PROJECT

PROJECT IDENTIFICATION DOCUMENT

ANNEXES

(682-0237)

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I. Bibliography

Annex A

DIROL PLAIN PROJECT

ENGINEERING INVENTORY, ANALYSIS AND SUMMARY

PROJECT IDENTIFICATION DOCUMENT

Prepared by

Development Alternatives, Inc.
624 9th Street
Washington, D.C. 20001

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ENGINEERING ANALYSIS AND INVENTORIES

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A. Inventory - Engineering

1. Costing Methodology

a. 1984 unit prices for materials and labor and total costs for floodgates and alternative dikes are available from a study carried out by Jean Le Bloas, of USAID, (RBDO, Dakar). (See Bibliography). Total costs are in UM and Dollars. At the time of the study the value of the UM was one Dollar equals 56 UM. Currently the U.S. Dollar value is 72 UM.

b. 1982 unit prices for the Grogol Irrigated Perimeter Project near Kaedi were obtained from a rehabilitation study. carried out for this project by SONADER.

c. We propose to compare unit prices from the above two sources. Then based on experience, we will select a unit price. The unit prices will be escalated to the 1987 level by using an inflation value of 10 % per year. This represents the average rate of inflation in Mauritania during this period. The unit price will then be converted to U.S.Dollars at the present value of 72 UM per U.S. Dollar.

2. Topography

a. Maps at a scale of 1:200,000, 1:50,000 and 1:10,000 are available. For the area around the mouth of the Dirol, 1:2,000 topography is available. The contour interval for this topography is 0.5 meters.

b. A plan and profile survey was carried out for the dike alignment 1A, 14.7 km., proposed by Le Bloas in his 1984 study.

c. Photo mosaics are also available at a scale of 1:10,000. They are of very poor quality.

d. If a dike alignment different from item b. above is selected, then a new plan and profile survey should be carried out. In any case, cross sections should be taken every one hundred meters along a dike alignment during the PP Phase.

e. For locations where water control structures are recommended, detailed plane table topography should be prepared. This topography should have a scale of 1:200. A contour interval of 0.25 meters is recommended, since the surrounding lands are extremely flat. This survey should be carried out during the PP Phase.

3. Construction Materials.

a. Riprap Material

Materials to be used for riprap can be obtained from the edge of the hills located near the village of Ndiafane. This is at the eastern end of the 14.7 km. dike proposed by Le Bloas. This riprap will be processed from the laterite rock available at these locations. Laterite rock is common as an outcrop at the bottom edges of most of the small hills in the project area. It is also available in the form of a rock outcrop in the two small hills at the western end of the 14.7 km. dike proposed by Le Bloas. The maximum size that can be utilized is in the range of 0.15 to 0.20 meters. The rock occurs in larger sizes and must be processed and broken down by a crusher or by hand to the required size. The total thickness of the riprap protection proposed is 0.30 meters.

b. Filter Material

Filter material can be processed hand or machine crushing from the same laterite material but a smaller size is required. The filter material thickness required is in the range of 0.05 to 0.15 meters. The total filter layer thickness is 0.30 meters.

c. Road Surface Materials

Road bed and surfacing material can be obtained from the same laterite material. It should be processed to the same approximate size as the filter material.

d. Dike Embankment Material

Dike embankment materials can be obtained along the length of the proposed dike alignment. Pockets of cohesive, clayey loam are observed all along the proposed alignment. When this material is placed as dike embankment it will require mechanical compaction or equivalent hand compaction under close supervision. Compaction should be carried out on the material in a wet condition. Ideally, it should be at its optimum moisture content, the content at which the soil has its maximum density.

e. Sand and Gravel

Sand required to make concrete can be obtained from a location along the edge of the Senegal River approximately three kilometers from the proposed Dirol floodgate site. This material will require screening to obtain the desired gradation. It should be tested before it is used. Gravel can be obtained from hills at the eastern end of the plain, approximately 7 to 15 kilometers from the Dirol floodgate location. This gravel will also require screening to obtain the required gradation. Concrete cylinders

made from these materials should be made and tested before the materials are approved for use.

4. Initial Engineering Concepts - Inventory

a. Dike Riprap Protection

It is recommended that riprap protection be provided for both faces of the proposed dike. This option will be expensive, but is necessary to reduce future maintenance costs and to protect against rain and flood induced erosion and frequent animal traffic.

b. Dike Roadway

If a dike is constructed, it is proposed that it be provided with a roadway for small vehicle traffic. This roadway will be located on top of the dike. Any structures provided along the dike must have provision for the passing of vehicle traffic. Each structure should be provided with a roadway deck. Vehicle traffic must be limited to the lightest vehicle weight class by the use of curbs and overhead bars.

c. Floodgate at Mouth of Dirol Creek

We propose that a flood retention structure be constructed at the mouth of Dirol Creek. It will be a two directional floodgate. It should be located just downstream from the intersection of the two main branches of the Dirol Creek. This is the location proposed and surveyed by Le Bloas. (1984) This location is approximately 1.4 km. upstream from the intersection of the Dirol Creek with the Senegal River. A small dam/floodgate structure when used in conjunction with a low dike can hold back flood waters originating in the watershed of the Dirol Creek and/or collect waters that enter the Dirol Creek from Senegal River floods. We anticipate that significant benefit can be derived from this floodgate even without a dike. Ultimately this water can be used for flood recession agriculture, and in the future, could be pumped to other farm lands for irrigation. The structure will retain and spread flood water on lands where crops have been grown previously. The structure will provide a greater quantity of water and will hold this water for longer periods than if there were no structure. The floodgates should be designed to allow flood water to flow in two directions. This will allow Dirol Creek flood water to be stored when available or Senegal River flood water to be captured when available.

The structure will be approximately 7 meters high, 6 meters wide and span across a 75-meter wide creek. Seven gates are proposed. Each gate will be four meters wide and five meters high. The gates will be mounted in a reinforced concrete frame.

This concrete frame will be held in place by compacted embankment material. Gates will capture the two different types of flood waters described above. The gates should be manually-operated, steel, vertical-slide gates designed to allow water to flow in two directions.

5. Geology

(This information was obtained from "Resourse Inventory, Southwestern Mauritania", by the Remote Sensing Institute, South Dakota Sate University, 1982)

a. General

A broad range of Pre-Cambrian to recent surface geology exist in Southeastern Mauritania. The Pre-Cambrian and Cambrian Formations constitute the "L'Arc des Mauritanides"; the dominent rocks are granites, granodiorites, and diorites in the Pre-Cambrian and chlorites, sericites, schists and mica schists in the Cambrian. The Cambro-Ordovician Period is represented by sedimentary formations that form the base of Tagant and Assaba Plateaux and that exist as outliers and plateaux in the eastern area. Rock types from this period are mainly mudstones, sandstones and tillites. The western part of the area is a depositional depression of the Tertiary period. Sandstones, marls, limestones and dolomites are the dominent rocks in this period. Quaternary deposits include the terraces of the Senegal River, marine deposits near the coast, alluvial deposits in seasonal streams and aeolian sands which occur as dunes and gently undulating sand sheets.

Four tectonic movements have greatly shaped the structures of the region. The relatively-young formations were, however, affected only by the last tectonic movement and thus retained their original horizintal bedding. The major effect of the tectonic movement on these younger large domes have been identified on satilite imagery and are located east of Aleg. Numerous faults and fractures were mapped in Assaba, Tagant and the Brakna Regions; the linear trends are generally northeast to southwests.

b. The Dirol Plain

The lower Dirol Plain consists of alluvial clays and silts. The upper Dirol Plain, well away from the Senegal River, consists of soft, porous sand tones and dolomites. The project area fits into the terraces along the Senegal River and the alluvial deposits from seasonal streams.

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B. Analysis - Engineering

1. Operation and Maintenance

If a dike is constructed, it will be affected by periodic floods, erosion, animal traffic and possible over-topping by flood flows. The dike will be constructed from well compacted embankment materials and its slopes protected by riprap material. Nevertheless, it will require maintenance. Two men should be assigned for each kilometer of dike to spend approximately one-third of their time maintaining the dike. This work can be carried out with hand tools. If a breach in the dike should occur, all of the men assigned to maintain the dike can be called to the single location to repair the dike.

The annual budget for maintaining and operating the dam and dike would usually be estimated to cost approximately 2 per cent of the capital cost of constructing the dike. If a 14.7 km. dike were constructed, approximately 30 men would be required for maintenance. If the men worked four months per year at 22 days per month, this would amount to 4 x 22 x 30 = 2640 man-days of labor per year. Using a high daily labor rate of $ 5 per day per man, this would amount to $13,000 per year. A medium height dike would cost in the range of one millon U. S. Dollars to construct. Two per cent of this capital cost would amount to $20,000 per year. This difference in these two amounts would allow provision for equipment, materials and special occurances.

The funds to pay for the labor could come from a tax on the increased production resulting from the construction of the dike. A water user-type group should be formed well before the completion of the dike construction to operate and maintain the dike.

Additional funds must be provided to operate and maintain the floodgate proposed for the mouth of the Dirol Creek. Two men will work year-round for normal operation and maintenance. During the flood season one person should be provided for operating each gate. It is anticipated that there will be periodic erosion at the toes of the upstream and downstream aprons. Maintenance costs in the amount of 2% of the capital cost of the floodgate should be provided. This would amount to $15,000 per year. These funds would be for labor, materials and supplies with some allowance for unexpected events.

Detailed simple operational procedures should be prepared in French, Poulaar and Hassanya for the operation of the gates. These procedures will deal with the possibility of receiving flood waters from two directions and the possibility that the timing of the two occurrances could overlap. A locally trained

technical supervisor should have the overall responsibility for the maintenance and operation of the gates.

2. Water User Groups

Before construction starts for the dike and/or the water control structure, the farmers should be organized into a water user group. This group must be organized before the final designs are prepared so that the farmers can provide their input into the final plans. The members of this group are those who will benefit from the construction. They will farm the lands which receive water from the project. They may be involved in the construction of the facilities and will be responsible for the operation and maintenance of the facilities.

Experience in many developing countries has shown that if the farmers are organized into a water user group early in the project implementation phase, the project will be better conceived, operated and maintained. Structures will be more fully utilized and will require fewer subsidies. The farmers will feel that they have a vested interest in the project and will be more inclined to contribute towards operation and maintenance. They will more fully accept the project and receive fuller benefits from it. Following are some of the specific benefits that can result from the formation of such a user group:

a. Increased crop yields per hectare.
b. Increased payments towards maintenance.
c. Increased per cent of arable land is farmed.
d. Fewer land tenure disputes.
e. More effective operation and maintenance.

3. River Bank Erosion/Protection

The sharp curve in the Senegal River just to the east of the location that the Dirol Creek joins the Senegal River was inspected on the Mauritania side for bank sloughing. In this area it was noted that the bank had sloughed for a length of nearly one hundred meters. This river bank erosion is only a few hundred meters from the location of the proposed Dirol Plain Dike alignment. If a dike is constructed at this location, this erosion could be slowed and perhaps stopped by placing rock gabions along this portion of the river bank to provide protection. Such protection would be required for approximately 100 meters and extend up the bank for four meters and cost in the range of $ 20,000. These gabions would be placed on a slope of about 1:1. Before the gabions are placed, the slope which will receive the gabions should be scarfied and graded. If the dike is not constructed this eroson will cause no great concern.

4. Dike Placement and Height Selection

To justify the construction of a dike, the incremental benefits that will result over a twenty year period from the dike construction should be roughly equivalent to the capital cost of the dike construction. If the incremental benefits are not roughly equivalent to the capital cost of the dike construction it will be difficult to justify the dike construction.

The team investigated three different dike heights along the the 14.7 km. alignment selected in the Le Bloas study. The three different average dike heights proposed are 1.25 meters, 2.25 meters and 3.25 meters. These dike heights result in dike-top elevations of 11, 12 and 13 meters IGN. The average dike heigth computation for the 3.25 meter dike is presented in Appendix A. The height was determined by trial and error from the Le Bloas 13-meter dike embankment quantity. The plan and profile of the dike alignment from the Le Bloas study are presented in Appendices B and C.

The respective flood levels that could be retained behind the dikes are 10, 11 and 12 meters IGN. The higher the flood level that is assumed to occur, the less likey is the chance that it will occur. The Team Hydrologist has determined the areas inundated for various height floods. The frequency and duration of these floods has also been established. Two floods are being investigated, one from the Dirol Creek watershed and one from the Senegal River. Using this information, incremental benefits were determined for the three dike heights selected by the Project Economist.

A fourth alternative was also be investigated. This alternative consists of the construction of a flood retention structure at the mouth of the Dirol and no dike facilities. The baseline benefits were computed from existing conditions without the construction of any new facilities.

5. Engineering Tasks to be Carried out During the PP Phase are presented below. A more detailed Terms of Reference with estimated man-day requirements is presented in Appendix N.

a. Prepare detailed design of Dirol Floodgate
b. Prepare detailed cost estimate of Dirol Floodgate.
c. Define specific construction material sources.
d. Prepare final construction specifications and contract documents for Dirol Floodgate.

6. Engineering Concepts for Dirol Creek Floodgate Structure

a. General

The construction of a dike and floodgate structures has been proposed to contain flood waters derived from the Dirol Creek watershed and to catch and contain flood waters inflowing to the Dirol Creek watershed from the Senegal River. A likely alternative is the provision of a floodgate structure without any associated dike. The floodgate is designed to allow waters to flow in two directions. Costs and benefits of dikes constructed to three different elevations were also investigated.

b. Floods

The flood originating in the Dirol Basin is smaller in peak discharge and volume than the flood arising from the Senegal River. The peak discharge of the Dirol Creek flood occurs appoximately one month before the peak of the Senegal River Flood. The FID Team Hydrologist computed that the Senegal River flood has a volume of 17,000,000 cubic meters per day. This is equivalent to a flow rate of 196.8 cubic meters per sec. The Hydrologist computed that ten per cent of the time a flood level of 11.24 meters IGN will occur in the Senegal River at the mouth of Dirol Creek for forty-five days. This flood has a maximum level of 11.95 m. IGN. Six weeks is the optimum time that soils should be wetted to get maximum output from flood recession agriculture. The flood occuring 50 per cent of the time at the same location for forty-five days was computed to be 10.31 meters IGN. The average of these two figures, 10.78 meters, is assumed to occur 33 per cent of the time, one year out of three, and has been used to size the-gate opening. The Dirol Creek floodgate structure is located 1.4 kilometrs upstream from the edge of the Senegal River. It is assumed that there is a hydraulic gradient of approximately 0.01 or a drop in the flood surface elevation of 0.01 meters per 100 meters of distance. Thus, the design water surface elevation at the floodgate structure is assumed to be 0.01 x 14 = 0.14 meters lower than at the edge of the Senegal River. The flood water surface elevation at the structure would be, then, 10.8 - 0.14 = 10.66 meters. The bottom elevation of the Dirol Creek at the structure location has been surveyed. The low point has an elevation of 5.85 meters IGN. Flood levels and frequencies computed by the Team Hydrologist are presented in Appendix D. Flood levels and frequencies from the Le Bloas study are presented in Appendix E.

The floodgate has been sized and structure elevations set according to the above described assumptions, but it will function quite well even if these conditions vary considerably.

Seven floodgates, four meters wide by five meters high, will

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be provided. Each gate opening would be 20 square meters and the total opening 140 square meters. This would result in a velocity of V = Q/A = 196.8/140 = 1.4 m./sec. This is an acceptable velocity. The gate bottom elevation or invert elevation was set at 5.85 meters and the top of the gates at 10.85 meters. This provides a gate freeboard of 10.85 - 10.78 = 0.07 meters, say 0.1 meters.

At the design flow rate, 4,000 hectares could be covered to an average depth of 2 meters in a week. In practice, due to losses and lower flood levels, it will take longer.

c. Structure Location

The floodgate will be constructed just downstream from the confluence of the two main branches of the Dirol Creek. This location was selected by Le Bloas in his study. A 1:2,000 scale plan of this location was prepared previously. A copy of this plan is included in the Le Bloas study. (See Bibliography.) The location is 1.4 kilometers upstream from the junction of Dirol Creek with the Senegal River. There is a sharp bend in Dirol Creek in this 1.4 kilometer-long section and the stream alignment will probably be shortened considerably in the future. This will not create a problem for the floodgate.

d. Structure Description/Design Considerations

The Dirol Creek flood retention structure is proposed to be a two directional floodgate structure. The gates will be fabricated from structural steel, and will be manually operated vertical-slide gates. Each gate will weigh approximately 25 tons. Seven gates are proposed. Each gate will have a clear opening of 20 square meters, four meters horizontally and five meters vertically. The gates should be designed to allow water to flow in two directions and withstand maximum differencial water pressure of seven meters from either side. The steel gate frames will be mounted in a reinforced concrete box. The reinforced concrete will be restrained by a compacted embankment. A preliminary plan and front elevation of the proposed structure are included in Appendices F and G. The natural ground at the structure location is at an elevation of approximately 11 meters IGN, 10.8 meters at the left abutment facing upstream and 11.3 meters at the right abutment. A roadway will provided over the top of the structure which will allow the passage of small vehicles. The road surface elevation will be placed at an elevation of 12 meters. This roadway elevation will provide the dam with a freeboard of one meter. With respect to the chance of overtopping, the Team Hydrologist has computed that there is only a ten per cent chance of the 12 meter flood arriving. (See Appendix D) The structure will not be overtopped, but if a high flood occurs and no dike is built, flood waters will flow around the structure. If no dike road exists, the floodgate can

not be reached by vehicles during the flood season.

A reinforced concrete deck structure six meters wide, thirty meters long and 0.5 meters thick is provided. Positive curbs and over head bars will be provided to prevent large vehicles from passing over the structure. The top opening of Dirol Creek at the structure location is 75 meters wide. The reinforced concrete should be designed to have a 28-day strength of 3,500 psi. Deformed steel reinforcing bars should be used in the reinforced concrete. The concrete should be mixed mechanically and vibrated into place. The concrete should be cured for at least 14 days after the forms are removed. Each gate will be provided with its own manual lift device. Since the gates are quite heavy, opening the gates could take an entire day. The hoists will require periodic greasing. Over the compacted dam embankment that will serve as the roadway surface, medium-graded gravel should be provided. This gravel layer should have a thickness of 0.15 meters. The sloped portions of the embankment should be provided with riprap protection on both the upstream and downstream faces. Under the riprap layer, a filter layer should be provided. The total thickness of both layers should be 0.6 meters.

The embankment material should be compacted mechanically and should be wetted to its optimum moisture content at the time of compaction. With close supervision, the embankment could be compacted with hand tampers. The slope of the embankment surfaces should be two to one, horizontal to vertical. The gates and hoist will be overhead, vertical-frame-type slide gates that are manually operated and designed to be lifted five meters and to allow water to flow in both directions.

The concrete mix should be a 1:2:4 mix, one part cement, two parts sand and four parts gravel. The water used to prepare the concrete mix should be free of impurities. The sand required to prepare the concrete mix can be obtained from the edge of the Senegal River approximately three kilometers from the construction site. The sand will have to be screened to obtain the proper gradation. Gravel can be obtained from the hills located at the east end of the plain approximately seven to fifteen kilometers from the site. The cement used should be an imported water-type cement that is normally used for water control structures.

Embankment materials are available at selected location near the structure. This material should be a cohesive clayey, loam material. It should be moistened during placement to obtain the best compactive results. Guard rails should be provided. The entrance and exit aprons will be reinforced concrete provided with energy dissipating baffle blocks. Rock gabions will be provided upstream and downstream from the aprons for erosion protection. thick.

e. Structure Quantities

1. Reinforced Concrete

a. Abutment

Walls:	Av. Height:	= 3	m.
	Length:	= 58	m.
	Av. thickness:	= 0.5	m.
	Number:	= 2	
	Volume: 3 x 58 x 0.5 x 2	= 174	cu. m.

b. Slab:

Width:	= 6	m.
Length:	= 30	m.
Thickness:	= 0.5	m.
Volume: 6 x 24 x 0.5	= 90	cu. m.
Minus: opening 4x0.5 x 7	= 14	cu. m.
Net volume:	= 76	cu. m.

c. Deck

Walls:	Length:	= 30	m.
	Height:	= 1.2	m.
	Thickness:	= 0.5	m.
	Number:	= 2	
	Volume: 30 x 1.2 x 0.5 x 2	= 36	cu. m.
	Total	286	cu. m.
	Say	290	cu. m.

2. Compacted Embankment

a.	End Area: 15 + 24 + 12	= 51	sq. m.
b.	Lengths: 8 m., 15 m., 28 m.		
c.	Volume: 15x8 + 24x15 + 12x28	=816	cu. m.
d.	Number:	= 2	
e.	Total Volume: 816 x 2	=1632	cu. m.
	Say	1640	cu. m.

3. Gabions

a.	Area: 60 x 8	= 480	sq. m.

b. Thickness: = 0.5 m.

c. Number: = 2

d. Volume: 480 x 0.5 x 2 = 480 cu. m

Say 480 cu. m.

4. Concrete Apron

a. Av. Length: = 36 m.

b. Width: = 8 m.

c. Thickness: = 0.5 m.

d. Number: = 2

e. Volume: 36 x 8 x 0.5 x 2 = 288 cu. m.

Say 290 cu. m.

5. Baffle Blocks

a. Area: 1 x 0.5 + 0.5 x 0.5 = 0.75 sq. m.

b. Thickness = 1.0 m

c. Number: = 32

d. Volume: 32 x 0.75 x 1.0 = 24 cu. m.

Say 30 cu. m.

6. Gate Hoists/ Gates

a. Number: = 7

b. Area: = 20 sq. m.

c. Thickness: = 0.15 m.

d. Volume: 7 x 20 x 0.15 = 21 cu. m.

21 x 3.28 x 3.28 x 3.28 =741 cu. ft.

e. Weight: 741 x 450 lbs./cu. ft. = 333,500 lbs.

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	333,500/2,000	= 166	tons
	Say	170	tons
f. Overhead Hoist:	add 10 %	= 17	tons
	Total	= 187	tons
	Say	190	tons

7. Guard Rails: 2 m. posts at 3 m. spacing

a. Post Length:	2 x 2 x 40	= 160	m.
b. Rail Length:	2 x 120 x 2	= 480	m.
	Total	= 640	m.
c. Weigth: at 20 lbs/m.	640 x 20	=12,800	lbs.
	Total	= 6.4	tons
	Say	10	tons

8. Roadway Surface

a. Area: 24 x 43 + 15 x 8		= 1052	sq. m.
b. Thickness:		= 0.6	m.
c. Number:		= 2	
d. Volume:	1,052 x 0.6 x 2	= 1382	cu. m
	Say	1400	cu. m.

9. Move In, Clear, Grubb, Move Out

Lump Sum = $ 30,000

10. Foundation Excavation

a. Abut Area: 10 x 20	= 200	sq. m.
b. Thickness:	= 0.5	m.
c. Length:	= 40	m.
d. Number:	= 2	

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e. Volume: 200 x 40 x 2 =1600 cu. m.

f. Floor Volume: 44 x 24 x 0.5 = 528 cu. m.

Total =2128

Say 2130 cu. m.

11. Summary

a.	Reinforced Concrete	290	cu. m.
b.	Compacted Embankment	1,640	cu. m.
c.	Rock Gabions	480	cu. m.
d.	Concrete Apron	290	cu. m.
e.	Baffle Blocks	30	cu. m.
f.	Gate Hoists/Gates	190	tons
g.	Guard Rails	10	tons
f.	road Surface	1,400	cu. m.
g.	Move In/Clear/Grubb/Out		lump sum
h.	Foundation Excavation	2,130	cu. m.

f. Unit Price Determation

1. Reinforced Concrete

Le Bloas = $ 243/cu. m. without forms and steel

Escalate 1.33 to 1987 = $324/cu. m. x 1.3 for forms and reinforcing steel = $420/cu. m. Say $450/cu. m.

2. Compacted Embankment

Le Bloas = $3.33/cu. m.

Escalate 1.33 to 1987 = $4.43/cu. m. Since quantity small use $4.43 x 2 = $8.86/cu. m.

Say $8.00/cu. m.

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3. Gabions

Le Bloas = $62/cu. m.

Escalate 1.33 to 1987 = $83/cu. m. Say $80/cu. m.

4. Concrete Apron

Use same unit price as reinforced concrete.

5. Baffle Blocks

Use same unit price as reinforced concrete

6. Gate Hoists/Gates

Assume structural steel at $0.50/lbs = $ 1,000/ton

7. Guard Rails

Use same value as gates

8. Roadway Surface

Le Bloas = $ 17.85/cu. m.

Escalate 1.33 to 1987 = $18.47/ cu. m.

Say $ 18/cu. m.

9. Move In/Clear/Grubb/Move Out

Le Bloas used $140,000 for dike plus structures.

Assume 0.25 x $ 140,000 = $ 35,000

Say $30,000

10. Foundation Excavation

Work easier than embankment so use $ 7/cu. m.

Other historic construction costs for Mauritania are presented in Appendix D.

g. Cost Estimate

No.	Description	Unit	Quantity	Unit Price $	Cost $
1.	Reinforced Concrete	cu. m.	290	450	130,500
2.	Compacted Embankment	cu. m.	1,640	8	13,100
3.	Rock Gabions	cu. m.	480	80	38,400
4.	Concrete Apron	cu. m.	480	450	216,000
5.	Baffle Blocks	cu. m.	30	450	13,500
6.	Gate Hoists/Gates	tons	190	1,000	190,000
7.	Guard Rails	tons	10	1,000	10,000
8.	Roadway Surface	cu. m.	1,400	18	25,200
9.	Move In/Clear/Grubb/Out	l.s.	l.s.	l.s.	30,000
10.	Foundation Excavation	cu. m.	2,130	7	14,900
			Subtotal		681,600
			Contingency	10 %	68,200
			Total		749,800
			Say		750,000

7. Comparative Dike/Floodgate Scheme Costs

Four different schemes were costed and then a graph plotted to compare the costs of structures required to contain floods of different heights. One scheme consisted of the provision of a floodgate alone at Dirol Creek. The costs for this scheme are presented above. The details of the costs for the other three alternatives are presented below. The dike and Roufi floodgate costs were generated from the Le Bloas study and inflated to 1987 prices. The Dirol Floodgate quantities are from present calculations shown above. A graph showing the cost of retention versus 5-day flood levels at Dirol Creek was prepared. This graph is presented in Appendix I. The costs shown for riprap and riprap filter were escalated from the Le Bloas Study and appear to be provided for only one dike face. (See Appendix A for backup calculation).

A. 13 m. high dike, 14.7 km., 2 flood gates

No.	Description	Detail	Total $
1.	Startup	138,000 x 1.33	185,000
2.	Clear/Grubb	27,800 x 1.33	37,000
3.	Scrap ROW	111,160 x 1.33	148,800
4.	Dike Fill	1,610,500 x 1.33	2,142,000
5.	Crest		

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	Protection	107,999 x 1.33	143,500
6.	Riprap Filter	383,970 x 1.33	510,700
7.	Riprap	417,900 x 1.33	555,900
8.	Dirol Floodgate	681,600 x 1.1	749,800
9.	Roufi Floodgate	250,000 x 1.33	332,500
		Subtotal	4,805,200
		Contingency 10%	480,500
		Total	5,285,700

B. 12 m. high dike, 14.7 km., 2 flood gates

1.	Startup	same	185,000
2.	Clear/Grub	same	37,000
3.	Scrap ROW	same	148,800
4.	Dike Fill	4.43 x 283,000	1,253,700
5.	Crest Protection	same	143,500
6.	Riprap Filter	510,000 x 2/3	320,000
7.	Riprap	556,000 x 2/3	370,700
8.	Dirol Floodgate	681,600	681,600
9.	Roufi Floodgate	250,000 x 1.33	332,500
		Subtotal	3,472,800
		Contingency 10%	347,300
		Total	3,820,100

C. 11 m. high dike, 14.7 km., 2 flood gates

1.	Startup	same	185,000
2.	Clear/Grub	same	37,000
3.	Scrap ROW	same	148,800
4.	Dike Fill	4.43 x 110,970	492,000
5.	Crest Protection	same	143,500
6.	Riprap Filter	510,000 x 1/3	170,000
7.	Ripap	556,000 x 1/3	185,300
8.	Dirol Floodgate	681,600	681,600
9.	Roufi Floodgate	250,000 x 1.33	332,500
		Subtotal	2,375,700
		Contingency 10%	237,600
		Total	2,612,600

Best Available Document

8. Channel Construction

a. Talweg Drainage

Quantities required to excavate a passageway from the large talweg/pond, located just to the north of the location proposed for the Roufi floodgate in the Le Bloas 14.7 km. dike alternate have been computed. This channel would drain low lying water at the bottom of the northern plain into the Kotel pond at the top of the southern plain. The total length of excavation is estimated to be 1,950 meters. The width of the channel 15 meters, the bottom elevation assumed is 8 meters IGN and the maximum depth of cut is 3 meters. The total quantity of excavation required would be in the order of 38,000 cubic meters. At an estimated cost of $ 7 per cubic meter of excavation, the cost would be $266,000. After applying a 10 % contingency factor this amount would be $ 290,000. Later consideration might be given to the construction of the Roufi floodgate to work in conjunction with this drainage channel. A preliminary plan of this channel is presented in Appendix J. Backup computations for the excavation quantities are presented in Appendix K. The alignment studied is slightly east of the Roufi floodgate location proposed by Le Bloas. For final site selection a site survey will be required.

b. Flood Intake - From Senegal River to Southern Plain

A flood intake channel could be constructed to allow water from the Senegal River to flow into the Southern Plain when the flood level is high enough. This would deliver flood water to the low lying Faram Kabire area which has a bottom elevation of 7.5 m. IGN. The channel invert elevation should also be placed at elevation 9.5 m. IGN. The flood elevations at this intake location are assumed to be approximately 0.5 meters higher than at the mouth of Diro' Creek. The channel would be approximately 2,000 meters long, 7 meters wide and have a maximum depth of 2.5 meters. The volume of excavation required would be 26,000 cubic meters. At a unit price of $ 7 per cubic meter for excavation, the cost would be $ 180,000. After applying a 10 percent contingency factor, the total cost would be $ 200,000. A small floodgate structure with three gates could be considered to retain the flood waters after they had backed into the low lying areas. This structure is estimated to have a rough cost of $ 250,000. A preliminary plan of this flood intake is pesented in Appendix L. Backup excavation quantities are presented Appendix K.

Best Available Document

9. Summary, Conclusions and Recommendations

a. Staged Construction

The project should be carried out in at least three stages. In the first stage, a two-directional floodgate structure should be constructed on the Dirol Creek at the location proposed in the Le Bloas Study. The structure crest should be constructed to an elevation of 12 meters IGN. This would accomodate possible dike construction up to an elevation of 12 meters. In the future the structure could easily be raised to an elevation of 13 meters IGN, but such a high flood has a very little probability of occurring, and, in the future, regulation by the upstream Manantali Dam will probably control flood levels to such an extent that the construction of a 13 meter high dike floodgate could not be justified. Details of the Manantali flood level controls are not known at this time.

b. Dirol Creek Floodgate

The floodgate will be designed to allow floodwaters to flow in two directions. It will initially capture Dirol Creek runoff and then capture high flood waters inflowing from the Senegal River. The structure should be designed to withstand maximum differencial water pressure of seven meters in either direction. The estimated cost of the floodgate with a top elevation of 12 meters IGN is $ 750,000.

c. Topography

Detailed topographic surveys of the Northern Plain would be very helpful to determine precisely what lands will receive water from various flood levels. The Team Engineer has judged that such a survey could is not justified at this time because the estimated cost of constructing the first stage floodgate at on Dirol Creek would probably be similar to that of a detailed topographic survey of 6,000 hectares. Such a survey using aerial photography is estimated to cost in the range of $ 100 per hectare. It would be more cost effective to construct the structure and then determine from actual operation for a few years what the actual benefits are. After this determination, USAID and the GIRM can decide if a second stage will be justified. The second stage will consist of some combination of dike construction, pumped irrigated perimeter, water harvesting structures, talweg drainage and the provision of flood inlet channels on the Southern Plain in conjunction with the provision of small floodgate structures.

The Dirol floodgate alone could provide water to approximately 4,000 hectares. This value was determined from the area capacity curve provided in the Le Bloas Report using a

Senegal River flood of 9.5 meters IGN. This curve is presented in Appendix M. Because the inacurracy of the existing maps and the contradictory information received from the farmers, this area is approximate. Historicaly, such a flood level has occurred often and after the construction of Manantali it may occur annually. The actual benefits of this scheme will only be known after the implementation, but the Team Economist has projected that benefits over twenty years could be in excess of the capital costs. The increased benefits due to the construction of a floodgate without a dike occur because locals farmers have stated that presently they rarely crop more than 2,500 hectares.

10. Bibliography - Engineering

1. Amenagement Hydro Agricole De La Plaine Du Dirol
Avant - Project Sommaire
USAID, Dakar, RBDO, Le Bloas, 1986

2. Water Management Synthesis II Study
University of Arizona Team
July, 1985

3. Resource Inventory of Southwestern Mauritania
Geology - Soil - Foresty - Pasture
Remote Sensing Institue
South Dakota State University

4. Rehabilitation of Dirol Project
1982, SONADER

5. Preliminary Land Tenure Study of the Dirol Plain
Park, Rogers, Ngaide
Land Tenure Center
University of Wisconsin
June 1986

C. Technical Summary - Engineering

1. Water Control Structures

a. Dirol Floodgate

We reccommend construction of a floodgate structure at the mouth of Dirol Creek which allows two directional flow and storage of Senegal River and Dirol Creek flood water to an elevation of 9.5 meters IGN without dikes. The floodgate should be provided with seven steel, vertical-lift, mannual-operated slide gates, 4 m. wide x 5 m. high. Creek top opening at structure is 75 m., structure height 7 m., deck width 6 m., length 30 m. Design flow 200 cu. m./sec. Velocity 1.4 m./sec. Structure freeboard 1 m. Gate freeboard 0.1 m. for 10.8 m. flood with frequency of 0.33.

b. Dikes

Three alternative dike heights for 14.7 km. Le Bloas alignment were investigated. Heigths = 1.25 m., 2.25 m. and 3.25 m. Dike crest elevations = 11 m., 12 m. and 13 m. with flood levels = 10 m., 11 m. amd 12 m. Top width 3.5 m., roadway provided on top, riprap at both faces and 2:1 slide slopes. We recommend postponing dike construction until Phase II of the project.

c. Roufi Floodgate

Two directional flow. Design same as Le Bloas report. Cost = $ 332,000. We recommend postponing the construction of the Roufi floodgate intil Phase II.

2. Materials

Riprap, filter material, road surface materials and gravel are available from laterite rock outcrops found at bottom of hills near Ndioafane at the east end of the plain near Feralla at west end of the plain. Sand is available from Senegal River but will require screening. Embankment materials can be obtained near Dirol Creek floodgate and along dike alignment at selected locations. The material should be cohesive, clayey loam. Gates, reinforcing steel and water-type cement assumed to be imported.

3. Costs

a. Le Bloas unit prices escalated 10 % per year from 1984 to 87. UM costs converted to $ costs at rate of 1 $ = 72 UM. 10 % contingency factor provided.

b. Dirol floodgate with 12 m. crest, cost = $ 750,000.
c. 13 m. dike, 14.7 km., 2 floodgates, cost = $ 5,285,700.
d. 12 m. dike, 14.7 km., 2 floodgates, cost = $ 3,820,100.
e. 11 m. dike, 14.7 km., 2 floodgates, cost = $ 2,613,300.
f. Drainage, northern plain to south, channel 1,850 m. long, 15

m. wide, depth 0-3 m., volume 38,000 cu. m., = $ 290,000.
g. Flood inlet channel from Senegal River to Southern Plain, Channel 2,000 m. long, 7 m. wide, depth 0-2.5 m., excavation volume, 26,000 cu. m., cost = $ 200,000.

4. Geology

The lower Dirol Plain geology consists of alluvial clays and silts. The upper Dirol Plain, well away from the Senegal River, consists of soft, porous sandstones and dolomites.

5. Engineering Tasks Proposed for PP Phase

a. Prepare detailed designs Dirol floodgate.
b. Prepare detailed cost estimates for Dirol floodgate.
c. Define and locate specific borrow sources.
d. Prepare contract documents for Dirol floodgate.

DIROL PLAIN PROJECT

CALCULATE

1. AV: DIKE HEIGHT

TRIAL ERROR	LE BLOAS VOL.
13 m. dike	emb = 2/80,000 m3.

(3.25 x 3.5) + 3.25 x 6.5/2 x 2 = 11.375 + 21.125 = 3,250 m2

32.50 m2 x 14,796 m = 480,870 m3

so Av. height of Le Bloas 13 m dike = <u>3.25 M</u>

2. Did Le Bloas. Provide riprap at both h dike faces

7.83 x 0.3 x 14,796 = 34,355 m3.

Le Bloas used quan. 30,090 m3

thus he provided for only one face

FROM LE BLOAS

Compute Freq vs. Flood Level of Dirol Mouth

Freq. %	Kaedi IGN (m)	x 1.08 - 1.83. =	(m) Dirol IGN
0.5	13.4		12.64
1.	13.3		12.53
5	13.2		12.43
10	13.05		12.26
20	12.65		11.83
30	12.45		11.62
40	12.25		11.40
50	12.10		11.24
60	11.90		11.02
70	11.70		10.31
80	11.40		9.48
90	10.90		9.94
95	10.30		9.29
98	9.55		8.48
99	8.95		7.84
99.5	8.40		7.24

1986
Floods Levels at Kaedi

Level Kaedi, Senegal	Days 5 Day	15	30	45	60
Kaedi "S".	10.4	10.1	9.7	8.7	7.8
Dirol "S".	9.2	9.1	8.6	7.4	6.6
Area Ha.	3,700	3,600	2,600	900	300

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TABLE 5.3: UNIT PRICES FOR IMPORTED MATERIALS (Including transport to site, handling and storage)

Item	Unit	Unit Prices (UM)			
		Foreign	Local	Taxes	Total
Ordinary Portland Cement	Tonne	6300	300	100	6700
Tor Steel	Tonne	56600	300	100	57000
Mild Steel	Tonne	35600	300	100	36000
Formwork	m^3	17780	240	80	18100
Mesh Wire	m^2	80	18	2	100
Asphalt 60/70	Tonne	27000(1)	2210	390	29600
Cut-Back MCO/1 or RC250	Tonne	30750(2)	2210	390	33350

(1) The CIF Nouakchott price of asphalt cement 60/70 or 80/100 PEN is close to 320 US dollars/tonne, as priced by SHELL INTERNATIONAL (LONDON) in January 1987.

(2) The CIF Nouakchott price of cut back RC 250 or RC 800 is close to 370 US dollars/tonne, as priced by SHELL INTERNATIONAL (LONDON) in January 1987.

TABLE 5.4 (Cont'd)

No.	Description	Unit	Financial Rates: Foreign	Financial Rates: Local	Financial Rates: Total	Economic Rate	Range of Rates in Mauritania (1981-86)
13.	Mild steel reinforcement	kg	50.79	10.63	61.42	59.75	67-70
14.	Mesh wire reinforcement	m^2	131.10	106.20	237.30	223.70	150(1983)
15.	Excavation in foundation	m^3	519	146	665	600	500-687
16.	50 cm Top Soil Removal at irish crossings	m^3	55.42	12.46	67.88	64.48	-
17a.	Loose Riprap	m^3	1500	3500	5000	4200	3500-5000
17b.	Grouted Riprap	m^3	4860	4140	9000	7650	6500-9000
18.	Cyclopean Concrete	m^3	4631	3338	7969	7393	6000-9600
19.	Granular layer under Irish Crossing Slabs	m^3	1350	1650	3000	2820	2200(1983)

13 M. - FLOODGATE - DIROL CK

JUSTIFICATION FOR USING 10%

INCREASE FOR 13 M FLOODGATE OVER 12 M.

ROUGH COST ESTIMATE

1. Concrete
   Walls 7 x 25 x 0.5 x 2 = 175 m3
   Slab Same 62
   237 m3 say 240 m3

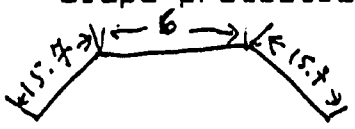
2. Compacted Embankment
   $(7 \times 6) + \frac{7 \times 14 \times 2}{2} = 42 + 90 = 140$ m3
   140 x 5 x 2 = 1,400 m3

3. Gabions Same = 200 m3

4. Gates Add 20 tons = 150 Tons

5. Guard Rails Same = 10 Tons

6. Slope protection



   15.7x2+6 = 37.4 m
   37.4x10x0.6x2 = 448 m3 = 450 m3

7. Move in lout Same L.S.

8. Exc. 22 x 120 x 0.5 = 1,320 cum. Say = 1,300 m3

No	Item.	Quan.	Unit Price $	Unit	Total
1.	R. Concrete	240 m3	400	m3	108,000
2.	Comp. Emb.	1,400 m3	8	m3	11,200
3.	Gabions	200 m3	80	m3	16,000
4.	Gates	150 T	1,500	Tons	225,000
5.	Guards Rails	10 T	1,500	Tons	15,000
6.	Slope Prot.	450 m3	18	m3	8,100
7.	Move in lout	L.S.	L.S.	L.S.	50,000
8.	Exc.	1,300 m3	7	m3	9,100
				Sub.	442,400
				10%	44,200
				$	486,600

* Assumed $440,000 x 1,1 = $ 485,000 Perfect

Note: * Costs later increased for 12 m flood gate.
Still using 1.1 x 12 m cost to get 13 m cost.

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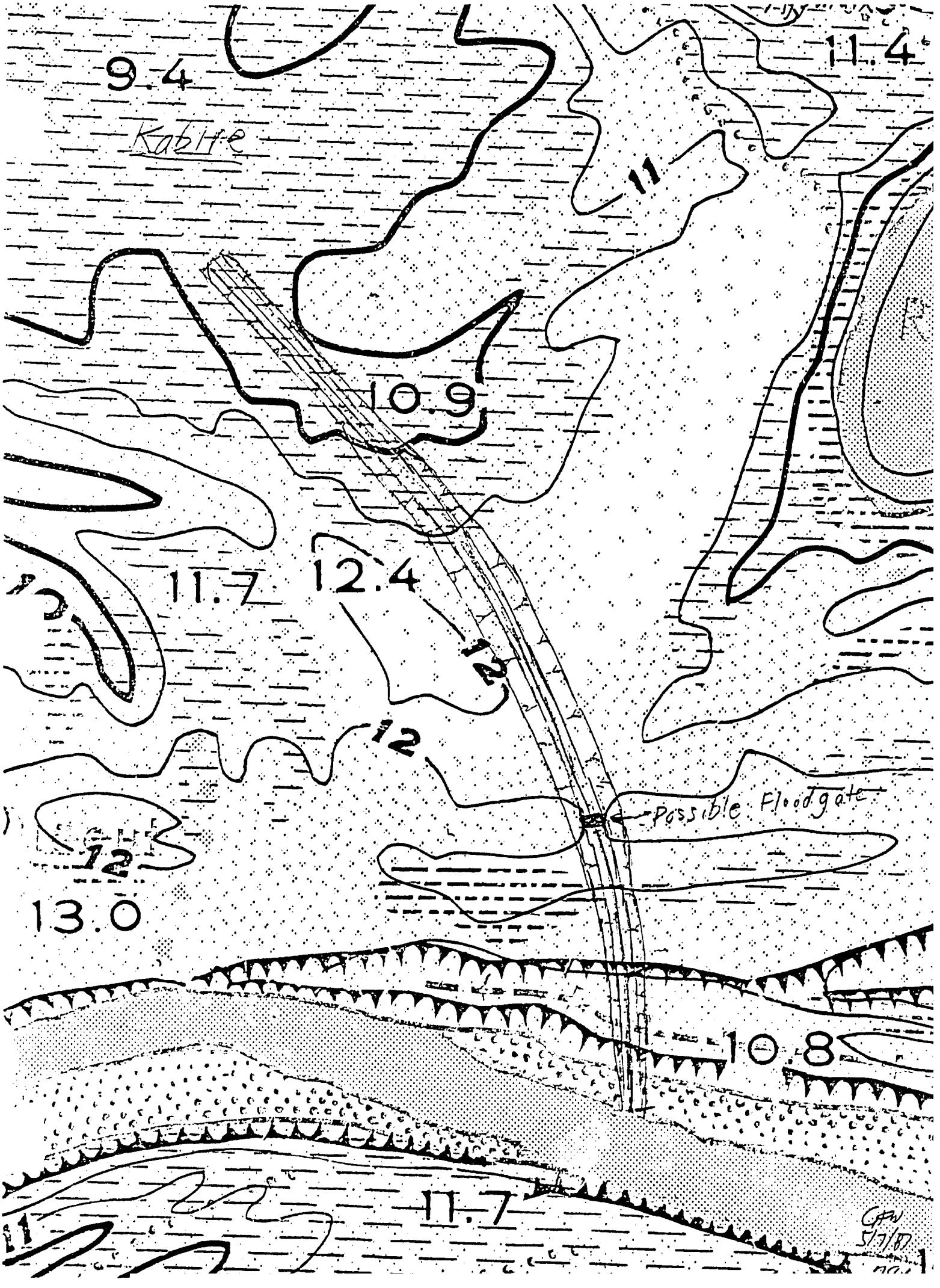
9.4
Kabire
11.4
11
10.9
11.7
12.4
12
12
Possible Floodgate
12
13.0
10.8
11.7
11
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DIROL PROJECT

TALWEG DRAINAGE
NORTHERN PLAIN TO SOUTHERN - EXCAVATION QUANTITIES

1:10,000 Map. 1 cm = 100 m

No	Contour m	cm.	Length m	Av. Depth m	W m	Vol m3	Vol m3
1	8-9	3	150x2	1/2 =0.5	15	1,125x2	1,125x2
2	9-10	0.2	10x2	1+0.5=1.5	15	225x2	1,350x2
3	10-11	4	200x2	2+.5 =2.5	15	7,500x2	8,850x2
4	11-9	5	250x2	2.0	15	7,500x2	16,350x2
5	9	2.5	125x2	1.0	15	1,875x2	18,225x2
6	9-8	2	100x2	0.5	15	750x2	18,975x2
		16.7	925x2 = 1,850 m			Say	19,000 m3
							x 2
							38,000 m3

Flood Intake Channel
Senegal to Kebire
Excavations Quans.

1:10,000 Map. 1 cm = 100 m

No	Contour m	cm.	Length m	Av. Depth m	W m	Vol m3	Vol m3
1	8.5-10	6	300x2	0.75	7	1,575x2	1,575x2
2	8.5-11.5	3	150x2	3.00	7	3,150x2	4,725x2
3	11	8	400x2	2.50	7	7,000x2	11,725x2
4	8.5-11	3	150x2	1.25	7	1,312x2	13,037x2
		20	1,000x2 = 2,000 m			Say	13,000 m3
							x 2
							26,000 m3

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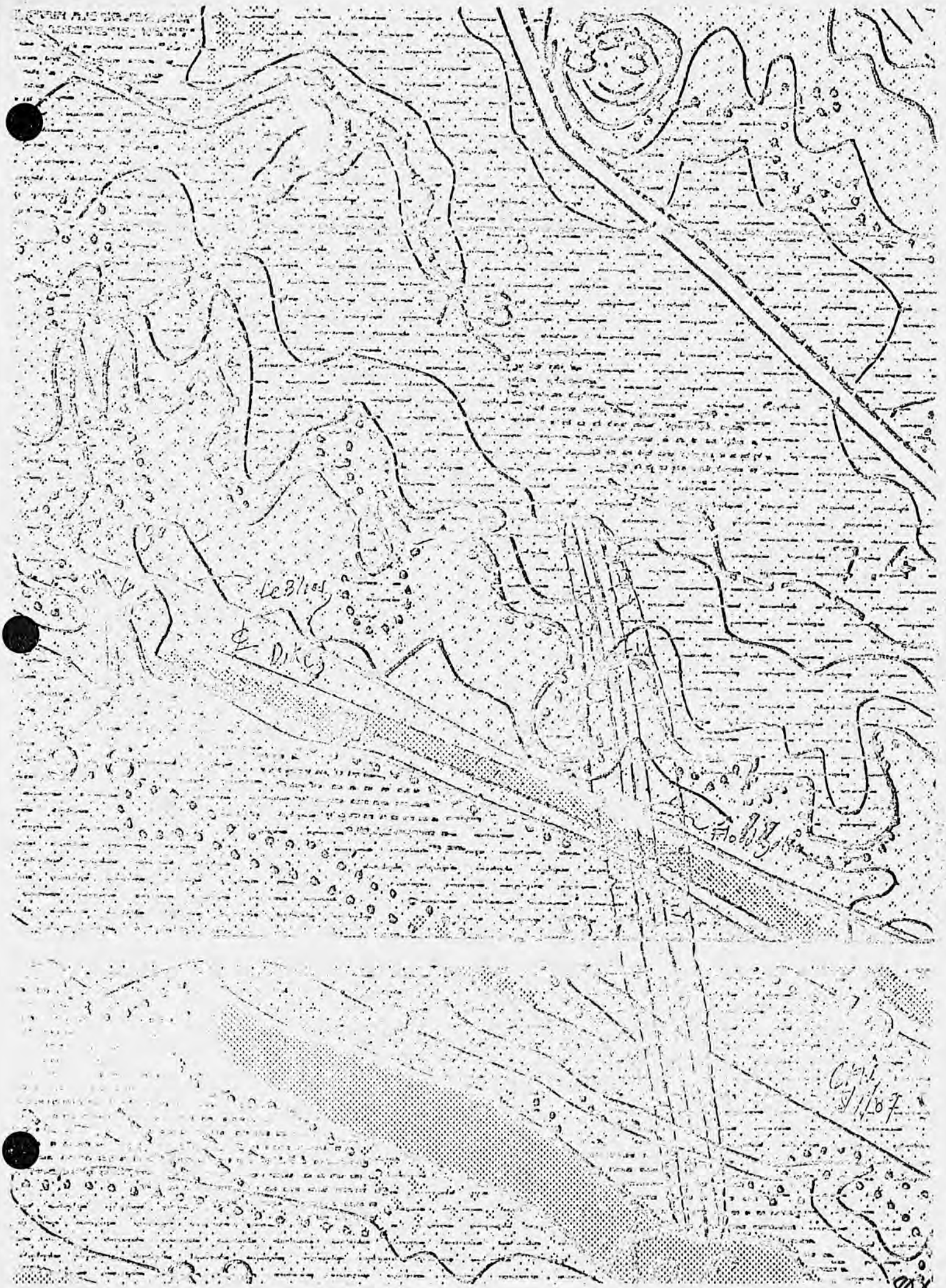
Le Blue
℄ Dike
Holly
Cal
3/4 67
80x

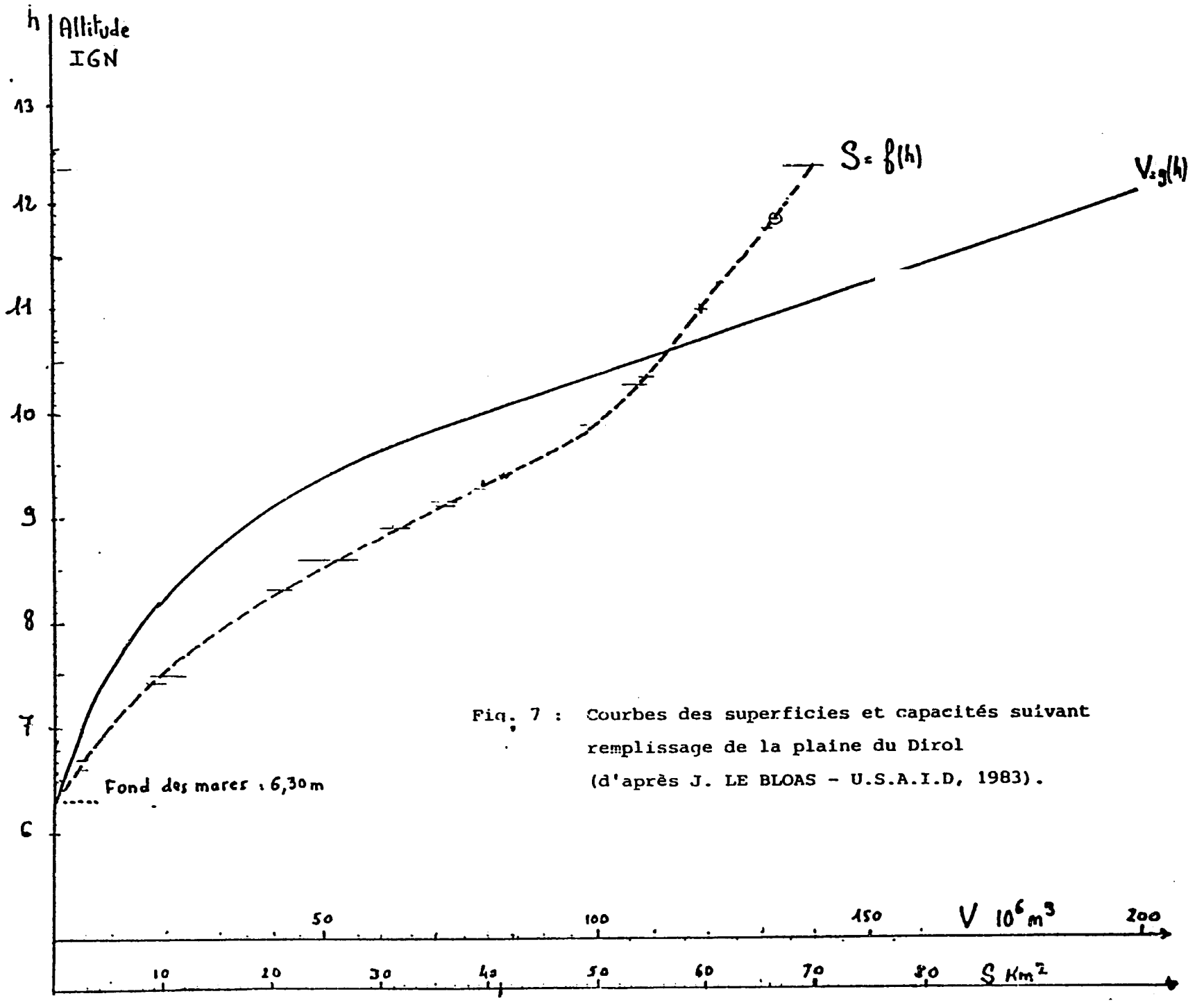

Fig. 7 : Courbes des superficies et capacités suivant remplissage de la plaine du Dirol (d'après J. LE BLOAS - U.S.A.I.D, 1983).

APPENDIX O

BACK-UP COSTS

OTHER SCHEMES/MAINTENANCE

1. Excavate Flood Channel to Rous/Deppression on Southern Plain

   L = 6,5 cm 65 x 500 = 3,250 m
   D = 1,5 m A = 12.75 m2
   Vol. 3250 x 12.75 = 41,437 m3
   Cost. 41,437 x 7 = 290,000 x 1,1 = $320,000 too high

2. Drainage Northern Plain Low-Area - Drain to W. Dioumme to Main Dirol

   7 cm = 3,000 m D = 1.5 m W = 7 m. Area 12,75 m2
   Vol. 38,250 x 7.3 266,000 x 1.1 = $290,000

3. Drainage Channel - Upper Dirol to Lower

   3,000 m x 12.75 m2 = 38,250 = x 7 x 1.1 = $290,000

4. Drainage Connection - Southern Plain Ponds: Kofel to Saya to Kebire

   Same as 3 = 3,000 m = $290,000

5. Maintenance Ditches/Channels.

   2 men 1 Km x $5/day x 22 day/mo x 4 mo/yr = $800/Km ... say $1,000/Km/yr.

6. Small Flood gate - 3 gates

   6 x 5 gates (440,000) = 264,000 = Say $250,000 .

7. Cheap Dike - by Farmers/Mo Riprap.

   1/2 m high Av.3 m w.(0,5 x 3.57 + 5 2/2 x 2) 14760 = 29,000 m3
   29,000 x 8 x "0.4" (Cheap Const) = $94,000 Say $100,000

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Feasibility Study for Appendix Boghe - Kaedi Road

TABLE 5.4

Financial and Economic Unit Rates (UM) for Road Construction

Jan 87 Unit Prices

No.	Description	Unit	Financial Rates Foreign	Financial Rates Local	Financial Rates Total	Economic Rate	Range of Rates in Mauritania (1981-86)
1a.	Clearing, grubbing and 10 cm topsoil removal.	m^2	14.66	2.94	17.60	16.82	12-16
1b.	Subgrade preparation	m^2	25.91	11.42	37.33	34.28	17-69
2.	Common excavation and borrow to embankment	m^3	207.39	46.19	253.58	240.94	148-494
3.	Excess excavation to waste	m^3	156.58	29.58	186.06	178.02	84-248
-	Transport of material beyond 1000 m	m^3xkm	19.75	4.25	24.00	22.57	20-35
4a.	Lateritic Gravel Sub-base Compacted to 95% OPM	m^3	336.36	111.67	448.02	419.93	(400-550)
4b.	Lateritic Gravel Base compacted to 100% OPM	m^3	403.62	134.00	537.62	503.92	518-680
5.	3.5 cm Asphalt Concrete Wearing course	m^3	9552.44	3608.33	13160.77	12616.44	11000-24720
6.	Double Surface Dressing	m^2	159.89	62.67	222.56	214.21	
7.	Prime Coat	m^2	51.87	9.48	61.35	60.06	55-73
8.	Tack Coat	m^2	24.63	5.21	29.84	29.06	27-56
9.	Concrete Class 400	m^3	8927.33	3451.67	12379.00	11896.33	
10.	Concrete Class 350	m^3	6966.00	2626.67	9592.67	9257.67	9000-15800
11.	Concrete Class 200	m^3	5279.00	2827.00	8106.00	7726.67	5258-9615
12.	Tor steel reinforcement	kg	79.82	13.57	93.39	91.35	70-150

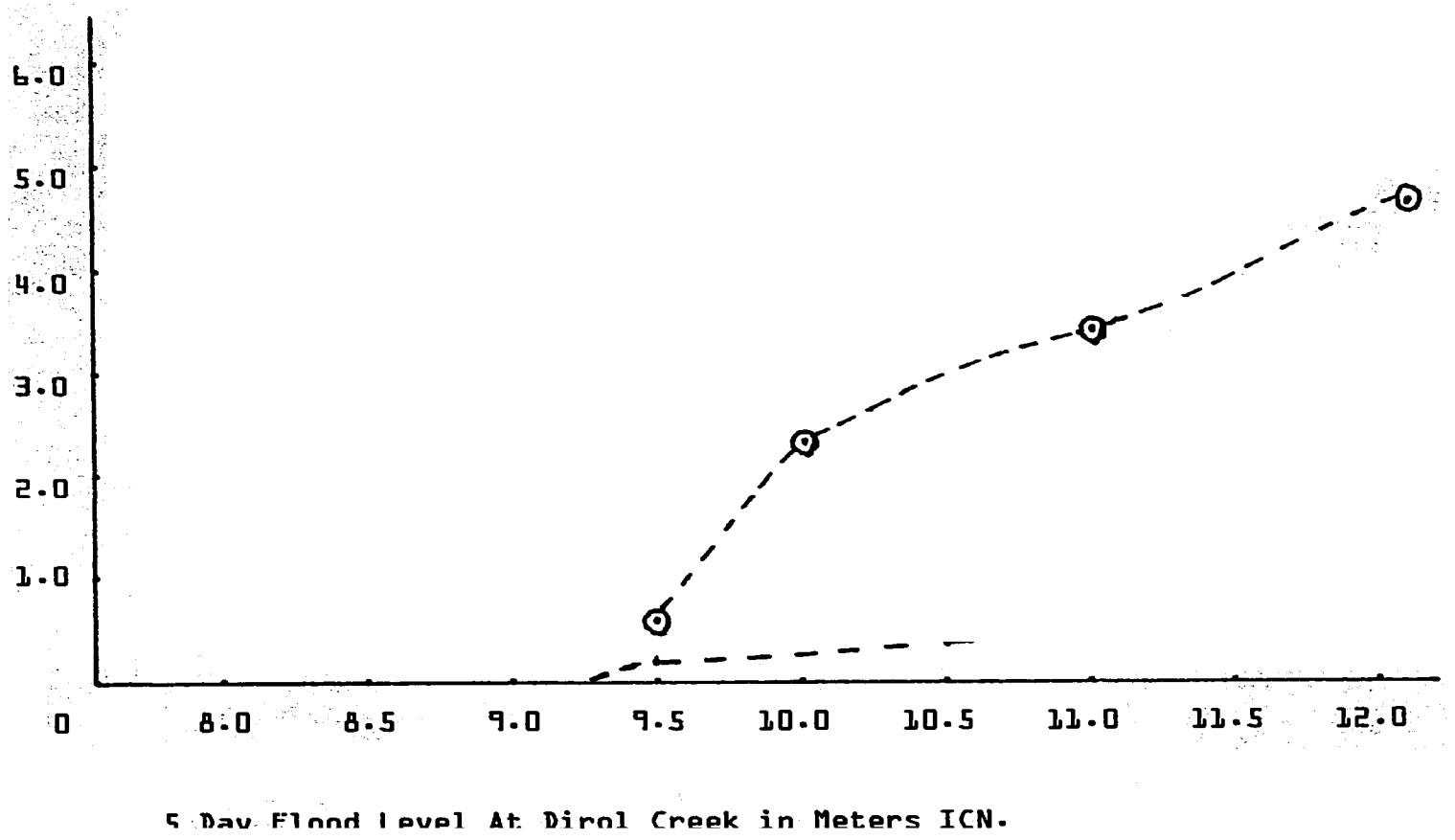
TABLE A.4.9: CONCRETE CLASS 400
COMPOSITION AND COSTS OF A CONSTRUCTION UNIT ACHIEVING $3m^3$/HR

		Rate UM/HR	Foreign Cost UM	Local Cost UM	Taxes UM	Total UM
11.1	Staff					
	1 Engineer (part-time)	891	286	100	60	446
	1 Foreman	514	286	143	85	514
	1 Carpenter	179	-	143	36	179
	9 Assistants or Labourers	75	-	621	54	675
11.2	Equipment					
	Concrete Mixer ($12m^3$/hr)	869	621	199	49	869
	2 Dumpers and 2 Vibrators (part-time)	513	400	90	23	513
	1 Water Tanker (part-time)	1 842	749	113	60	922
11.3	Materials					
	Cement including transportation:					
	$400kg/m^3$ x 3 = 1.2 Tonne		7 560	360	120	8 040
	Aggregate $0.88m^3$ x 3 x 3000 UM/m^3		3 643	3 802	475	7 920
	Sand $0.44m^3$ x 3 x 500 UM/m^3		297	251	112	660
	10% waste		1 120	416	60	1 596
11.4	Formwork ($5m^2$ per m^3 of concrete)		5 080	70	25	5 175
	Total Direct Costs		20 042	6 308	1 159	27 509
11.5	Overheads and Profits to Contractor		6 740	2 599	289	9 628
			26 782	8 907	1 448	37 137

Financial Rates:
Foreign: 26 782 ÷ 3 = 8 927.33 UM/m^3
Local : 10 355 ÷ 3 = 3 451.67 UM/m^3

Total : 12 379.00 UM/m^3

Economic Rate
Without shadow price factors = 11 896.33 UM/m^3



DIROL PLAIN PROJECT

COSTS OF RETENTION

$1,000,000

TYPICAL WATER LEVELS OF THE SENEGAL RIVER
AT DIROL CREEK CONFLUENCE

(Present Conditions)

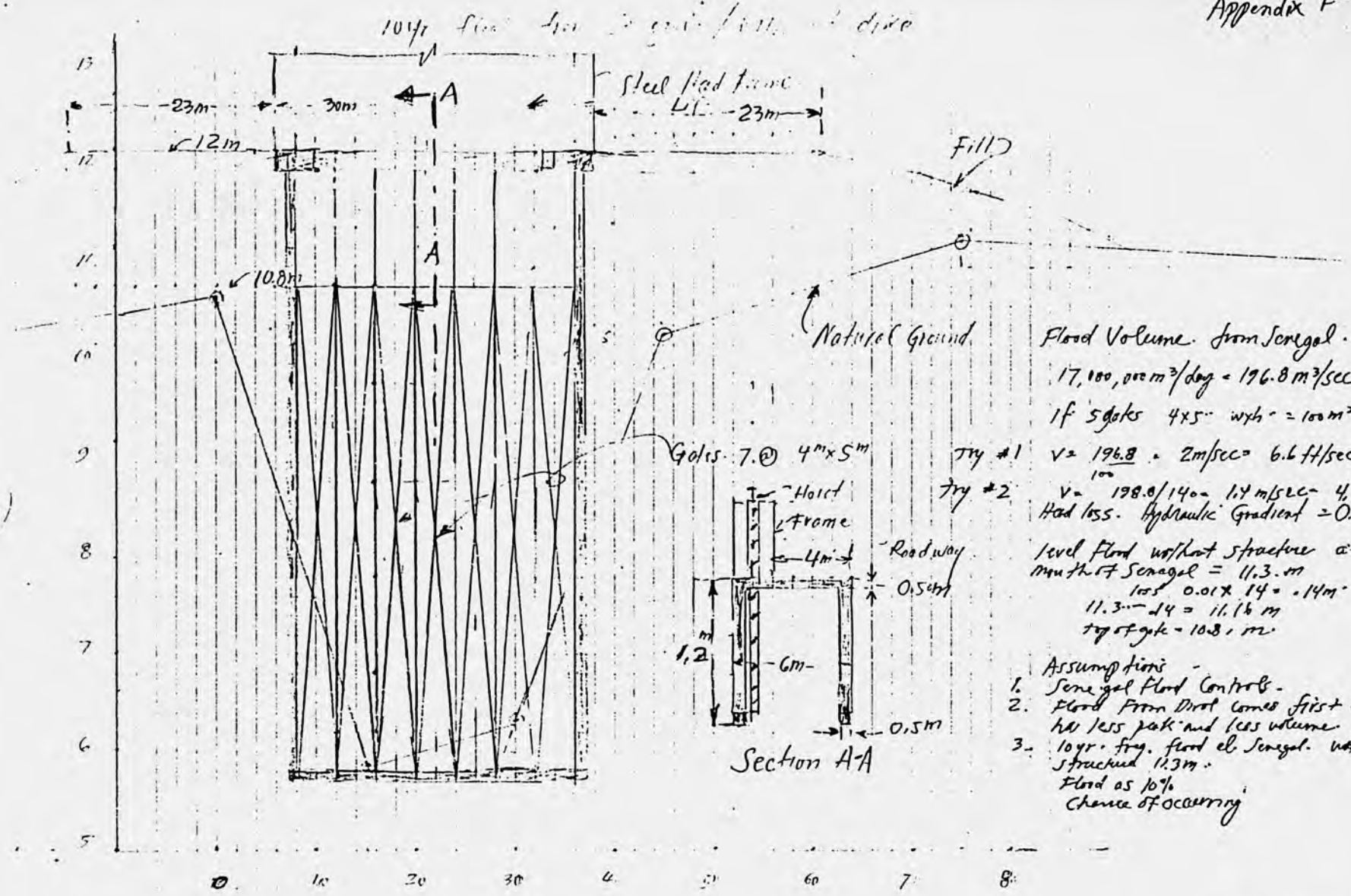
Frequencies F %	Max	Water Levels (IGN)1/ Duration (Days) 5	15	30	45	Dirol Plain Area→Volume (Water Increments (5 vs. 45) Δ WL CM	Δ Area Submerged Hectares with control structures	Δ Vol. 10^6 M^3	Submerged Area Natural Conditions Hectares (45 days)
1	12.53	3/ 12.48	12.33	12.10	11.78	2/ 0.22			6,700
5	12.26		12.05	11.83	11.48				6,400
10	11.95	11.89	11.75	11.56	11.24	0.65	550	38	6,050
50	11.11	11.05	10.95	10.70	10.31	0.74	600	42	5,400
90	9.88		9.68	9.42	9.03				3,400
95	9.24		9.08	8.90	8.53				2,500
99	7.80		7.58	7.50	7.25				

1/ Water Level is adjusted for confluence at peak 498 instead of peak 503.
2/ Assumed maximum retention at 12.0 meters.
3/ Five-day period water level from typical hydrograms of Senegal River at Bakel.

4240M

86 x

Appendix F



Flood Volume from Senegal.

17,100,000 m³/day = 196.8 m³/sec.

If 5 gates 4x5 wxh = 100 m².

Try #1 V = 196.8/100 = 2m/sec = 6.6 ft/sec. ok

Try #2 V = 198.8/140 = 1.4 m/sec = 4.6 ft/sec

Head loss. Hydraulic Gradient = 0.01.

Level flood without structure at mouth of Senegal = 11.3 m

loss 0.01 x 14 = .14m

11.3 − .14 = 11.16 m

top of gate = 10.8 m

Assumptions -

1. Senegal flood controls.
2. Flood from Diref comes first but has less peak and less volume.
3. 10 yr. freq. flood el Senegal without structure 11.3m.

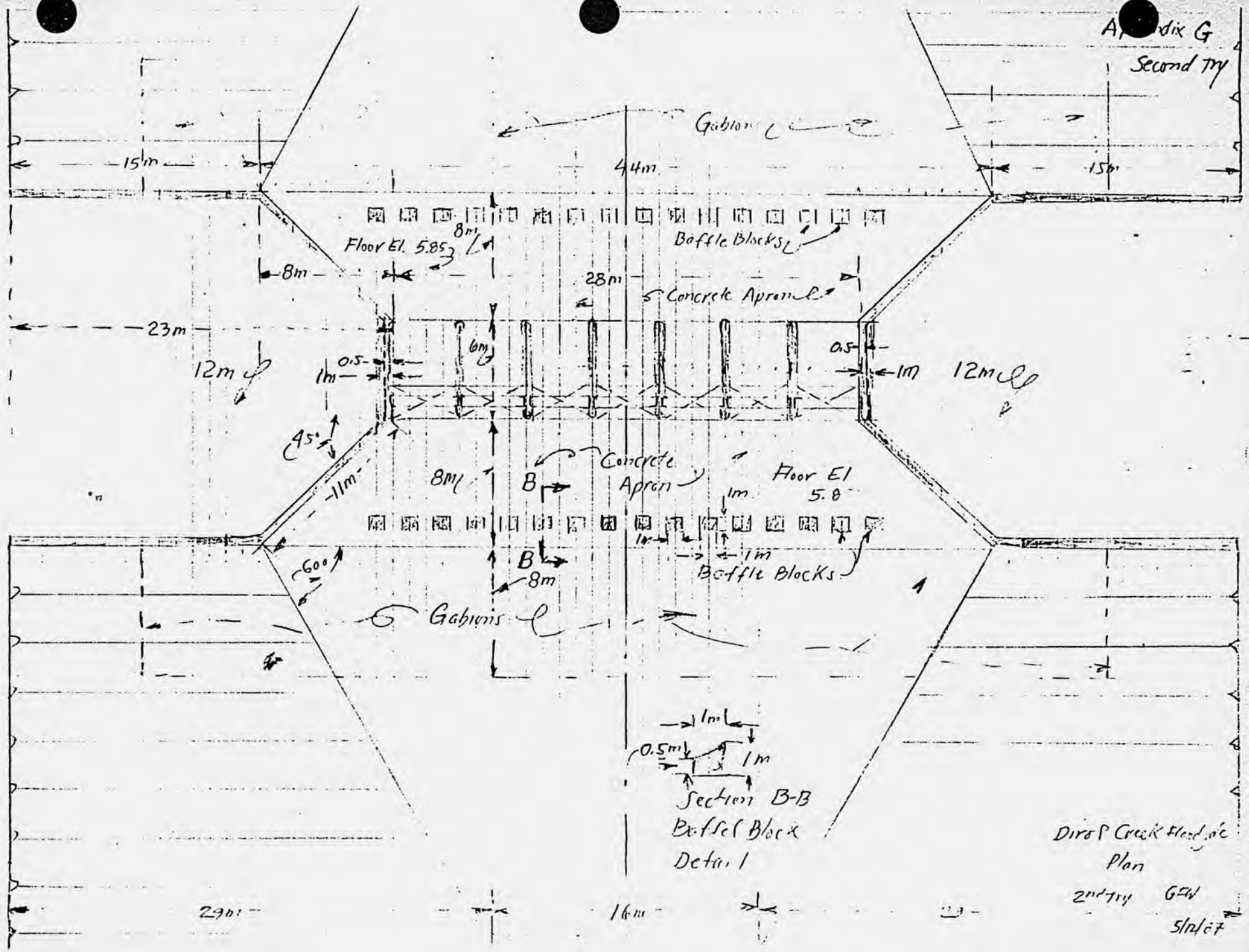
Flood as 10% chance of occurring

Diref Creek Flood Gate
Front Elevation
H. 1 : 2m
V = 1

Diref Creek Flood Gate
Front Elevation

Gtw 1 2/1
4/24/67

87


Appendix G
Second try
Gabion
15m
44m
15m
8m
Floor El. 5.85
Baffle Blocks
8m
28m
Concrete Apron
23m
6m
0.5
1m
0.5
1m
12m
12m
45°
11m
8m
B
Concrete Apron
Floor El 5.8
1m
1m
1m
Baffle Blocks
B
8m
60°
Gabions
1m
0.5m
1m
Section B-B
Baffel Block
Detail
Dirst Creek Flood gate
Plan
2nd try
GEW
5/17/67
29m
16m

288x

First try

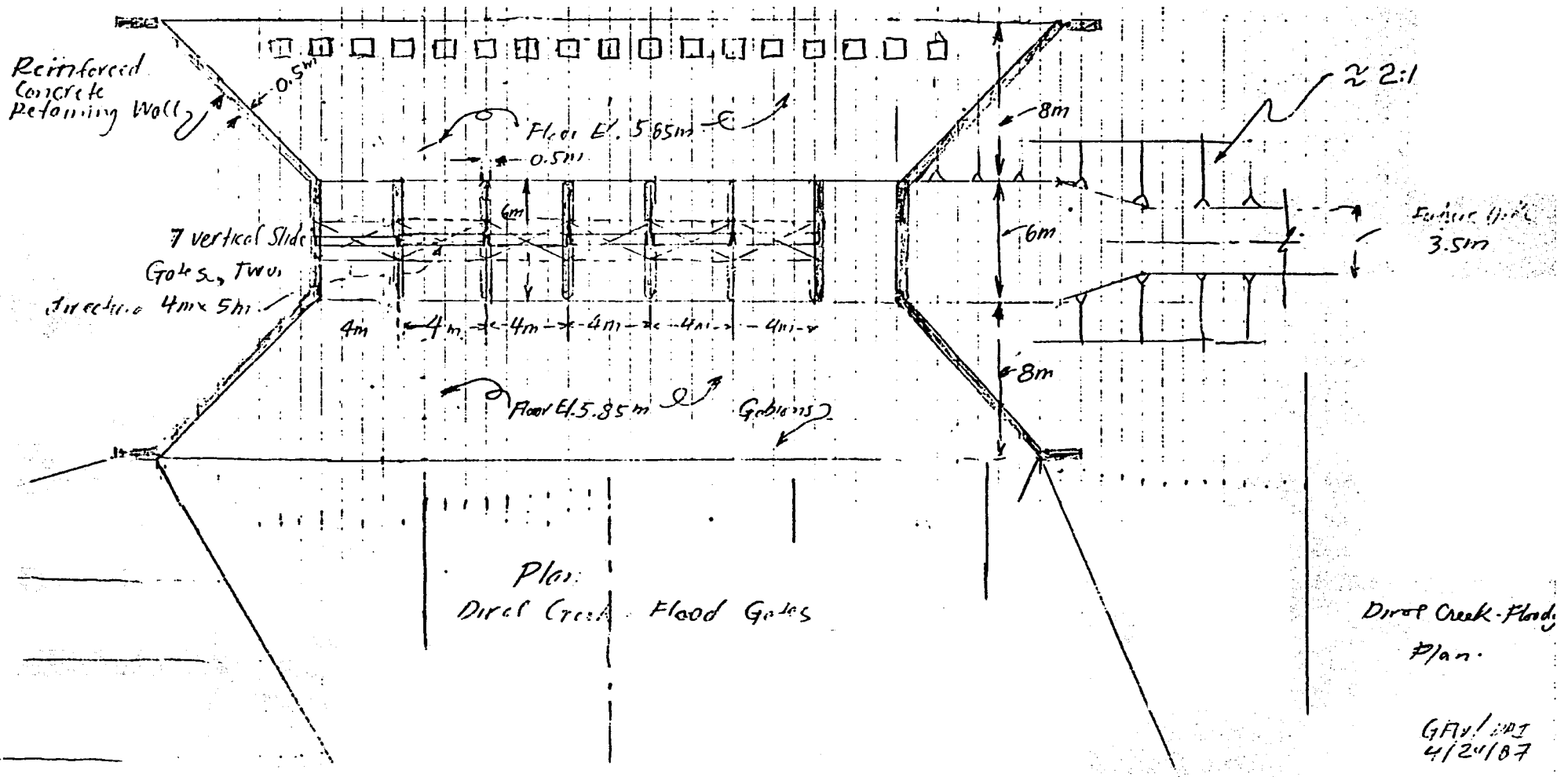

Reinforced Concrete Retaining Wall
0.5m
Floor El. 5.85m
0.5m
7 vertical Slide Gates, Two, Invert 4m x 5m
6m
4m
4m
4m
4m
4m
4m
8m
6m
8m
≈ 2:1
Future Gate
3.5m
Floor El. 5.85m
Gabions
Plan
Dirot Creek Flood Gates
Dirot Creek - Floods
Plan.
GAIV/DI
4/24/87

Tableau 1 - DEVIS ESTIMATIF DES DIGUES A RECONSTRUIRE (Travaux 1ère phase)

N.	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNIT. U.M.
1	Laboratoire de chantier pour effectuer les essais concernant les matériaux de la digue	forfait	1	5.000.000
2	Déblai pour la mise en plate-forme de l'assiette de la digue y compris le compactage de la plateforme et la mise en dépôt, des terres	m^3	72.000	250
3	Terrassement en remblai compacté pour confection de digue, y compris l'extraction en chambre d'emprunt ou en surface des matériaux nécessaires, l'épandage des matériaux rejetés ou mis en dépôt, le transport à pied d'oeuvre des matériaux utilisables, leur mise en forme, humidification, compactage par couches de 0,20 m d'épaisseur maximale y compris toutes sujétions	m^3	205.000	450
4	Plus-value au prix n. 3 pour distances de transport supérieures à 150 m:			
4.1	- jusqu'à 500 m	m^3	40.000	40
4.2	- jusqu'à 1.000 m	m^3	25.000	90
4.3	- jusqu'à 3.000 m	m^3	30.000	260
5	Fourniture et mise en place d'une nappe textile de tissu non-tissé sur le talus extérieur de la digue au dessous du revêtement, compris toutes sujétions	m^2	31.000	180
6	Extraction, transport et mise en dépôts du matériau de revêtement latéritique de la digue, y compris toutes sujét.	m^3	27.000	2.000
7	Mise en place du matériau de revêtement mis préalablement en dépôt, y compris le terrassement en déblais pour la réalisation de fouilles au pied de la digue, y compris toutes sujétions	m^3	27.000	1.800
	TOTAL PARTIEL			
	IMPREVUS 15%			
	TOTA GENERAL (Trav. 1ère phase)			

au 2 - DEVIS ESTIMATIF - REHAUSSEMENT DIGUES DE CEINTURE DU "CASIER" (Travaux 2ème phase)

DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNIT. U.M.	TOTAUX U.M.
oussaillage pour digues restées en place mais à re ser, y compris mise en dépôt du materiau de déblai et es sujétions	m^2	46.800	7	327.600
page des digues du poste 1 y compris la mise en dépot iatériau de déblai et toutes sujétions	m^3	14.040	240	3.369.600
ification des digues restées en place et de celles onstruites, dans les zones de liaison entre remblais iens et nouveaux, y compris toutes sujétions et tra x complémentaires ouvelle digue Sud = 2.750 m^2 ouvelle digue Nord-Est = 20.075 m^2 ouvelle digue Nord = 8.250 m^2 autres digues restées en place = 62.400 m^2 Total	m^2	93.475	20	1.869.500
blai compacté pour le rehaussement de la cote de crête s digues de ceinture du "Casier", avec extraction, ansport, mise en dépôt, humidification et compactage, compris toutes sujétions et travaux complémentaires nouvelle digue Sud = 2.000 m^3 nouvelle digue Nord-Est = 14.600 m^3 nouvelle digue Nord = 6.000 m^3 autres digues restées en place = 158.730 m^3 Total	m^3	181.330	450	81.598.500
lus-value au prix n. 4 pour distances de transport su- érieures à 150 m:				
- jusqu'à 500 m	m^3	35.000	40	1.400.000
- jusqu'à 1.500 m	m^3	20.000	90	1.800.000
- jusqu'à 3.000 m	m^3	25.000	260	6.500.000
Extraction, transport et mise en dépôt de matériaux des tinés à réaliser le revêtement latéritique type "perré non maçonné de 30 cm d'épaisseur - nouvelle digue Sud = 1.150 m^3 - nouvelle digue Nord = 7.225 m^3 - autres digues restées en place = 21.060 m^3 Total	m^3	29.435	1.300	38.265.500
				135.130.700

(à reporter)

Grogol Rehab. 1982 Unit Prices

(suite Tab. 2)

N.	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNIT U.M.
	(report)			
7	Mise en œuvre et compactage du matériau dont au poste 6, y compris toutes sujétions et travaux complémentaires	m^3	29.435	700
8	Fourniture et mise en œuvre de nappe de tissu non-tissé sur la bande de rehaussement du talus externe de la digue Nord-Est, y compris charge de connection et accrochement à la nappe mise en œuvre dans la première phase de reconstruction	m^2	7.300	180
9	Extraction, transport et mise en dépôt du matériau destiné à réaliser le completement du revêtement latéritique du type lourd le long du talus externe de la digue Nord-Est	m^3	1.825	2.000
10	Mise en œuvre et compactage du matériau dont au poste 9, y compris toutes sujétions et travaux complémentaires	m^3	1.825	1.800
11	Couche de latérite compactée, de 10 cm d'épaisseur en moyenne, type tout-venant, sur la crête de toutes les digues de ceinture après le rehaussement, avec extraction, transport de n'importe quelle distance, mise en dépôt, reprise, humidification, compactage, y compris toutes sujétions - nouvelle digue Sud = 1.500 m^2 - nouvelle digue Nord-Est = 10.950 m^2 - nouvelle digue Nord = 4.500 m^2 - autres digues restées en place = 23.400 m^2 Total	m^2	40.350	200
	TOTAL PARTIEL			
	IMPREVUS 15%			
	TOTAL GENERAL (Travaux 2ème phase) arrondi à			

Tab. n. 3 - DEVIS ESTIMATIF DES TRAVAUX DE REHABILITATION DES INFRASTRUCTURES DU "CASIER"
(digues non comprises)

N.	CODES	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNITAIRES U.M.	MONTANT PARTIEL
		CANAUX D'IRRIGATION				
	I-E	CANAL C_1				
1	B	a) du début au module 1 (500 m)				
		reprofilage talus	m^3	200	220	44.000
		revêtement talus à côté du drain D_1 en béton à 3,5 q (e = 7 cm) avec mailles métalliques électro-soudées	m^2	40	2.500	100.000
2	D	b) du mod. 1 au mod. 4 (1.250 m)				
		reprofilage talus	m^3	350	220	77.000
3	C	c) du mod. 4 au mod. 7 (2.000 m)				
		reprofilage talus	m^3	650	220	143.000
		scarification sur digues	m	1.400	25	35.000
		remblai compacté sur digues	m^3	200	400	80.000
4	B	d) du mod. 7 au mod. 8 (750 m)				
		reprofilage talus	m^3	300	220	66.000
		scarification sur digues	m	600	25	15.000
		remblai compacté	m^3	100	400	40.000
5	A	e) du mod. 8 au mod. 9 (500 m)				
		fouilles du canal y compris profilage talus	m^3	3.000	300	900.000
		TOTAL PARTIEL				
	I-E	CANAL C_2				
6	D	a) du début au module 11 (875 m)				
		reprofilage talus	m^3	250	220	55.000
7	C	b) du mod. 11 au mod. 12 (250 m)				
		reprofilage talus	m^3	80	220	17.600
		scarification digues	m	100	25	2.500
		remblai compacté	m^3	25	400	10.000
8	B	c) du mod. 12 au mod. 13 (625 m)				
		reprofilage talus	m^3	250	220	55.000
		scarification digues	m	500	25	12.500
		remblai compacté	m^3	80	400	32.000
		TOTAL PARTIEL				
	I-E	CANAL C_{11}				
9	C	a) du module 5 au module 17 (1.000 m)				
		reprofilage talus	m^3	340	220	74.800
		(à reporter)				

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CODES	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNITAIRES U.M.	MONTANT U.M. PARTIEL	MONTANT U.M. TOTAL
I	CANAL C_{21} (report)					1.759.400
E	a) du module 12 au partiteur 16/3 (1.000 m)					
	reprofilage talus	m^3	350	220	77.000	77.000
I-E	CANAL C_{2002}					
A	a) du mod. 13 à la fin (1.750 m)					
	scarification digues	m	1.600	25	40.000	
	remblai compacté	m^3	220	400	88.000	
	fouilles de canal y compris profilage talus	m^3	5.500	300	1.650.000	
	TOTAL PARTIEL					1.778.000
	DRAINS					
I-E	DRAIN D_1					
A	a) de F76 au point 1.125 (1.125 m)					
	fouilles de canal y compris profilage talus	m^3	7.600	300	2.280.000	
B	b) du point 1.125 a F29 (750 m)					
	reprofilage talus	m^3	350	220	77.000	
	scarification digues	m	600	25	15.000	
	remblai compacté	m^3	100	400	40.000	
C	c) de F29 au point 2.250 (2.250 m)					
	scarification digues	m	1.500	25	37.500	
	remblai compacté	m^3	230	400	92.000	
B	d) du point 500 jusqu'à la fin (500 m)					
	reprofilage talus	m^3	350	220	77.000	
	fouilles pour gabions à proximité de la station de pompage	m^3	50	1.000	50.000	
	mise en place des gabions	m^3	50	4.000	200.000	
	matelas type Reno (e = 25 cm)	m^2	350	1.500	525.000	
	tissu non tissé	m^2	350	200	70.000	
	TOTAL PARTIEL					3.463.500
I-E	DRAIN D_{11}					
C	a) du début à F44 (625 m)					
	scarification digues	m	420	25	10.500	
	remblai compacté	m^3	60	400	24.000	
	reprofilage talus	m^3	210	220	46.200	
B	b) de F44 à F29 (1.375 m)					
	reprofilage talus	m^3	560	220	123.200	
	TOTAL PARTIEL					203.900
	(à reporter)					7.281.800

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(suite tab. n. 3)

N.	CODES	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNITAIRES U.M.	MONTANT U.M. PARTIEL	TOTAL
		(report)					7.[illegible]
	I-E	DRAIN D_{12}					
18	B	a) de F50 à F64 (1.000 m)					
		reprofilage talus	m^3	410	220	90.200	
		scarification digues	m	800	25	20.000	
		remblai compacté	m^3	120	400	48.000	
19	A	b) de F64 à F77 (1.375 m)					
		reprofilage talus	m^3	600	220	132.000	
		fouilles canal y compris reprofilage talus	m^3	6.200	300	1.860.000	
		TOTAL PARTIEL					2.[illegible]
	I-E	DRAIN D_{13}					
20	D	a) du début à F71 (375 m)					
		reprofilage talus	m^3	110	220	24.000	
21	C	b) de F71 à F72 (375 m)					
		scarifications digues	m	250	25	6.250	
		remblai compacté	m^3	40	400	16.000	
22	B	c) de F72 à F80 (1.125 m)					
		reprofilage talus	m^3	450	220	99.000	
		scarification digues	m	920	25	23.000	
		remblai compacté	m^3	140	400	56.000	
23	A	d) de F80 à F76 (500 m)					
		fouilles canal y compris profilage talus	m^3	2.500	300	750.000	
		TOTAL PARTIEL					[illegible]
	I-E	DRAIN D_{1001}					
24	B	longueur totale (375 m)					
		reprofilage talus	m^3	150	220	33.000	
		scarification digues	m	300	25	7.500	
		remblai compacté	m^3	45	400	18.000	
		TOTAL PARTIEL					
	I-E	DRAIN D_{1203}					
25	B	longueur totale (500 m)					
		reprofilage talus	m^3	200	220	44.000	
		scarification digues	m	400	25	10.000	
		remblai compacté	m^3	60	400	24.000	
		TOTAL PARTIEL					
	I-E	DRAIN D_{1204}					
26	B	longueur totale (500 m)					
		reprofilage talus	m^3	210	220	46.200	
		(à reporter)				46.200	[illegible]

DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNITAIRES U.M.	MONTANT U.M. PARTIEL	MONTANT U.M. TOTAL
(report)				46.200	10.542.750
scarification digues	m	450	25	11.250	
remblai compacté	m^3	90	400	36.000	
TOTAL PARTIEL					93.450
DRAIN D_{1205}					
toute la longueur (750 m)					
reprofilage talus	m^3	300	220	66.000	
scarification digues	m	600	25	15.000	
remblai compacté	m^3	120	400	48.000	
TOTAL PARTIEL					129.000
DRAIN D_{1207}					
toute la longueur (1.500 m)					
fouilles canal y compris profilage talus	m^3	4.500	300	1.350.000	1.350.000
DRAIN D_{1208}					
a) du début à F70 (750 m)					
reprofilage talus	m^3	310	220	68.200	
scarification digues	m	650	25	16.250	
remblai compacté	m^3	95	400	38.000	
b) de F70 à F54 (125 m)					
fouilles canal y compris profilage talus	m^3	500	300	150.000	
TOTAL PARTIEL					272.450
TOTAL CANAUX ET DRAINS					12.387.650
PISTES					
PISTES DE CONTOUR					
a) tronçon le long du canal C_1 (5000m)					
scarification des pistes	m^2	4.250	20	85.000	
remblai compacté	m^3	1.500	400	600.000	
reprofilage talus	m^3	2.000	220	440.000	
fouilles pour fossés d'écoulement	m^3	2.250	500	1.125.000	
revêtement fossés en ciment (e = 0,05)	m^2	4.500	600	2.700.000	
couche de latérite compactée (e = 0,10)	m^2	5.500	350	1.925.000	6.875.000
b) tronçon le long de la digue Oualo (2.600 m)					
scarification profilage et compactage	m^2	25.000	110	2.750.000	
fouilles fossés d'écoulement	m^3	1.650	500	825.000	
revêtement fossés en ciment (e = 0,05)	m^2	3.300	600	1.980.000	
couche de latérite compactée (e = 0,10)	m^2	25.000	350	8.750.000	14.305.000
(à reporter)					33.567.650

(suite tab. 3)

N.	CODES	DESIGNATION DES TRAVAUX	UNITE	QUANTITE	PRIX UNITAIRES U.M.	MONTANT PARTIEL
		(report).				
		Pour petits travaux et divers				28.850
		TOTAL TRAVAUX DE REHABILITATION				
47	I/I.I R	PROTECTION SUR LA BOUCLE DU SENEGAL				
		a) fouilles pour gabions (270 x 2 x 1)	m^3	540	1.000	540.000
		b) gabions mis en place (270 x 2 x 4)	m^3	2.160	4.000	8.640.000
		TOTAL PARTIEL				
48	I/II III-R	TRAVAUX D'ENTRETIEN EXTRAORDINAIRES				
		a) canaux tertiaires non concernés par les réparations	m	3.000	300	900.000
		b) drains tertiaires " " "	m	6.000	400	2.400.000
		c) pistes mineures " " "	m	5.000	200	1.000.000
		TOTAL PARTIEL				
		TOTAL GENERAL				

CODES.

A efficacité résiduelle entre 0% et 20%
B " " " 20% et 50%
C " " " 50% et 80%
D " " au-delà de 80%
I interventions à effectuer en première année
II " " deuxième "
III " " troisième "
E interventions à effectuer par entreprises
R " " en régie

ANNEX B

DIROL PLAIN PROJECT

HYDROLOGY ANALYSIS

PROJECT IDENTIFICATION DOCUMENT

Prepared by

Development Alternatives, Inc.
624 9th Street
Washington, D.C. 20001

HYDROLOGY SUMMARY

A. Kaedi Climatological Data

1.	Yearly Maximum Termperature	36.7 Degrees Centigrade
2.	Yearly Minimum Termperature	22.9 Degrees Centigrade
3.	Yearly Mean Temperature	29.8 Degrees Centigrade
4.	Average Relative Humidity	35 %
5.	Yearly Sunshine Hours	3,106
6.	Yearly Evaporation	4,180 mm.
7.	Yearly Mean Rainfall	399 mm. 1921-85

8. Kaedi Rainfall Probability

	Cumulative Probability									
Mean	.01	.02	.05	.10	.20	.50	.80	.90	.95	.99
	mm.									
399	153	173	206	239	283	384	506	579	644	778

B. Groundwater

Static water levels in the Dirol Plain are 10-15 meters below the ground surface. Salinity levels are low and the water is acceptable for irrigation use.

C. Salinity

The salinity levels in the Senegal River and Dirol Creek have been measured in the range of 100-300 micromhos. These levels are quite acceptable for recessional agriculture.

D. Senegal River Flood Flows

The frequency and corresponding flood levels of Senegal River flood flows along with area inundated without any structures are summarized below:

Frequency %	Max Level m. IGN	45 Day Level m. IGN	Area Inundated 45 days ha.
1	12.5	11.8	6700
5	12.3	11.5	6400
10	11.9	11.2	6050
50	11.1	10.3	5400
90	9.9	9.0	3400
95	9.2	8.5	2500
99	7.8	7.2	-

E. Dirol Creek Runoff

The Dirol Creek flood discharge is smaller in peak and volume than the Senegal River flood and arrives one month sooner than the Senegal River flood. The return period, flood level, area inundated and volume stored are summarized below:

Return Period years	Flood Level m. IGN	Area Inundated ha.	Volume Stored cu. m.
1 in 10	9.7	4750	67,000,000
1 in 5	9.3	4000	48,000,000
1 in 2	8.8	3000	31,000,000

F. Effect of Manantali On Dirol Plain

After the upstream Manantali dam is fully operational, an optimium artificial flood release during a transition period until hydroelectric facilities are ready would result in a Dirol flood level of 10.6 m. IGN and would inundate 5,800 ha.

G. Design Factors

A floodgate on Dirol Creek designed to capture first Dirol Creek unoff and later Senegal River runoff. The Senegal River flood level of 10.3 m. IGN for 45 days is estimated to occur one year out of two and and to a level of 11.2 m. IGN for 45 days one year out of ten. We reccommend that the floodgate be designed for a level of 10.8 m. IGN which occurs 1 year out of 3 and inundates 5,700 ha. This is equivalent o a flow rate of 200 cu. m. sec.

H. TOR for Hydrological Work PP Phase

1. Confirm elevation difference by ground survey between the Kaedi guage and the mouth of the Diro Creek.
2. Review and update Hydrological data for Senegal River and Dirol Creek to confirm floodgate design assumptions.
3. Review report on proposed operation of Manantali Dam with and evaluate effect on Dirol Plain Project.
4. Review new groundwater data expected from USAID financed project.

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HYDROLOGY SECTION

INVENTORIES

1. Climatological-Meteorological Data

- See section 2 of Analytical report

2. Ground Water

The following valuable information on the Dirol Plain aquifer concerning potential ground water quality, water movement and static water levels was retrieved from USAID Resource Inventory study of Southwestern Mauritania (1982):

- Mid 1987, the USAID "Senegal Valley Groundwater Survey" will install 6 piezometers on the Dirol Plain and will integrate a number of suitable reference wells in the Dirol catchment into the above project. The eastern limit of the Trarza, a large promising aquifer, cuts across the upper catchment of the Dirol on a W-NW direction.
- Every effort should be made to closely follow up the implementation and monitoring of this project.
- Ground water may well be an attractive complementary source for irrigating perimeters on higher grounds, "Fonde", in a second development phase.

4. SURFACE WATER QUALITY

Chemical analyses of the Senegal river water samples are reproduced in the report. They provide sufficient information on the sodium absorption ratio (SAR) and the electrical conductivity (total salt content) to classify the flood water as C2-S1, i.e. good for irrigation purposes, (USDR irrigation water classification). There are no available data for the Dirol Creek runoff water. Only one chemical analysis of the Gorgol at Kaedi

was noted. This water is also acceptable for irrigation. One may tentatively assume a certain degree of correlation between the chemical composition of the runoff from the two-rivers since their catchment areas have similar geographic formations.

5.1 Available Information

The following information was collected, analyzed, and updated from various reports and technical documents. (See reference list of documents).

Maximum and typical water levels at Bakel, Kaedi and the Dirol plain for present conditions.

Estimated flow pattern at Bakel, Kaedi and the Dirol after Manantali.

Management guidelines for Manantali Reservoir during various development scenarios in the Senegal River valley concerning agriculture, electrical energy production, water supply, and navigation.

Possible conflicts between the above users water requirements in the medium and long term.

5.2 Preliminary findings on the above issues and flood characteristics/Water levels correlations

Discrepancies between predicted maximum water levels at the Dirol were found (+40 cm) between ORSTOM and GERSAR computations. GERSAR (see reference list) used the SOGREAH model. ORSTOM is presently finalizing its "Flood Propagation Model" used successfully on the NIGER RIVER for similar purposes. We think that the ORSTOM model is better adapted to meet our objectives the SOGREAH being conceived more specifically towards the

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simulation of future development in the Senegal River valley.

Bakel is the reference hydrographic station for the middle Senegal River valley (including the Dirol plain stretch) of the Senegal River. The rating curve is unstable and not constant throughout all stages of the rising and falling limits of the curve. This problem is presently being corrected and will permit an updating of the complete series of water observations going back to the year 1903. Therefore, frequency analyses will use representative periods, including the extreme dry spells of the last 15 years. The above study results will be part of the report entitled "ETUDE DE LA GESTION DES OUVRAGES COMMUNS DE L'OMVS" by the following consultants consortium: Sir Alexander Gibb and Partners - E.D.F. - Euroconsult.

It is important to note that this up-to-date report is to be presented to the OMVS High commission in June 1987. This report needs special attention as it fills the main technological gaps required to plan the Dirol Plain Project. The other technical gap concerning ground water will be filled as mentioned in Sec.2.

5.3 Prerequisites

In the report Annex, detailed terms of references are presented to cope with the following aspects of the Senegal and Dirol Creek hydrology:

A. Senegal River

Revised water levels at Bakel.

Updating of the statistical studies by using longer and more representative series.

Correlation of Bakel water levels (reference station) and stations along the Dirol plain using the ORSTOM

simplified model.

Integration of one of these stations (possibly at Dawale) in the Senegal basin network for the proposed "Flood Warning System".

B. Dirol Creek

Field and office work on the Dirol water catchment will determine:

Rainfall, intensity, duration curves for various frequencies over the basin.

Runoff coefficients by correlation with similar representative basins in the region.

Water yields of the basin for various frequencies.

Water balance evaluation of the basin. This study should be undertaken as soon as possible, preferably in August to catch the next 1987 rainy season, by a consultant familiar with the hydrological conditions in the region.

6. Recession Agriculture in the Valley

Preliminary information on the proposed development scenarios already give some indications on the following aspects (Annex 2):

- Present and expected flow patterns of the Senegal River water levels "after Manantali".
- Expected conflicts between water user, electricity, agriculture, and the respective rate of development of irrigation and recession agriculture.
- Management guidelines for the use of Manantali Reservoir and the uncontrolled catchment.

HYDROLOGY SECTION

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~~1. Terms of reference - Hydrological Studies~~
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HYDROLOGY SECTION

1. INTRODUCTION

For this section the latest available date were collected and assessed. Reports were scrutinized , and technical gaps identified. Detailed terms of reference for supplemental hydrological studies required to fill these gaps are presented in Annex 1. The goal is to provide sound information for floodgate sizing and the selection of development scenarios (financial/economical analysis).

The final section of this report represents the general outlook for recessional agriculture (Annex 2) and the long term flood water flows in the Dirol Plain area. It identifies potential conflicts between various users of Manantali reservoir releases and indicates the effect and priorities of an "artificial flood".

2. CLIMATOLOGICAL DATA IN THE PROJECT REGION

2.1 Rainfall in the Dirol -

2.1.1 Monthly Precipitations

The Aleg and Kaedi meteorological stations can be considered as representative respectively of the rainfall on the upper catchment of the Dirol creek and on the Dirol plain. Table 1 below presents monthly rainfall values at Kaedi for the period 1921-1985. References: (ORSTOM, CNRADA, SONADER)

To prevent unnecessary repetition of references documentation, a list of selected reference is presented at the end of this report.

Table 1

MONTH	J	F	M	A	M	J	J	A	S	O	N	D	YEAR mm.
MEAN 1921-58 (ORSTOM)													409.0
MEAN 1951-80	1.3	2.6	-	-	1.3	22.2	73.7	120.6	87.1	18.9	2.4	Tr.	330.3
MEAN 1971-80	-	-	-	-	-	19.8	75.2	108.6	50.9	7.8	-	-	262.3
1978	-	-	-	-	-	27.6	54.3	118.0	95.0	12.0	13.2	0.5	214.4
1979	7.1	-	-	-	-	15.4	47.7	80.7	39.0	12.6	0.2	-	202.7
1980	-	6.8	-	-	-	11.3	74.7	170.2	16.0	3.0	-	-	284.5
1981	-	2.7	-	-	-	1.9	14.2	35.6	89.4	7.5	-	-	151.3
1982	-	-	-	-	-	19.8	94.2	106.5	17.5	-	-	-	238
1983	-	-	-	-	-	17.5	13.6	54.2	84.4	-	-	-	183.6
1984	-	-	-	-	-	41.0	55.0	48.0	36.0	46.0	10.0	-	236.0
1985	-	-	-	-	-	-	54.1	73.1	37.8	-	-	-	165.0

Average number - Days of rain

1971-80	*-	-	-	-	-	2	5	6	5	2	-	-	20

The "monographie Hydrologique du fleuve Senegal" (11) gives the following mean annual rainfall at Aleg:

Years observed	Mean value (min)
49 (1910-72)	399

* No precipitation

At the Kaedi station it is observed that the dry period in the post colonial era has distorted the long normal rainfall value, which is in the range of 370 mm/year for a 60 year period.

Recent data for the station were not available. The normal yearly rainfall for the period 1951-1981 should be on the order of 200-220 mm. A statistical study of the annual rainfall was made (2) excluding non representative periods for the three stations presented below.

Table 2

STATION	MEAN	Cumulative Probability of Yearly Rainfal									
		0.01	0.02	0.05	0.10	0.20	0.50	0.80	0.90	0.95	0.99
		Values altained in mm									
KAEDI	399	153	173	206	239	28[illegible]	384	506	579	644	778
BOGHE	319	143	158	183	207	23[illegible]	310	393	442	485	573
ALEG	279	85	99	124	149	18[illegible]	264	367	429	485	603

2.2.2 Daily rainfall

CNRADA has recorded daily precipitation in Kaedi for the years 1982-83:

Table 3

	JUNE	JULY	AUGUST	SEPTEMBER	YEAR
1982	30: 19.8	14: 48.9	[illegible]1: 18.1	14: 13.7	mm
		19: 22.1	[illegible]4: 17.6	17: 4.8	
		24: 10.2	[illegible]3: 8.9		
			[illegible]3: 23.6		
			[illegible]5: 25.4		
			[illegible]6: 1.0		
			[illegible]9: 11.9		
TOTAL	19.8	94.2	106.5	17.5	238

110 x

1983	18:	8.7	8:	13.6	1:	0.7	10:	1.8	
	26:	8.8			2:	1.6	11:	4.4	
					10:	9.4	17:	30.2	
					21:	30.0	21:	46.5	
					23:	2.4	24:	1.5	
					24:	12.4			
TOTAL		17.5		13.6		54.2		84.4	183.6

Daily rainfall for various periods of return from ORSTOM are given below:

Table 4

Max. Daily Rainfall - mm

Return periods: (Years)	1	2	5	10	20	50	100
ALEG	46.4	60.8	82.8	102	123	155	183
KAEDI	53.2	67.8	89.5	108	129	160	185

2.2 METEOROLOGICAL DATA (1)

The following average values were computed the data of CNRADA in Kaedi for the period 1970-1981.

Table 5

J	F	M	A	M	J	J	A	S	O	N	D	YEAR	
32.2	34.8	36.9	40.2	41.3	40.4	36.6	35.2	36.0	38.5	35.7	32.0	36.7	max
17.4	19.0	21.8	25.0	26.7	26.3	25.5	25.3	25.2	24.3	20.8	18.0	22.9	min
24.8	26.9	29.4	32.6	34.0	33.4	31.1	30.3	30.6	31.4	28.3	25.0	29.8	mean T
24	23	20	20	26	38	52	62	59	40	26	27	35	U%(Rel.Hum
260	269	279	291	264	258	264	202	255	267	249	248	3106	I(sun hrs)
9.4	11.5	13.6	16.2	16.7	14.3	12.2	8.7	7.8	9.2	9.5	8.6	11.5	E mm/day

Evaporation: 4,180 mm/yr. Class A pan

///

2.3 TEMPERATURES

The maximum monthly temperature at Kaedi is generally recorded during May . The minimum temperatures occur in December and January: The daily variations which depend heavily on humidity are larger in January and February and are at a minimum during the rainy season when the humidity associated with the monsoon limits back radiation during the night.

2.4 WIND

The predominate wind directions in the Kaedi area are from north to north-east. At the beginning of the year , the trade winds originate from the zone of high barometric pressure centered over the Azores Islands and extend towards equatorial low pressure zones. Towards the interior of the continent, the wind loses velocity and becomes irregular.

This trade wind is replaced in February-March by a continental wind from the East, the Harmattan, which is hot and dry (2--4 gr. water vapor per m3 of air). This desiccating wind prevails during the dry season in the Dirol Plain and can become a major constraint to recessional agriculture.

Prevailing wind directions are as follows:

- East; north-east : November to March
- East : April and May
- West : June to September

Mean wind velocities are lowest from October to end of December. They rapidly increase until July. During these storms, wind velocities of 15 to 25 m/s. can be recorded.

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Table 6

Average monthly wind speed recorded at Kaedi (1971-80)

	Jan	Feb	Mar	Apr	May	Jun	
Daily wind (km/day)	144.2	155.2	177.0	186.6	198.6	209.9	
Wind speed (m/s)	1.67	1.80	2.05	2.16	2.30	2.43	
	Jul	Aug	Sep	Oct	Nov	Dec	Year
Daily wind (km/day)	222.1	176.9	127.5	95.5	107.9	116.7	159.9
Wind speed (m/s)	2.57	2.05	1.48	1.10	1.25	1.35	1.85

2.5 EVAPORATION

Evaporation (E) in the project area is very high. The measured values on a class A pan at Kaedi (1971-80) are given below. The mean yearly evaporation amounts to 4,180 mm. In the Dirol plain, ORSTOM suggests that a coefficient of 0.7 be applied to the Pan values for the water surface. The yearly total evaporation would vary between 2,500-2,900 mm and daily evaporation on free surface would be as follow:

- 5.2 to 6.1 mm/day in August
- 4.7 to 5.5 mm/day in September
- 5.5 to 6.4 mm/day in October
- 5.7 to 6.7 mm/day in November

Given below is evaporation measured from a Colorado Pan (1960-64) at ALEG, north of the Dirol basin. The Pan to free water surface coefficient K is approximately 0.8 and is representative of the upper basin conditions.

Table 7

ALEG	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
pan (mm)	236	243	335	363	387	372	298	261	219	245	249	251	3,459
free surface (mm/day) (K = 0.8)										6.7	5.8	6.3	6.6 6.5 = 7.6 Total (Dirol Plain Submersion Period)

This unusually high rate of evaporation poses a serious constraint to agriculture during the dry season.

2.6 EVAPOTRANSPIRATION

Potential evapotranspiration (E.T.P.) based on climatic data (sunshine hours, relative humidity and wind) has been computed (1) for some typical crops in the Kaedi area and indicative values of the seasonal crop water consumption for the rainy and the dry season are presented below:

	Rainy season		Dry season	
CROP		ETP (crop) in mm		ETP (Crop) in mm
Rice	(June 20- Sept. 20)	738	(Feb. 20 - May 20)	1071
Maize	(July - October)	467	(Oct. 15 - Feb. 15)	624

This does not present undue stress for crops grown in the dry season under recessional conditions.

3. GROUND WATER

3.1 Introduction

To our knowledge no ground water survey has ever been made in the Dirol plain but field observations undertaken during this mission and correlation with some findings of remote sensing imagery (10) provide a preliminary estimate of the ground water potential in the Dirol plain.

114x

The southern limit of the Trarza aquifer crosses the Dirol Creek upper catchment in a northwesterly direction (See fig.1). Ground water of variable but not high salinity is found in most of this zone at several depths.

3.2

Water and salinity contours on the western edge of the upper Dirol Creek catchment show static water level contours approximately 10 to 15 m. below ground level in the Dirol plain. Field observations of some hand dug wells showed average static water elevations of 8 to 10 m below ground level.

Water salinity in the area is about 0.5 grams per liter which is acceptable for irrigation purposes.

Most of the wells on the plain are hand-dug to a maximum depth of approximately 15 m and do not penetrate beyond the upper horizons of the aquifer which is probably recharged by the runoff from the upper creek catchment.

A buried channel of the Senegal river was spotted on the imagery and underlies the Dirol Creek on a North/South direction. This fossil river channel is not recharged by the Senegal River since the level of the buried channel is higher than present water levels in the River.

3.3 Ground Water Survey in the Dirol Basin

Within the frame work of the ongoing USAID "Ground Water Survey of the Senegal river Valley" piezometers and reference wells will be installed on the Dirol plain this summer and monitored to evaluate the aquifer potential and ground water quality and movement in the Dirol Plain (See Fig. 2).

3.4 Follow-up of the Survey

In the future, irrigation of high ground perimeters in the Dirol plain will be considered. Reliable information on the aquifer potential and water quality will be of great value for successful implementation of irrigation perimeters.

4. SURFACE WATER QUALITY

4.1 SENEGAL RIVER AT DIROL PLAIN

Available information on chemical water analyses is presented in the following table.

Table 8

Analyses of Senegal River Water

STATION	CE 25 micromohs	pH	Dry Matter mg/l	m.e per liter Ca	Mg	K	* in p.p.m. (at Bakel) Na	N	Co3H	Cl
KAEDI	69	7.6	69	0.27	0.46	0.03	0.08	-	0.90	0.24
BAKEL*	309	5.7			-	0.96	1.00	0.005		0.3
BAKEL*	325					0.86	1.22	0.005		0.4

At Bakel in March 1984, the estimated sodium absorption Ratio (SAR) fell between 5 and 10 and electric conductivity was 310 micromhos; the water can be classified C2-S1 for irrigation pruposes. This water classification does not present a major constraint for irrigation purposes.

4.2 DIROL CREEK

The only analysis available for the region comes from the Gorgol River at Kaedi. This analysis indicates that it is suitable for irrigation. See Table.9 below:

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Table 9

Water Analysis of the Gorgol River (3-19-64) at Kaedi

CE 25 microm	pH	Dry Matter mg/l	in m.e. per liter							
			Ca	Mg	K	Na	CO3H	Cl	SO4	SO4Cl
168	6.9	-	0.57	0.63	0.25	0.31	0.70	0.37	0.23	0.62

5. HYDROLOGY OF THE SENEGAL RIVER AND THE DIROL PLAIN

5.1 INTRODUCTION

A comprehensive review of hydrological data made available to the mission gives the latest perspective on future development of the Senegal River valley, before and after Manantali, and its effect on expected flood water levels at the Dirol plain for short and long term periods. Technical information gaps are identified and adequate steps are proposed for the updating and acquisition of missing data.

5.2 AVAILABLE DATA

Most of the information in this section comes from recent reports. A slight error in OLIVRY's document is to be noted; the Dirol Creek outlet is at PK*498 instead of PK 503, therefore lowering water level values by approximately 9 cm.

Abstracts from management studies of the Manantali dam give some guidelines on hydrologic conditions to be expected when the dam becomes operational. Some information is also available on sediment load and river bed morphology.

5.2.1 Present status of data on river flow and water levels

The reference station for the evaluation and production of flows and water levels at the Dirol Plain is at BAKEL for the following reasons:

- It is on the Senegal River just upstream of the intermediate valley and no significant tributaries contribute to the flow in the Bakel-Dirol stretch.
- The water levels have been read without interruption since 1903.

- At this station flood flows come from the main tributaries of the uncontrolled basin (Falame, Bafing, and Bakoye Rivers).

The discharge rating curve is not constant at this section because of the small hydraulic gradient. In the mid-sixties, some river bed modifications may have changed the rating curve. This condition is being taken into account as data is updated. A complete series of water levels and river flow data should be available in mid 1987 for further correlation with the Dirol plain.

5.2.2 SEDIMENT LOAD AND RIVER BED STABILITY

A limited amount of data is available on suspended and bed load. One report gave some information, presented below, on samples taken at Bakel and can, at best, be considered as indicative:

- Below Bakel the river bed consists exclusively of silts and forms numerous meanders. These facts point to an unstable river bed configuration.
- Sediment concentration reached its maximum at the beginning of the flood; the maximum concentration observed reached 300 mg per liter.

* PK = "Point Kilometre" distance in km from Faidherbe bridge at St. Louis.

- It is noteworthy that the organic matter content amounts to about 20 to 30 mg per liter in nearly all the samples taken. This has an important natural fertilizing effect for recession agriculture in the Dirol Plain.
- Due to the leveling of the alluvial stretches, river

beds are hardly stable on the flat plain. It is probable that the process of lateral erosion presently observed at the Dirol Creek outlet will be intensified after operations of Manantali when some of the sediment is trapped in the reservoir.

5.3 WATER LEVEL CORRELATIONS

Water levels at Kaedi, Diorbival and the Dirol (PK 498) were correlated by regression analysis:

H Dirol = H Diorbival - 0.17 m

H max. Dirol = 1.08 H max. Kaedi 1.83 m

H Kaedi = 0.693 + 0.527 Bakel

* Hc 30 day Dirol = Hc 30d Kaedi - 0.90 m
* Hc 60 day Dirol = 0.99 Hc 60d Kaedi - 0.74 m
* (Hc is the duration in days of the sustained water level).

The Dirol plain stretches from PK 496 (Ferrala) to Ndiafane at PK 520, with Dawalel at PK 495.

The extreme low flood water level of 1983 at Kaedi needs to be referenced to the I.G.N. nerwork, the reference level network, (0 = mean sea level at St. Louis).

5. RIVER FLOW PATTERN - PRESENT CONDITIONS

5.4.1 Extreme and typical water levels

From the statistical analysis in "Monographie du fleuve Senegal" at Kaedi, OLIVRY updated the results which were then correlated to water levels at the Dirol outlet. These values need to be lowered by 7 cm (maximum floods), 9 cm (average) and 12 cm for flood peaks below 10.50 I.G.N.

Table 10 gives adjusted maximum and typical water levels for

120x

TYPICAL WATER LEVELS OF THE SENEGAL RIVER

AT DIROL CREEK CONFLUENCE

(PRESENT CONDITIONS)

FREQUENCIES FZ	WATER LEVELS (IGN) 1) DURATION (DAYS) MAX	5 3)	15	30	45	AREA-VOLUME (WATER) INCREMENTS (5 VS 45 D: ΔWL CM 2)	Area Submerged Ha With Control Structures	VOL. 10 M3	SUBMERGED AREA NATURAL CONDITIONS: Ha (45 days)
1	12.53	12.48	12.33	12.10	11.78	0.22			6.700
5	12.26		12.05	11.83	11.48				6.400
10	11.95	11.89	11.75	11.56	11.24	0.65	550	38	6.050
50	11.11	11.05	10.95	10.70	10.31	0.74	600	42	5.400
90	9.88		9.68	9.42	9.03				3.400
95	9.24		9.08	8.90	8.53				2.500
99	7.80		7.58	7.50	7.25				

1) WL's adjusted for confluence at PK 498 instead of PK 503 Km.

2) Assumed Max Retention at 12.0 m.

3) 5-day period WL from typical hydrograms of Senegal River at Bakel.

various frequencies and the corresponding submerged area in the Dirol plain for durations of 5 to 45 days.

Table 10

(See next page)

From Table 10 presented below, the following observations were made:

- Every two years the peak water level reaches 11.11 m IGN, stays above 10.31 m, for 45 days and 10.95 m for 15 days, submerging approximately 5400 ha in the northern zone of the plain.
- The 100 year flood reaches 12.60 m and would stay above 11.78 m for 45 days. In the upstream stretch of the Dirol plain, at Ndiafane and Sinthiou Pomar, peak water levels would be in the order of 13.00 m.
- In a dry ten year flood, water levels reach 10.00 m and stay above 9.70 m for 15 days. The 1983 absolute minimum flood water level is estimated to be 7.40 IGN at the Dirol. It would have submerged less than 500 ha during a few days because the recession rate was extremely fast.
- In the above statistical analysis some of the latest dry years were not considered because their doubtful quality or incomplete ness.

Therefore, it is highly probable that the figures presented are not representative of the long-term statistical distribution. The true water levels could be lower than the ones shown above. Details of supplementary studies to update the water level correlations are presented in Annex 1.

5.4.2 <u>Period of peak water levels</u>

Based on Rochette observations, the maximum water level occurs at Kaedi on the following dates:

- on the average, September 24
- between the extreme dates of August 28 and October 26
- 2/3 of the time between September 16 and October 2
- 1/3 of the time between September 20 and 26

5.5 RIVER FLOW PATTERN - AFTER MANANTALI

5.5.1 PROJECTED WATER LEVELS AT KAEDI

The filling of Manantali reservoir is due to start sometime in 1988; if the present dry period continues, it may take more than four years to fill even with the minimum releases.

There is an on-going study for the management of Manantali and Diama dams; the conclusions and recommendations of which will be know mid-1987.

GERSAR used the SOGREAH mathematical model to simulate future water levels in the Senegal River valley. During a transitory period, Manantali will generate an "artificial flood" which will benefit recession agriculture during the next fifteen years (up to year 2005).

The "optimal" flood proposed by the "Groupement de Manantali" (Q max = 2,500 m3/sec and Q = 1,800 m3/sec during 30 days at Bakel) represents an enormous volume of water (5.6 x 10. cu.m. during one month and 9.9 x 10. cu.m for the total volume under the flood hydrograph. This volume of water will not be available for storage of the dam (7.85 x 10. cu.m).

The intermediate basin between Manantali and Bakel

represents, on the average, 55% of the upper basin catchment; therefore any unusal dry year will considerably hamper the availability of water for the "optimal flood" in the valley.

5.5.2 Manantali expected water management during average hydrologic conditions

Average water levels at Kaedi computed for the "artificial flood" are as follows:

Water levels at Kaedi (IGN)

J	F	M	A	M	J	J	A	S	O	N	D
5.90	5.90	5.80	5.65	5.65	5.90	6.45	9.25	11.50	10.80	8.45	6.26

The maximum water level at Kaedi (11.50 m) corresponds to a water level of 10.59 m IGN at the Dirol Plain. The 100 year flood controlled by Manantali would bring the following water levels at Kaedi and the Dirol Plain:

STATION IGN	Natural Conditions	Middle-Term Development	Long-Term Development
Kaedi	13.70	13.85	14.85
Dirol	12.97	13.13	13.84

Under natural conditions, the maximum water levels given by SOGREAH are 44 cm. higher than the ones shown in para 5.4.1 (ORSTOM). This discrepancy will be resolved by hydrologic studies proposed in Annex 1. In the medium and long term, the flood peak reduction effect of the Manantali may be compensated for by valley development such as dikes around agricultural schemes.

5.5.3 Conclusions

On the average, the optimal flood should reach 10.60 IGN on

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the Dirol plain and inundate 5,800 ha in the northern zone. Wet years (average and above), during the transitional period, should meet basic needs for up to 100,000 ha of recessional agriculture in the Senegal River valley. In dry years (10 year return period) the need for water for electric energy generation will seriously challenge water needs for recessional agriculture (Annex 2).

6. HYDROLOGY OF THE DIROL RIVER BASIN

6.1 The flood of the Senegal River reaches peak levels during the last ten days of September on the Dirol plain. Most of the rain falls on the project zone from August through mid September. It is attractive to store the Dirol Creek runoff in the plain to extend the period of submersion and the area inundated, especially during dry spells. Data on the Dirol Creek water levels and discharges do not exist; it is then imperative to use available information on the rainfall in the basin area and derive rainfall runoff coefficients to estimate the water yields, water levels and discharges for various frequencies. (See Annex 1.)

6.2 AVAILABLE DATA

ORSTOM conducted numerous studies of representative basins, comparable to the Dirol Creek catchment, in the Oued Ghorfa and some river basins north of the Dirol.

In 1983, J.C. Olivry, (ORSTOM), and J. LeBloas, (RBDO/Dakar), made an extensive field study to assess the Dirol basins characteristics and to collect historical information on the hydrology of the Dirol Creek.

In April 1987 relevant information was collected by the PID team through field studies and historical data collection. It appears that the Dirol creek flash floods are of relatively short duration. The flood wave is estimated to be 3 m high in some places. There are indications that, if retained at the mouth of the creek, the runoff of the Dirol could flood up to 3,000 ha under average rainfall conditions, It is observed that the catchment area is significantly reduced in comparison to computed values based on the 1:200,000 scale map. The upper catchment area is approximately 1270 sq.Km. Significant runoff is reported each year (outlet of the upper basin on to the Dirol plain). Additional basin characteristics are presented in para. 6.3.

6.2.1 Sediment load of the flood waters

The following conclusions concerning the Dirol Plain are observed from the Bakel sediment load records:

Sediment concentration reaches its maximum at the head of the flood wave.

The maximum observed suspended load of 300 mg/liter is uniformly spread over the channel cross section.

Material in suspension in the Senegal River consists almost exclusively of particles finer than the smaller particles of the river bed in the vicinity of the Dirol Creek.

The organic matter content amounts to about 20 to 30 mg. per liter. In terms of total concentration, organic matter accounts for approximately 30% at the beginning of the flood, decreasing to 10% in the later flood stages.

In Bakel and Kaedi, the origin of some of the coarse elements (up to 20 mm) has to be attributed to the Faleme

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basin.

At the Dirol mouth, the Senegal River bed is hardly stable and lateral erosion takes place. This process of lateral erosion presently observed will be itensified by the flow regulations expected from Manantali due to salt trapped in the reservoir.

In conclusion, flood water from the Senegal River conveys and deposits significant quantities of mineral and organic fertilizer on the Dirol plain during submersion. The Dirol Creek sediment load probably contains more mineral than organic matter.

6.3 RIVER BASIN CHARACTERISTICS

Preliminary evaluations are made from available data on some catchment basins physical parameters. They include ground cover, soil texture, average slope, and erodibility.

6.3.1 Characteristic

The compacity index is defined below:

$$Kc = 0.28 \frac{P}{\sqrt{A}}$$

A: Area of basin in sq. m.

P: Basin perimeter in meters

This index indicates the relation between the basin area and one in the shape of a circle. The index value for the upper catchment area of 1270 sq. Km. is 1.6.

Density of the hydraulic network (upper catchment)

- Index Dd is the ratio between total length of main and secondary channels and the basin area where:

$$Dd = \frac{Li}{A} = \frac{250\ m}{1270\ Km2} = 0.2$$

where Li = length in meters and A = area in square Km.

6.3.2 Soils, and erodibility hazards

Soil chararcteristics of the upper catchment were derived from the soil association map of the Remote Sensing Resource Inventory carried out by South Dakota State University. Nearly 75% of the area consists of nearly level, shallow, sandy loam soils and steep rock landscapes. The remaining portions consist of gently and moderately sloping sands to sandy - loams. The vegetative cover is poor to fair and erosion is often severe. Crusted areas sometimes exist in eroded zones. As shown in Figure 1, most of the upper catchment consists of soft porous sand-stones, dolomites, and limited areas of eolian sands, dunes, and undulating sheets.

The wischmeir formula (U.S. Soil Conservation) is used to estimate the amount of eroded soils in basin. It takes into account the basin area, soil-sensitivity to erosion, slope and ground cover. A subjective preliminary estimate based on the above estimated parameters would give values in the range of 60,000 tons of eroded soil per year in the Dirol Creek catchment.

6.4 ESTIMATED BASIN YIELDS

J.C. OLIVRY (ORSTOM) undertook a preliminary study to determine probable river basin yields and flow patterns of the Dirol Creek for various probabilities (Appendix 3). A summary of the results is presented below:

ESTIMATED YIELDS OF THE DIROL PLAIN

Table 10

RETURN PERIOD years hum./dry yr.		IMMERSION LEVEL on the Plain - IGN.	INUNDATED AREA - ha.	VOLUME stored 10. m3
1/10	(hum.)	9.70	4750	67

128x

1/5	(hum.)	9.30	4000	48
1/2	(dry)	8.80	3000	31
1/5	(dry)	8.00	1750	18.3
1/10	(dry)	7.40	850	9.4

6.5 Rainfall runoff coefficients

Typical rainstorms

The ORSTOM hydrological study identified two catchment areas with high runoff coefficients of 400 km2 east and west of the Dirol plain and of 300 Km2 in the region of Mbarde. Runoff values for the Dirol catchment presented below were estimated from comparable representative basin runoff coefficients:

Table 11

Probability of a larger value	P mm.	P eff. mm (1)	Kr%.	D Depth mm	V 10 m3 (2)
1/10 years	108	81	40	32.4	22.7
1/5 years	90	67.5	35	23.6	16.5
1/2 years	68	51	35	17.9	12.5
once a year	53	40	30	12	8.4
twice a year	41	31	30	9.3	6.5
5 times a year	26	19.5	20	3.9	2.7
10 times a year	15	11.2	15	1.7	1.2

(1) Efficient period before Senegal River flood

(2) Total catchment area = 700 km2

D = Depth

V = Volume 10 m3

P = Gross rainfall

P eff = net rainfall (less infiltration)

Kr% = Rainoff coefficient

6.6 Flow Prediction System in the Senegal River Basin in Relation to the Dirol Plain

Proper management of the Dirol flood gate and dikes could benefit from the use of a prediction system for the plain tied to the Senegal River flow prediction system. A hydrographic station could be installed at Dawalel and integrated in the Senegal River prediction system network.

ORSTOM (J.C. Olivry, 1982) has proposed such a system to OMVS. It is a prerequisite for the operation of the Manantali dam. Therefore, the farmers in the Dirol plain (if proper institutional structures are assured in Kaedi) would be told ahead of time area expected to be flooded and could undertake soil preparation accordingly including fertilizer application.

6.7 CONCLUSIONS

The relative importance of the Dirol runoff as compared to the Senegal River flood is minimal in terms of the area submerged in the plain. The lowest areas would be inundated anyway by the Senegal River flood for adequate periods of time.

Nevertheless, even in extremely dry years, when floods do not exceed 8 m IGN, some three thousand hectares may be flooded by retention of the Dirol Creek runoff. It becomes, in fact, a guarantee that whatever the constraints may be in the future on water allocations of Manantali for recession agriculture, the proposed Dirol floodgate would back up the effective runoff long enough to inundate 3000 ha. in the Dirol Plain.

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ANNEX C

DIROL PLAIN PROJECT

SOILS AND AGRONOMY ANALYSIS

PROJECT IDENTIFICATION DOCUMENT

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TECHNICAL FACTORES

SOILS

Stored moisture agriculture works at extremes in soil texture and is common in areas where, precipitation is inadequate for efficient cropping. Stored moisture agriculture works with heavy clay soils because of the high moisture retention capability of these soils. It works with very light, sandy soils because of the high permeability of these soils. In the former case water must be confined on the soils long enough to saturate the slowly permeable profile. In the latter case the effect of erratic rainfall is neutralized by the ability of the soil quickly to absorb and store whatever precipitation falls on it.

The recessional agriculture of the lowland/walo of the Dirol plain is an example of stored moisture agriculture on heavy soil. The rainfed agriculture of the upland/dieri landscaps surrounding the plain is an example of stored moisture agriculture on light, sandy soil.

Irrigation works best on soils with a balanced texture--loams. Sandy loams are favored in temperate regions. However, in lower latitudes slightly heavier loams are favored because open, unlined ditches are often used for water conveyance and because high fertilizer and water costs combined with low soil organic matter make soils with higher active clay content more profitable than lighter soils for irrigation.

The lowland/walo land of the northern Dirol plain is excellent for recessional agriculture but of limited use for irrigation. The soils here are the heavy clay Vertisols which dominate the plain from its lowest points up to the 10 meter contour. Vertisols have excellent moisture and nutrient retention capabilities but they are difficult to work and crack when they dry. On both the Dawalel and southern sections of the plain the recessional agricultural capability of this land is docked to class 3 because topography prevents it from being inundated on a regular basis.

The midland/djedjegol land of the Dirol plain dominates from the 10 meter to the 13 meter contour and is found around the rim of the plain as well as along old or current water courses. In terms of texture and topography most of this land is excellent for irrigation and fair for recessional agriculture. However, again on the basis of texture and topography, about 1/3 of this land is only fair for irrigation and is worthless for recessional agriculture. About half of the excellent irrigation soils are found at sites on the plain which are remote from the river. Consequently they are docked to class 2 irrigation capability because of the expense of obtaining water.

On the upland/dieri land only the sandy loam/waljo soils would be moderately responsive to irrigation. Otherwise this land is worthless for irrigated or recessional agriculture.

TECHNICAL FACTORS

AGRONOMY

The dominant agriculture of the Dirol plain is recessional sorghum production on the lowland/walo land.

Recessional agriculture is one of the lowest risk forms of traditional, subsistence agriculture. When a farmer plants he can anticipate with a high degree of accuracy what his yield will be. No inputs such as water or ferilizer are added after planting. Pests and diseases are an unpredictable variable--in this case the most difficult ones are birds and domestic livestock. Also, weeding is crucial because weeds compete with the crop for the fixed supply of water and nuturients. However, basically everything required to bring the crop to maturity is there at the time of planting. It is this same characteristic which makes recessional agriculture unresponsive to management.

In the agronomic sense management means primarily the management of water and nutrients. Keeping soil moisture at optimum levels for plant growth is a major component of agronomic management. Also, an application of water is required after the application of fertilizer in order to put the fertilizer into solution and make it available to the plant. When neither water nor fertilizer are added in the course of the growing season the range of management options becomes very limited.

Recessional agriculture is variable because it is dependent on the height and duration of the flood level. Enough water must saturate the profile and be stored to bring a crop to maturity. Since the level of the flood varies from year to year the amount of recessional sorghum produced varies from year to year as well.

The classic approach to improving yields with stored moisture agriculture is to monitor moisture in the profile with the goal of making sure that planting densities are at optimum levels to exploit all of the moisture which is available in the profile. A preflood application of fertilizer could also be very beneficial. However, the problem here is deciding where to place the fertilizer and how much ground to fertilize since one does not know how groune will be effectively inundated.

In Mauritania Sorghum is the primary recessional agriculture crop. Cowpeas are also important. Experiments with planting densities in conjunction with soil moisture monitoring and experimentation with preinundation fertilizer application offer the best possibilities for successful agronomic innovation with recessional agriculture. The baseline yield is low, about 400 kg/ha for Sorghum and 150 kg/ha for niebe. With improvements in moisture and nutrient management combined with modifications in planting density, it should be possible to triple yields. Research station data shows yields of recessional sorghum on small plots topping 2500 kg/ha.

Another form of stored moisture agriculture is found on the uplands around the plain. This is rainfed agriculture which is risky, unresponsive, and variable. This upland/dieri agriculture is a very low intensity method of production both millet and sorghum. It succeeds in producing grain under very adverse conditions with very low inputs. A correllery to this is that it does not have a capacity to exploit additional inputs. Consequently, the project will not attemps to introduce innovations for upland/dieri agriculture.

A very limited but neverthless important cropping method takes place on the midland/djedjegol lands where levee/fonds soils are sometimes found on steep banks--usually along rivers or streams. These areas benefit from slowly receding water and possibly from seepage from the surrounding area. This is referred to as "falo" agriculture and is commomly used to produce maize, tomatoes, pepper, aubergine, melons, and squash. It is an important source of variety in diet and of comparatively high value production for traditional farmers. Falo agriculture is important to the project because, with a means of controling the rate at which the flood recedes, it could be possible to practice falo agriculture wherever the flood reaches levee/fonds soils--even on flat ground.

The midland/djedjegol lands are also the best for irrigation. On the basis of their texture and topography, combined with the climate during tghe winter growing season, the levee/fonds soils of the midland/djedjegol would be highly responsive to management for a wide variety of grain, vegetable, and fruit crops.

AGRICULTURAL POLICY IMPLICATIONS

The MRVDP is an agricultural production project, not a policy advisory project. Nonetheless, successful production projects can profit from favorable policy environments and often provide the best arguments for needed policy changes. The MRVDP should not neglect the important potential impact of the GIRM's agricultural policies on cereals production on the Dirol Plain. It should also remain constantly aware of the impact that project success orfailure will have on decisions about policies that will govern the establishment of priorities for the use of the water of the Senegal River after the Manantali Dam begins operations.

Currently, the agricultural policy climate in Mauritania is relatively favorable to small farmers. Cereals marketing is completely free and numerous small merchants and entrepreneurs participate in the market. The Commissariat de Securite Alimentaire acts as a buyer of last resort for certain crops, including sorghum, and sets a floor price which is close to the import parity price. For the last several years, in spite of mountainous annual cereals deficits, free market sorghum prices have stayed below the CSA floor price for most of the year. Exceptions are at periods between harvests when stocks are low. In 1986, for example, sorghum prices shot up to over 25UM/kg before the harvest. The apparent anomoly of huge cereals deficits and low free-market cereals prices may be related to imports of sorghum and other grains provided as food aid by donor nations.

On the other hand, GIRM land tenure policy puts recessional agriculture at a disadvantage. By declaring that all land must be owned by private individuals, in conformity with Islamic Law, the GIRM has tried to facilitate the adaptation of traditional land-holding practices (see annex) to irrigated agriculture. If applied to the Dirol Plain, the current land tenure law would probably paralyze agricultural production. If the MRVDP's water management interventions are wholly successful and the amount of flooded acreage stabilized, such application may eventually become feasible. For now, the GIRM has not sought to apply the official land tenure rules to floodplains.

When the Manantali Dam becomes fully operational, a conflict will inevitably arise between competing requirements for the limited supply of available water in the reservoir. While Mali is unlikely to take a strong stand on such issues, Senegal and Mauritania may differ dramatically in their positions. Both countries now place very high priority on the availibility of water for pump-irrigated agriculture along the SRB. The Senegalese very badly want Manantali to generate as much electricity as possible, to fuel the mines and industries in their Eastern regions. Mauritania has very little need for electricity from Manantali, but badly needs a continued controlled flood for recessional agriculture. Senegal has expressed little or no interest in a controlled, "artificial" flood.

Since the water management requirements for a constant flow of hydroelectricity are incompatible with those of the "artificial" flood, Mauritania is going to have to bring very strong arguments to bear to carry the day, even if optimal artifical flood levels arelower than currently anticipated. The MRVDP should provide a major part of the arguments in favor of recessional agriculture. For this reason, careful monitoring and evaluation of the costs and benefits of all project activities will be exceptionally important if they are to contribute effectively to policy formation.

Verifying the SEDAGRI Map

SEDAGRI produced both a soils map and a land capability map of the Senegal river valley. There are important differences between a "soils" map and a "land capability" map. For example in the United States, a soils map uses a system of classification developed by the Soil Conservation Service of the United States Department or Agriculture. In this system soils are classified according to their taxonomy. This is a generalized system of classification which seeks to define the characteristics of a given soil within the context of the soils of the entire world. The study of soils in this manner can be an academic/scientific pursuit completely independent of any application of the information to agriculture. This approach to soil classification is often seen as relating more to geology than it does to agriculture.

Again using the United States as an example, a land capability map is based on a system of classification developed by the Bureau of Reclamation of the United States Department of the Interior. The purpose of a "land" map is to classify land according to its ability to respond to management. This is a flexible, site-specific, approach which was developed for use in judging the economic feasibility of irrigation projects in the United States. Since this system was developed for use in the United States its categories and criteria reflect conditions prevailing there. However, the principles used in developing this approach are universally applicable and its flexibility has been exploited to cover a wide variety of situations. Ideally a land map relates soils not only to the technological innovations which are being proposed but also to the economic and social condition prevalling in the area being mapped.

Since the Dirol Plains project is concerned with land and water development, it is the SEDAGRI land capability map which is of interest rather than the SEDAGRI soils map.

Given its scale (1/50,000) and the area covered (the Senegal River Basin) the SEDAGRI map does a good job. With reference to plans for developing the Dirol plain the following should be kept in mind.

The SEDAGRI map makes no claim to classify land according to its suitability for recessional agriculture. Its focus is exclusively on irrigation. Consequently, a seperate classification must be made for recessional agriculture. Also the SEDAGRI map is too general to include factors such as nutrient status of the soil and accessibility to water--both of which are included at various points in the more detailed map prepared for this study.

The SEDAGRI map is accurate in its classification of the land adjacent to Dawalel. However, it makes one major mistake in favor of the southern plain and another major mistake to the detriment of the northern plain.

On the southern plain large areas are designated as class II (moderate limitation) soils for irrigation when in fact they are not any different from the land which is classified as being suitable only for rice production on the northern plain. In this case the SEDAGRI soils map gives a more accurate picture of the capability of the soils than the land map provides. The soils map shows both the northern and southern plains as dominated by Vertisols. Vertisols are always heavy, impermeable soils. Add to this the fact that, in this region, Vertisols develop on poorly drained sites and you have a southern plain dominated by class 4 land--suited only for rice. (Referred to as class 1R soils on the map.) The effect of this inaccurate classification is to give an over optimistic picture of the suitability of the southern plain for irrigation.

All of the land given a class I capability rating have levee/fonds soils and are actually found on levees or on the deltas of streams draining onto the plain. Within the northern plain some of these soils, such as those along Dirol Creek, are designated as Class II soils even though they would have the same textural and topographical characteristics as soils designated as class I everywhere else on the map. Also, the SEDAGRI land map fails to recognize that "levee" soils have formed around the rim of the entire northern plain between the effective and crest flood levels. Consequently, large areas of the northern plain which should have been given a class I rating have instead been given a class II or class IR rating.

The most serious criticism which can be brought against the SEDAGRI map is the decision to use the designation class I R instead of class 4 R to designate soils which are suitable only for rice production. Usually soils which are suitable only for one crop are designated as class 4 soils even if they are very well suited for one specialized crop. The fact is that the heavy, poorly drained, lowland soils of the Dirol plain simply do not qualify as class I soils of any type for irrigation. The very fact that expensive dikes have to be built to protect them when they are used for irrigation should result in their being docked severely for high development costs. They are class I soils for recessional agriculture. If the class 4 R designation had been used planners would have been alerted to their limitations for irrigation development.

The following six land classes will be used for the land map of the Dirol plain:

Class 1	Highly suitable land
Class 2	Moderately suitable land
Class 3	Marginally suitable land
Class 4	Special use lands
Class 5	Temporarily non-arable
Class 6	Non-arable land

Subclasses are indicated by lower case letters that indicate the reason for the land being downgraded to a lower class. Thus, appended with the letters s, t, and d, singlely or in combination to show whether the deficiency is in soils, topography, or drainage. The basic subclasses of the land classes are s, t, d, st, sd, td and std. R stands for specialized use--Rice.

In the denomination of the notation the first number denotes a crop production constraint. The second number denotes a land development cost constraint. 0 denotes no qualifier. I denotes a minor qualifier. 2 denotes a moderate qualifier. 3 denotes a major qualifier.

LANDSCAPE NAME		SOIL NAME					LAND CAPABILITY		HECTARES/PLAIN		
PROJECT	TRADITIONAL	PROJECT	TRADITIONAL	TAXONOMIC	MAP COLOR	PROFILE #	RECESSIONAL	IRRIGATED	NORTH	SOUTH	DAWALEL
LOWLAND	WALJO	MARIGOT	HALLALDE	VERTISOL	Blue	NONE	3d / 0.2	4Rds / 0.2	360	-	-
		BASIN	HALLALDE	PALEUSTOLIC Chromustert	Black	1	1	4Rs	2200	550	190
		SANDY Clay	WAKAJIJU	PALEUSTOLIC Chromustert	Brown	3	2s / 20	4Rs	1100	-	-
MIDLAND	DJEDJEGOL	LEVEE	Fonde	Typic Torrifluvent	Yellow	2,6	3Is / 2,0	1	1650	1285	500
		STONY	Waka Rouge	Typic Torrifluvent	Red	5	6Is	3s / 22	1000	365	60
UPLAND	DICRI	SANDY Loan	WALJO	Typic Ustorthent	Not Mapped	4	6Is	3st / 02	---	---	---
		DUNE	SEENO	Psamment	Not Mapped	-	6Is	6Is			
	Villager				Violet						

INVENTORY

SOIL/WATER AND AGRICULTURE OF THE DIROL PLAIN

SOIL/WATER

Land capability and project design

On a scale of six with 1 being excellent and 6 being ussless the soils of the three major landscapes of the plain would be ranked on a general basis as follows:

LANDSCAPE	ELEVATION	IRRIGATION	RECESSION
Lowland/Walo	7-10 m	4	1
Midland/Djedjegol	10-13 m	1	3
Upland/Dierie	13 + m	5	6

The lowland/walo land is clearly more suitable for recessional agriculture than for irrigation. The midland/djedjegol land, which is highly suitable for irrigation, is at elevations well above those of normal floods. They will not require protective structures.

Soil development and land capability

The longterm inundation required for successful recessional agriculture also serves to accumulate the fine clays which comprise the best soils for inundated agriculture. The best soils for irrigation are the levee soils which were inundated for shorter periods of time--sufficient for silt but not clay to settle out--and which now, due to the influence either of a drier climate or of the Manantali dam, are unlikely to be often inundated again. This relationship between the land and water resources of the plain determined the development of the soils and is important for understanding how to exploit them in the most cost effective manner.

Irrigation and exploiting the midland/djedjegol lands

On the basis of response to innovative agronomic practice the midland/djejegol landscapes are where the most promising soils on

the Plain are found. However, the people who own these lands have been effectively landless for decades because of the dry climatic cycle which has prevailed recently. The project should not turn its back on irrigation. The highest capability soils of the plain will respond well to irrigation and, more importantly, the people who have been hit hardest by the currently prevailing dry climatic cycle will benefit directly from irrigation of the midland/diedjegol lands.

Cost of irrigation water

An important factor here is the lift required. If pumping started from the water control structure at the mouth of the Dirol creek in August when water started backing up there, comparatively cheap water would be available from early august through mid November. Perimeters on the Dawalel plain and some along the old levee seperating the northern and souhthern plains would have easy access to this water.

Access to irrigation water

There are large areas of levee/fonds soils in the midland/djedjegol lands around the rim of the plain which both topographically and texturally are excellent for irrigation but which would not have easy access to cheap water. Consequently, this land has less potential than land which is closer to the proposed pumping station at the mouth of the Dirol.

Access to flood water

There are large areas on the southern plain and some on the Dawalel plain as well which are class I in terms of texture for recessional agriculture but which are too high on the landcape to be flooded on a regular basis. Consequently, their value for recessional agriculture is accordingly diminished.

Importance of the upland/dierie lands

The sandy loam/waljo soils found on this land are of some small interest because if accessible groundwater proved available they would be ideal for drip irrigated fruit and vegetable gardens.

However, what is of immediate interest in the context of water development on and around the Plain is the fact that the rainfed agricultural methods used on the upland/dierie lands represent a potent alternative to any water harvesting scheme. Water harvesting converges and traps runoff so that comparatively intensive cultivation can be practiced on a small area. Both construction and maintenance, however simple, are required. On the upland/dierie lands the soils are highly permeable consequently there is little runoff. Rainfall is trapped in the soil profile. Crops are then cultivated in an extensive manner. There is no construction and no maintenance but effective utilization of limited, erratic precipitation is accomplished just as effectively as it is with water harvesting.

Recession control and exploiting the midland/diedjegol lands

Falo agriculture is now practiced on steep banks along waterways where levee/fonds soils are found. When the flood is high enough to reach levee/fonds soils around the rim of the plain, it is possible that the conditions required for falo agriculture could be duplicated by a slow recession of the flood across this land. If a sub-irrigation effect were achieved, this traditional form of diverse, high-value cropping could be practiced. At the very least this method would allow land to be used very effectively for niebe production and possibly maize as well. This would already represent a significant increase in diversification and value.

Drainage

For several hundred hectares on the Dirol plain the major problem for recessional agriculture is not insufficient duration of inundation but excessive duration of inundation. Due to poor drainage, this land is not farmed for traditional recession sorghum. Seasonal ponds form in these low-lying areas.

Waterlogged soil

The opinion is often voiced by farmers and specialists that there is an adverse effect on the soil resulting from excessive duration of inudation. This is said to be observable on soils inundated 60 days or more. An optimum inundation is considered to be 45 days. On the one hand conventional wisdom often has a grain of truth in it. On the other hand it is difficult to think of anything significant which would happen in the soil after 60 days inundation which would not have already happened before 45 days inundation.

The soils and land capability map

The 1/10,000 soils and land capability map produced as a part of this study is not as refined in its detail as one would normally expect of a map of this scale. However, given the requirements of the project and the characteristics of the land surveyed the map should be fully adequate. New lands are not being brought under irrigation neither are radically new technologies being proposed. Consequently, the traditional use of the land serves as an excellent indicator of its essential characteristics for project development. Very expensive, detailed mapping and sampling would not have been justified for this project. However, the availability of adequate topographic maps and air photos would have made possible a much higher degree of refinement and accuracy in the preparation of the map.

The Dirol creek floodgate

There is an important tradeoff between cost of construction and maintenance. This structure should be built so that maintenance requirements will be minimal. In order to fully utilize spike floods the gates should be wide enough so that inflow is not appreciably impeded. The structure should be built so that it can serve as a pumping station which is above any historical flood level. On paper it would be possible to defend a proposal for a much smaller and chaper structure. However, cutting the cost of the structure to minimal levels would be a false economy which would be bought at the price of decreased durability as well as increased need for maintenance.

CROPS

Planting date

Farmers plant sorghum soon after the waters recede from their land. They must plant late enough to avoid excess moisture that will rot their seed, but early enough to profit from all the moisture retained in the profile. However, during the first two weeks of December, yield potential for sorghum plantings goes into steep decline. This has been variously attributed to hot weather later in the growing season; excessive bird problems for grain which is ripening later than the surrounding grain; and water logging of soil. Why yields decline for sorghum planted during or after the first two weeks of Secember is debatable--although the

bird problems would seem to be the leading candidate. Poor drainage is the primary cause of delayed planting of recession sorghum.

Limited possibilities for adaptive research

Recession agriculture is a well adapted, effective way to use important soil and water resources of the Dirol plain. However, this type of agriculture is a limited phenomenon on a world scale. Consequently the availability of innovation and adaptations from other areas of the world is virtually non-existent. Experience being gained at R'Kiz may be useful and CNRDA has done some interesting fertilizer trials with recession agriculture.

Crops adapted to recession agriculture

Few crops are equiped to access the large quantities of stored moisture which can be held in the profile of the soils of the lowland/walo lands of the Dirol plain. The two which are widely noted for having the necessary vigor and root system are sorghum and cowpeas. Local farmers report having obtained good yields of traditional varieties of cherry tomatoes using traditional methods. Agres II got good results with sunflowers. Safflower might also do well given the experience with sunflower. Howver, it is not clear that either of these crops, especially the letter, would be of any great use to farmers. CNRADA reports some success with maize. If fertilizer can be used to give maize a sufficient boost to produce under recessional agriculture conditions it would be a major innovation because maize is not vulnerable to bird damage.

Other crops adapted to the Plain

Many villages have excellent hand watered vegetable gardens. Fruit is in very short supply so this might be an areas where rapid progress could be made. Fruit needs a year round source of water. If groundwater studies show promising results, it might be feasible to develop fruit orchards on the Waljo soils which surround the plain. Because of open range laws there is very little interest in forage as a crop.

Agronomic innovation for recession agriculture

Traditional farmers are usually very conservative. It is quite likely that the planting densities which they use reflect this. If work were done to establish a relationship between stored soil moisture and optimum planting density, it would probably provide information which could have a direct positive effect on yields. Another very big opportunity would be in developing effective methods of applying chemical fertilizers. The problems here would be deciding which fields are likely to be inundated and also seeding in correct proximity to where preflood banding of fertilizer had occurred. The obvious limiting nutrient is nitrogen, but phosporus and potassium should also be used in fertilizer trials. Research in Chad showed that soils which had been used for several decades for stored moisture agriculture had potassium deficiencies resulting from the constant export of this nutrient from fields where this type of agriculture is practiced. Nutrients which are properly applied pre-inudation would not leach or otherwise depart out of the rooting zone. Some of the phosphorus would become unavailable but it would not move.

Variety testing

There are some indications that, given the importance of evaporation in fields with widespaced planting, important advantages would result from closer planting of dwar varieties in order to shade the ground as quickly as possible. The yield per plant would be lower than it is now but yield per unit area would be higher, but planting would take more time and planting season is apparently the busiest season of the year.

Pest damage

Birds are a major problem due to the fact that sorghum, the major grain crop of the plain, is very vulnerable to bird damage. Livestock damage to crops is also a serious problem. Smut destroyed perhaps 10% of the 86 - 87 crop. Grasshoppers and field rats also destroy crops on the plain. Birds are generally considered the pest which is the most damaging and difficult to control.

APPENDIX 1

PROFILE DESCRIPTIONS

of the

SOILS OF THE DIROL PLAIN

SOILS/AGRONOMY ANNEX

There are four types of agriculture which are practiced on the Dirol plain: recessional, falo, irrigated, and dieri: The primary potential of the plain is found in its diversity of soils and water management practices which in their totally distribute and diminish risk of crop failure. The most important limiting factor is moisture. The greatest problems are found in the vulnerability of crops to pests and livestock. The greatest opportunities lie in developing the diverse resources of the plain so that each land and water resource will make its maximum contribution to the welfare of the people of the Dirol plain. The obvious starting point would be improved recessional agriculture. However, both falo and irrigated agriculture could also play important roles in future development plans.

It can be said of the soils of the Dirol plain that the fine textured parent materials of which they are composed were deposited on the plan by the Senegal river. The coarse textured parent materials were washed in by runoff from the surrounding countryside or blown in by the wind. It follows then that the heaviest clay soils are found at low points on the landscape which are the greatest distance from the rim of the plain and that soil texture tends to become coarser as one moves up the landscape. Consequently, for describing the soils of the Dirol plain a very useful differentiation can be made on the basis of position on the landscape. The three landscape designations which will be used in this analysis are as follows:

1. Lowland/Walo landscape
2. Midland/Djedjegol landscape
3. Upland/Dieri landscape

1. Lowland/Walo landscape

Bassin/Hallalde soils are the clay soils found on this landscape from the lowest points on the plain up to about the 9 m contour. These are the best soils for recessional agriculture. On this same landscape but a little higher on the contour, up to about 10 meters; and inland from the river where the influence of wind and water borne materials from the surrounding countryside is greater, are found the Sandly Clay/Wakajiju soils. These soils are slightly inferior to Bassin/Hallalde soils both in moisture retention and nutrient status. However, Sandy Clay/Wakajiju soils are still very productive and important for recessional agriculture on the plain.

Both of these soils are extremely heavy. They are difficult to work when moist and nearly impossible to work when hard and dry--except for a shallow, crumbly surface horizon. Cracks of an inch or more can open to a depth of a meter or more as these soils dry. This can shear roots and provide shelter for pests. When land is being prepared for planting these cracks complicate fertilizer application and, in the case of irrigation, the first water application. This latter characteristic makes these soils unsuitable for canals except in cases where the soil is always kept wet.

Because of the density of these soils, it is difficult for roots to explore the entire horizon. Consequently, these soils can show good chemical characteristic without the nutrients being available to a crop. These soils are also highly impermeable. In order for significant amounts of moisture to enter this soil it is necessary for water to be confirmed on the surface for days.

The major advantage of these soils is their ability to retain moisture and nutrients. It is this quality which makes these soils suitable for recessional agriculture. On the basis of one inundation sufficient water is stored to bring a sorghum or niebe crop to maturity. Nutrients which are properly applied pre-inundation will not leach out of the rooting zone. It is a slow process to move moistrue and nutrients into these soils and it is not every crop that would be able to access the stored moisture and nutrients. However, large quantities of moisture and nutrients can be held in the profile of these soils.

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Recessional agriculture is the traditional method of exploiting these soil resources. This is the basic, most dependable agriculture of the plain. However, recessional agriculture is completely dependent on flood levels to establish its extent for a given year. Consequently, its extent is difficult to predict from year to year. Recessional agriculture is not responsive to management because no moisture or nutrients are added in the course of the growing season. This lack of responsiveness means that recessional agriculture is not an enormously profitable enterprise. However, it could be a very important starting point for agricultural development. Being able to control the flood recession should give farmers confidence to try recommended/demonstrated techniques for fertilizer application and planting density as well as new crops and varieties.

The biggest apportunity for innovation would be in developing effective methods of applying chemical fertilizers. A common recommendation now is to apply 80 kg of urea per hectare with placement being ten inches away and ten inches down from the sorghum plants. How exactly this is accomplished with any level

of efficiency is not explained. A preflood fertilizer application would be both easier and more effective.

Modification in planting density is where the most immediate gains are most likely. It would appear that planting densities are vey consevative--7,000 to 10,000 pockets of seed per hectare--for the reason that it is more important to be sure of getting a reliable crop than it is to maximize yield. With moisture the limiting factor there could be substantial variation in soil texture and depth and thus moisture retention. Combine this with uncertainty as to the actual effect of a flood-How much difference is there in stored moisture between a 30 and a 45 day flood?--and you have good reason for a farmer to be conservative with planting density. However, if the recession of the flood is controlled, stored moisture is measured by core sampling, and this information is correlated with optimum planting densities: then recommendations could be made on planting density. This would directly effect yield per hectare without any further input than additional seed and labor.

There are some indications that, given the importance of evaporation in fields with widespaced planting, important advantages would result from closer planting of dwarf varieties in order to shade the ground as quickly as possible. The yield per plant would be much lower than it is now but yield per unit area should be higher. Planting would take more time but this is not the busiest time of the year so this should not be a problem.

The only crops grown extensively on the plain now with recessional agriculture are sorghum and niebe. There are some surprises as to what type of crops can be producd satisfactorily with traditional, recessional production practices. Traditional varieties of cherry tomatoes were grown in the lowland/walo this past season. AgResII obtained encouraging results with sunflowers on test plots. Safflower would also be a likely candidate. It is not clear that either of these latter crops would be of any widespread use within traditional economies. However, one crop which is of proven value is maize. Given the right variety, moisture control, and accurate measurements of stored moisture it is quite likely that maize could be grown with recessional agriculture. The big advantage for maize within the traditional system is that it is not vulnerable to bird damage.

2. Midland/Djedjegol landscape

This is where the Levee/Fonds and Stony/Waka rouge soils are found. Silt from the Senegal river is an important component in both of these soils. Texturally they are both classified as loams of varying degrees of heaviness. However, the Stony/Waka

rouge soils are higher on the landscape and are more influenced by the stony materials which are washed in from the surrounding area. These soils dominate from the 10 tO 13 meter contours on the plain.

This is where the class 1 irrigable soils of the plain are found. They have good internal and external drainage and are comparatively light, easy to work soils. These soils have reasonably good permeability but they are heavy enough for good moisture and nutrient retention as well as efficient canalization. With fertilizer, irrigation, and proper management these soils would be highly productive. By far the most productive soils on the plain.

In the past the leves/fonds soils were used for inundated agriculture. However most of these soils have not been effectively inundated except for two years in the last twenty. However, even when inundated, these soils are not being put to their most effective use, when they are farmed for recessional agriculture. Regardless of the length of inundation the Stony/Waka rouge soils do not have sufficient moisture and nutrient retention capacity to bring a crop to maturity.

The leves/fonds soils will produce a good crop once if the inun ation is sufficient but then yields will decline, if seasonal inundations continue, to virtually nothing after three years. With traditional methods of production it is not possible to crop these soils every year even if moisture is not limiting. They must be allowed to lie fallow at least once every three years in order to maintain satisfactory yields.

Falo agriculture constitutes a traditional method within the context of recessional agriculture to make the best possible use of levee/fonds soils. This is a unique agriculture found on steep leves banks. On these sites levee/fonds soils are intensively used for a wide variety of crops including egg plant, melons, tomatoes, pepper, and maize. If it would be possible to convert flooded levee/fonds soils throughout the plain to falo agriculture by controlling the speed with which the water recedes, then this could make a major contribution to diversifying the agriculture of the plain.

However, falo agriculture as practiced now is a method of production which requires an exact combination of topography, texture, and moisture source. Also, if it were possible to develop a water control program so that large areas of levee/fonds soils on the plain became useful for this type of agriculture the problem would still remain that it is not very often that the flood is high enough to reach large areas where these soils are found. Consequently, it is not clear that falo agriculture would have any widespread application in a project.

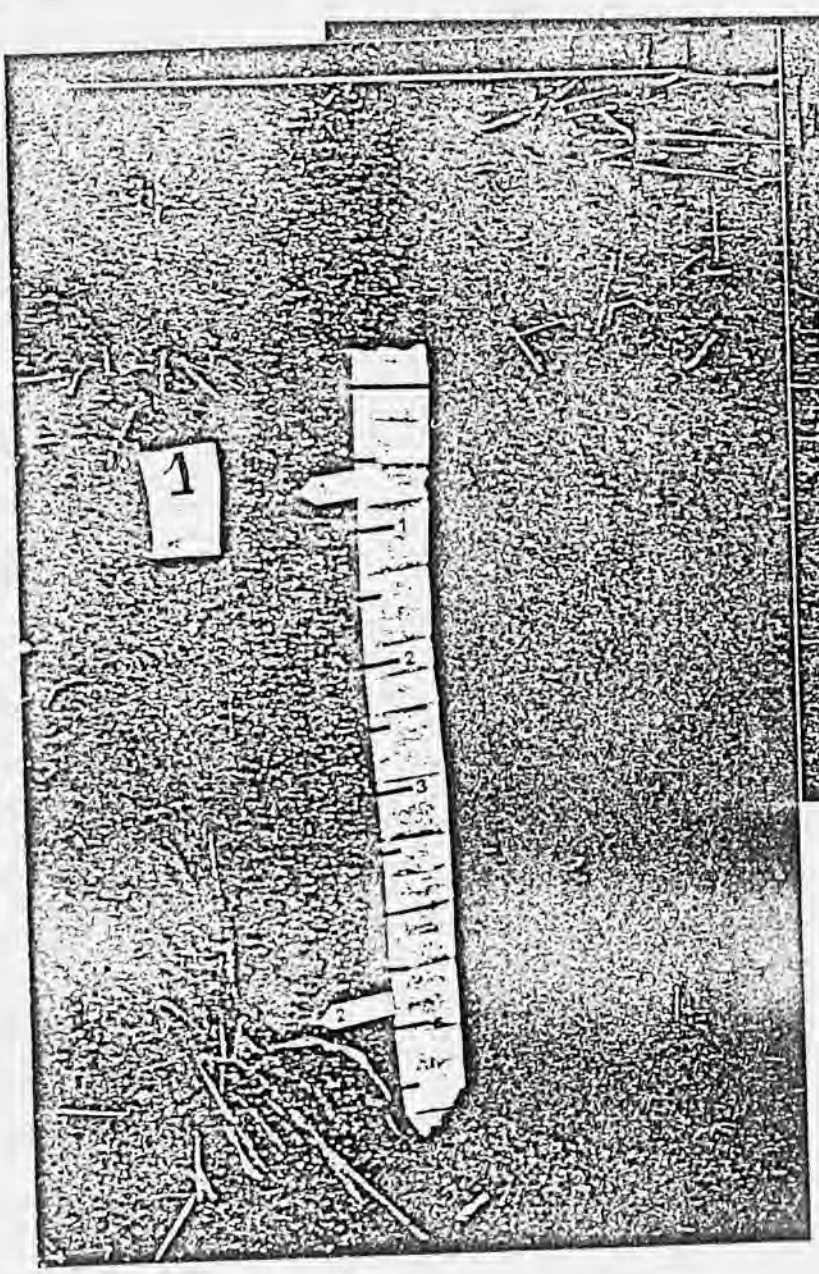
3. Upland/Dieri landscape

Two soils are found on this landscape. The Sandy Loam/Waljo soils and the Dune/Seeno soils. These soils are highly permeable and excessively well drained. They are naturally poor in plant nutrients. These soils are not inundated by the Senegal flood and generally do not have good access to irrigation water from the Senegal river.

These soils are used for rainfed crop production. This is what they are good for. They absorb and hold a high percentage of the precipitation which falls on them. Given the low intensity type agriculture required to exploit this type of situation the range for possible innovation is very limited.

The Dune/Seeno soils are virtually pure sand but they have a reputation for producting a crop even when rainfall conditions are extremely poor. The Sandy Loam/Waljo soils are lower on the landscape and slightly heavier. Given a decent, by local standards, rainfall they will produce a bigger crop than the Dune/Seeno soils. However, if the rainfall is poor, the Sandy Loam/Waljo soils will not produce any crop at all. For rainfed agriculture in this region it is necessary to have extremely light soils. Otherwise, some controlling or supplementing the moisture available is necessary.

Drip irrigation is not being recommended but the fact is that the Sandy Loam/Waljo soils would be highly responsive to drip systems for fruit and vegetable production. Ideally this would be accomplished by the use of groundwater resources which would provide clean water in the immediate vicinity of the land to be developed.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A. INFORMATION ON THE SITE SAMPLED.

1. Soil Name: Project name: Basin
   Traditional name: Hallalde

2. Higher Order Classification: Paleustolic Chromustert

3. Date of Examination: March 29, 1987

4. Authors of Description: King, Bamontaga, and Saleck

5. Location: As located on the accompanying soils map. Immediately south of the large seasonal pond in the middle of the Dirol plain and immediately north of the branch of Dirol creek leading out of this pond. Approximately 3200 M north of the west bank of the mouth of Dirol creek.

6. Elevation: 7 Meters

7. Land Form: a. Physiographic Position: Depression
   b. General Topography : Flat

8. Slope on Which Profile Is Located: Class 1 flat or almost flat 0 - 2%.

9. Vegetation or Land Use: Recessional moisture sorghum production.

10. Soil Climate: (Estimated) Ustic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Alluvium deposited by trapped flood waters of the Senegal river.

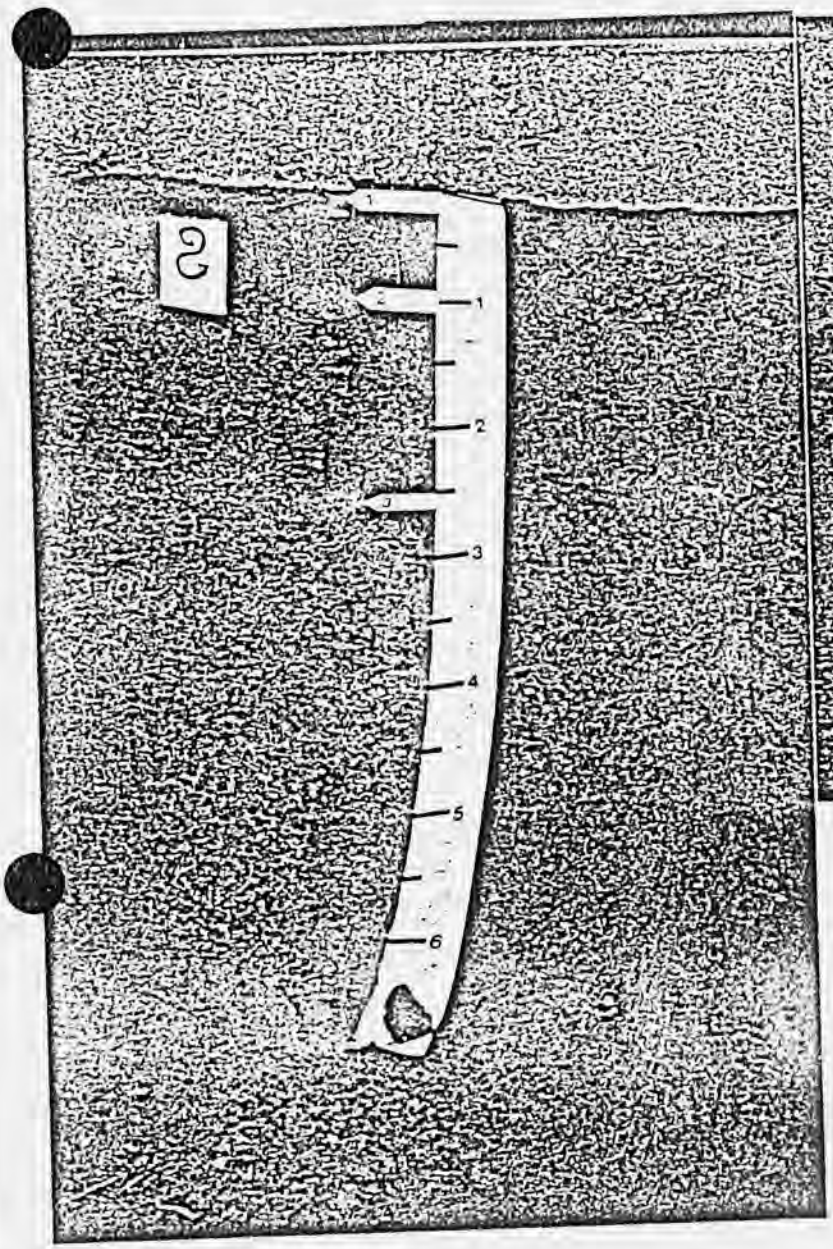
2. Drainage: Class 0 Very Poorly Drained

3. Moisture Conditions in the Soil Moist below 34 cm.

4. Depth of the Ground Water Table: There is an aquifer at about 3 M which has no effect on the soil. Of primary importance is the fact that the soil is submerged by flood water from the Senegal river for about 30 - 50 days per year.

5. Presence of Surface Stones or Rock Outcrops: None

6. Evidence of Erosion: Water Deposition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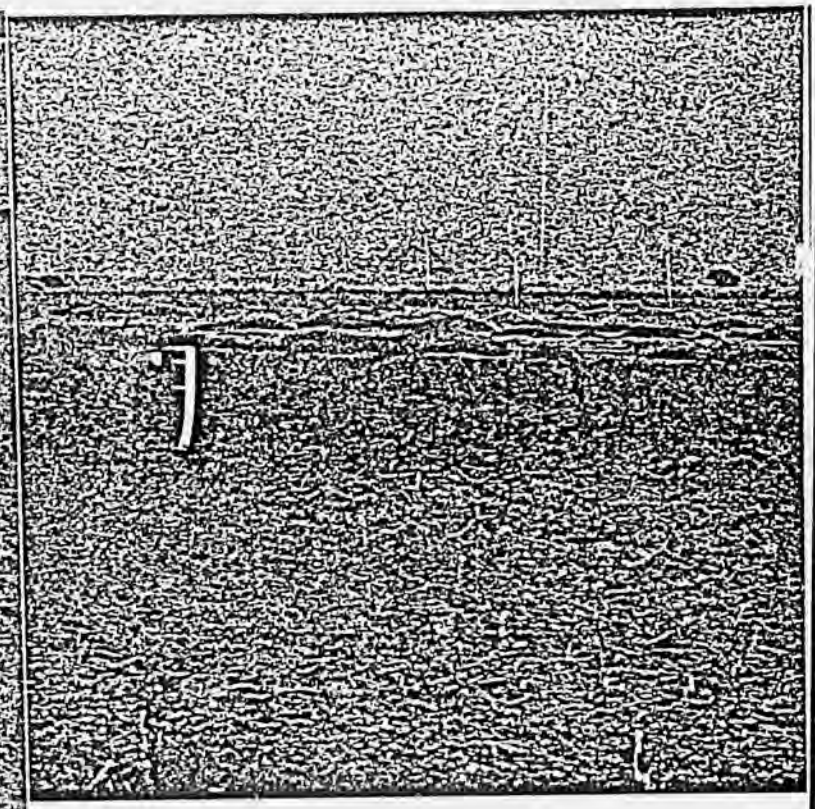
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A. INFORMATION ON THE SITE SAMPLED

1. Soil Name: Project Name: Levee
   Traditional name: Fonde

2. Higher Order Classification: Typic Torrifluvent

3. Date of Examination: March 30, 1987

4. Authors of Description: King, Bamontaga, and Saleck

5. Location: On east bank of west fork of Dirol creek. One hundred meters north of the last confluence of the creek before it enters the Senegal river. Two hundred meters north of the southernmost road crossing of Dirol creek.

6. Elevation: 10 meters

7. Land Form: a. Physiographic Position: Levee
   b. General Topography : Flat

8. Slope on Which Profile is Located: Class 1 flat or almost flat 0 - 2%.

9. Vegetation or Land Use: Range

10. Soil Climate: (Estimated) Ustic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Senegal river alluvium

2. Drainage: Class 4 Well Drained

3. Moisture Conditions in the Soil: Dry

4. Depth of the Groundwater Table: There is an aquifer at 5 M which has no effect on the soil.

5. Presence of Surface Stones or Rock Outcrops: None

6. Evidence of Erosion: Sheet erosionm Wind deposition.

7. Presence of Salt or Alkali: None

8. Human Influence: Severe clearing/Over grazing

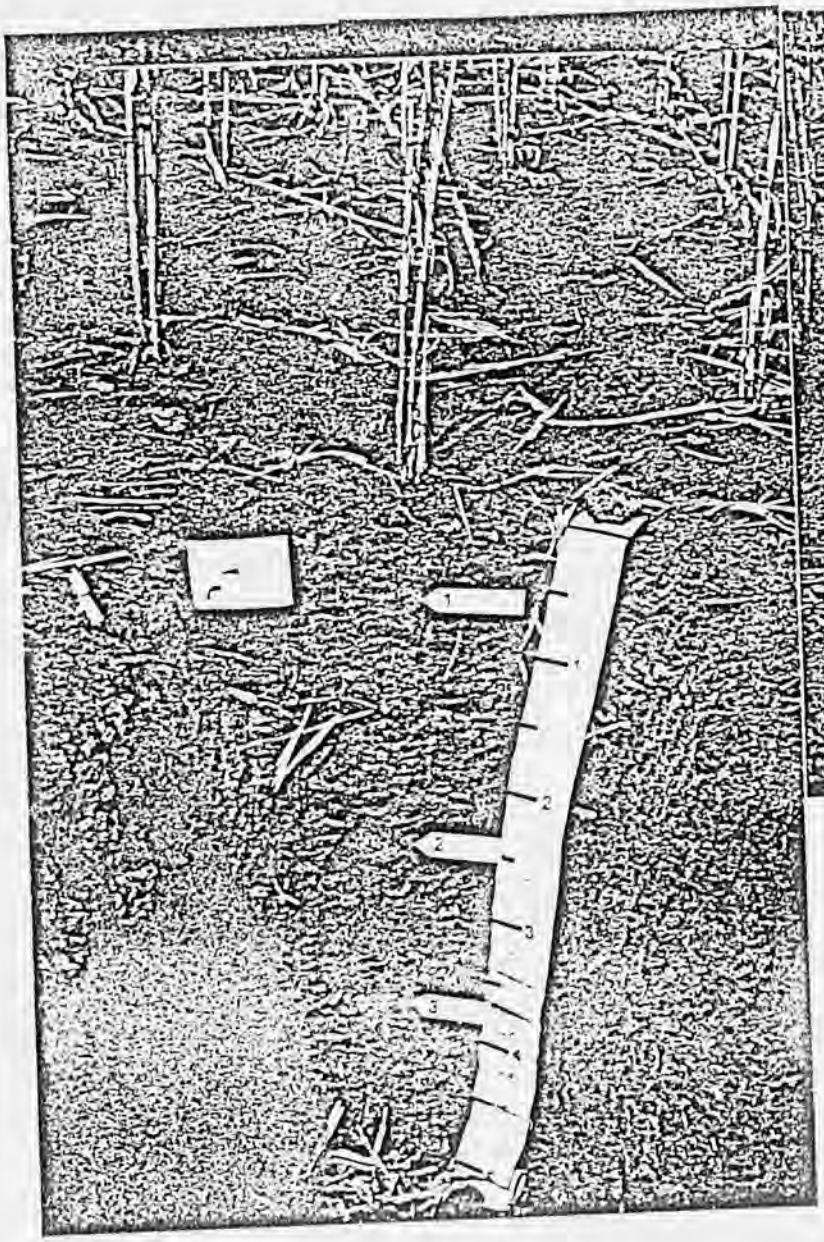
C. DESCRIPTION OF INDIVIDUAL SOIL HORIZONS

1. 0 - 5 cm: 10 YR 5/4 yellowish brown; Silt loam; Moderate, fine platy to subangular blocky structure; Sticky and plastic when wet; friable when moist; slightly hard when dry; Many micro tubular pores; few, fine to medium roots; Abrupt, smooth boundary to horizon 2.

2. 5 - 29 cm: 10 YR 5/4 yellowish brown, 5 YR 5/8 yellowish red; Common, medium, distinct, diffuse, red mottles; Silty clay loam; Strong, medium, subangular blocky structure; Sticky and plastic when wet; Firm when moist; Hard when dry; Many fine to medium tubular pores; Very few small, soft, spherical black nodules; Few round insect nests 2 cm in diameter; Very few fine to medium roots; Clear irregular boundary to horizon 3.

3. 29 - 77 cm: 10 YR 7/4 very pale brown, 7.5 YR 6/6 reddish yellow; Few, medium, faint, diffuse mottles; Silty, clay loam; Strong, medium, subangular, blocky structure; Sticky and plastic when wet; Firm when moist; Hard when dry; Many fine to medium tubular pores; Very few small, soft, spherical, black concretions; Few insect nests 2 cm in diameter; Few medium roots; Gradual smooth boundary to 4.

4. 77 - 200 cm: 10 YR 6/4 light yellowish brown; Silt loam; Strong, medium, subangular, blocky structure; Sticky and plastic when wet; Firm when moist; Hard when dry; Common fine to medium tubular pores.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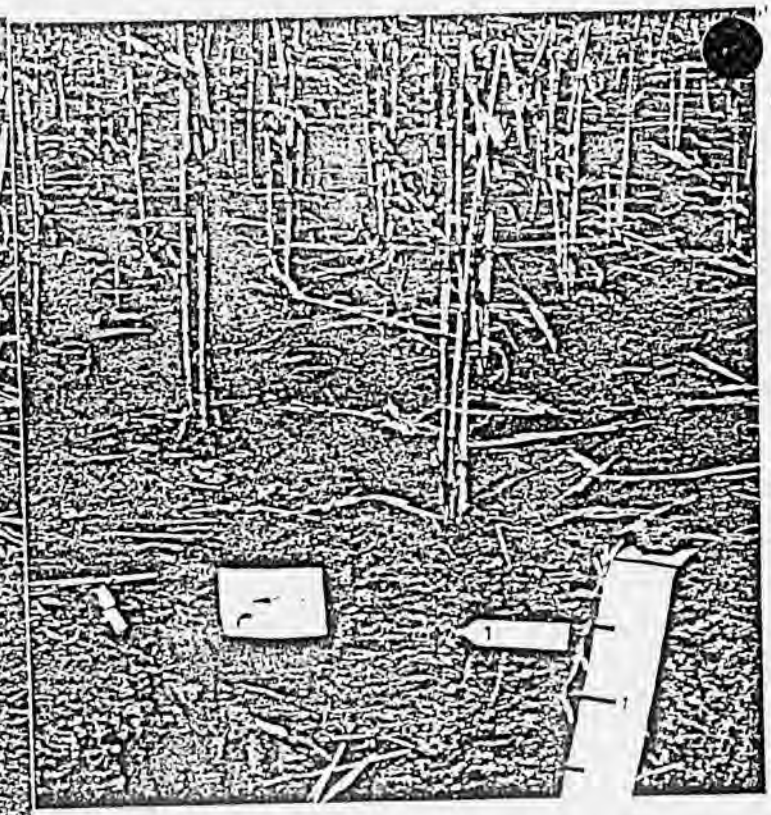
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A. INFORMATION ON THE SITE SAMPLED

1. Soil Name: Project Name: Sandy Clay
   Traditional Name: Wakajiju

2. Higher Order Classification: Paleustolic Chromustert

3. Date of Examination: March 31, 1987

4. Authors of Description: King, Bamontaga, Saleck

5. Location: As located on the accompanying soils map. Four hundred meters east of the group of large trees in the large seasonal pond in the middle of the Dirol Plain.

6. Elevation: 9 meters

7. Land Form: a. Physiographic Position: Plain
   b. General Topography : Flat

8. Slope on Which Profile is Located: Class 1 flat or almost flat 0 - 2%.

9. Vegetation or Land Use: Recessional sorghum production.

10. Soil Climate: (Estimated) Ustic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Alluvium deposited by trapped flood waters of the Senegal river. Sand form hills and dunes in the adjacent landscape:

2. Drainage: Class 2 imperfectly drained

3. Moisture Conditions in the Soil: Dry

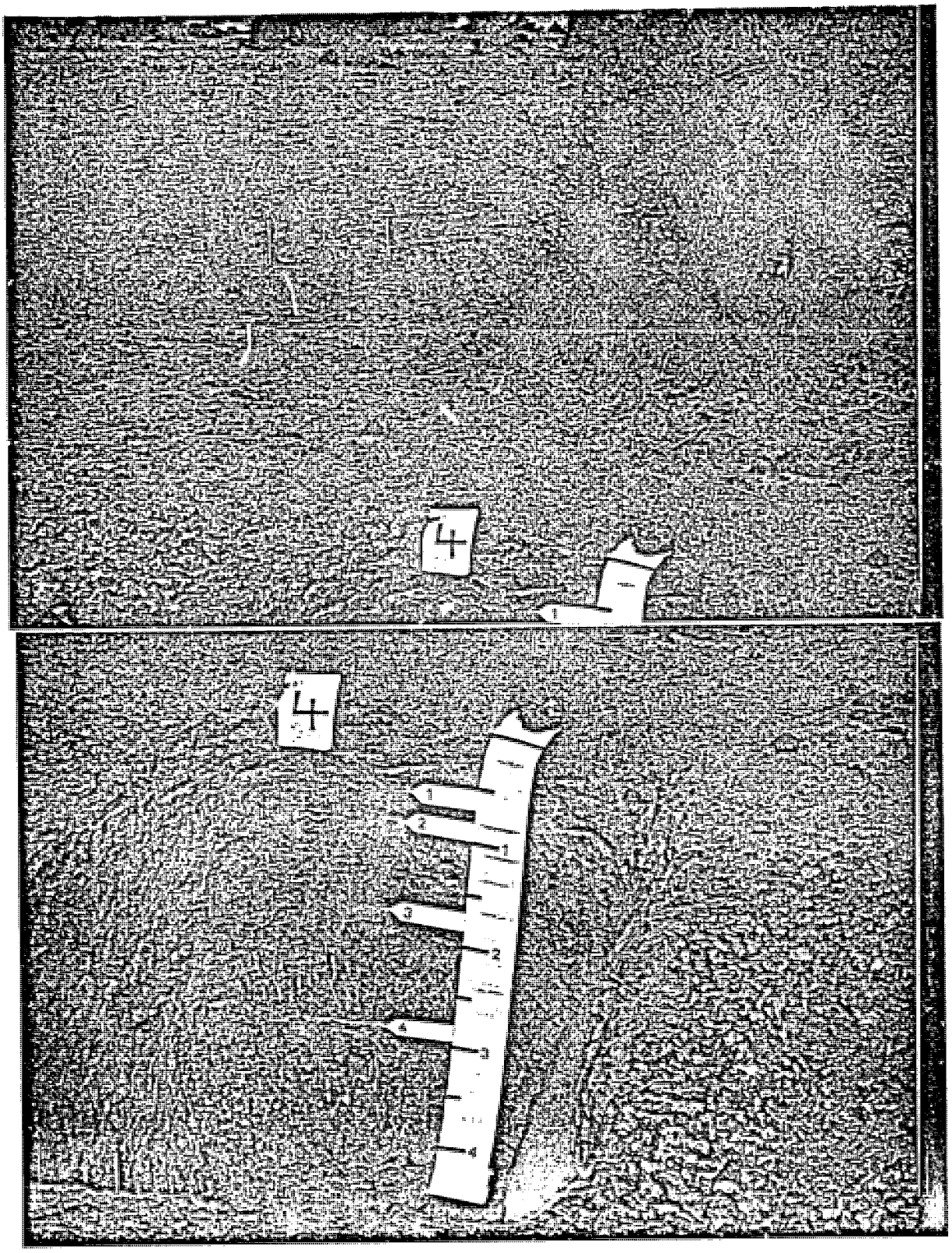
4. Depth of the Groundwater Table: There is an aquifer at about 4 m which has no effect on the soil. Of greater importance is the fact that the soil is submerged by flood water from the Senegal river for about 30 - 45 days per year.

5. Presence of Surface Stones or Rock Outcrops: None

6. Evidence of Erosion: Sand deposition

7. Presence of Salt or Alkali: None

8. Human Influence: Annual culture of recessional sorghum.



PROFILE IV is a Typic Ustorthent which is referred to locally as a Walio soil and which will be referred to in this report as a Loamy Sand/Walio soil. Please note that the unit of measurement on the tape showing the depth of the profile is feet, not meters. The numbered arrows denote boundaries between horizons.

A. INFORMATION ON THE SITE SAMPLED

1. Soil Name: Project Name: Loamy Sand
   Traditional Name: Waljo

2. Higher Order Classification: Typic Ustorthent

3. Date of Examination: March 31, 1987

4. Authors of Description: King, Bamontaga, and Saleck.

5. Location: As located on accompanying soils map. 2.5 km south of Bagodine just north of point where paths from Bagodine and Debai Doubbel converge.

6. Elevation: 14 meters

7. Land Form: a. Physiographic Position: Footslope
   b. General Topography : Undulating

8. Slope on Which Profile is Located: Class 2 gently sloping 2 - 6%.

9. Vegetation or Land Use: Range or rainfed agriculture.

10. Soil Climate: Ustic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Windblown sand

2. Drainages: Class 4 well drained

3. Moisture Conditions in the SOil: Dry

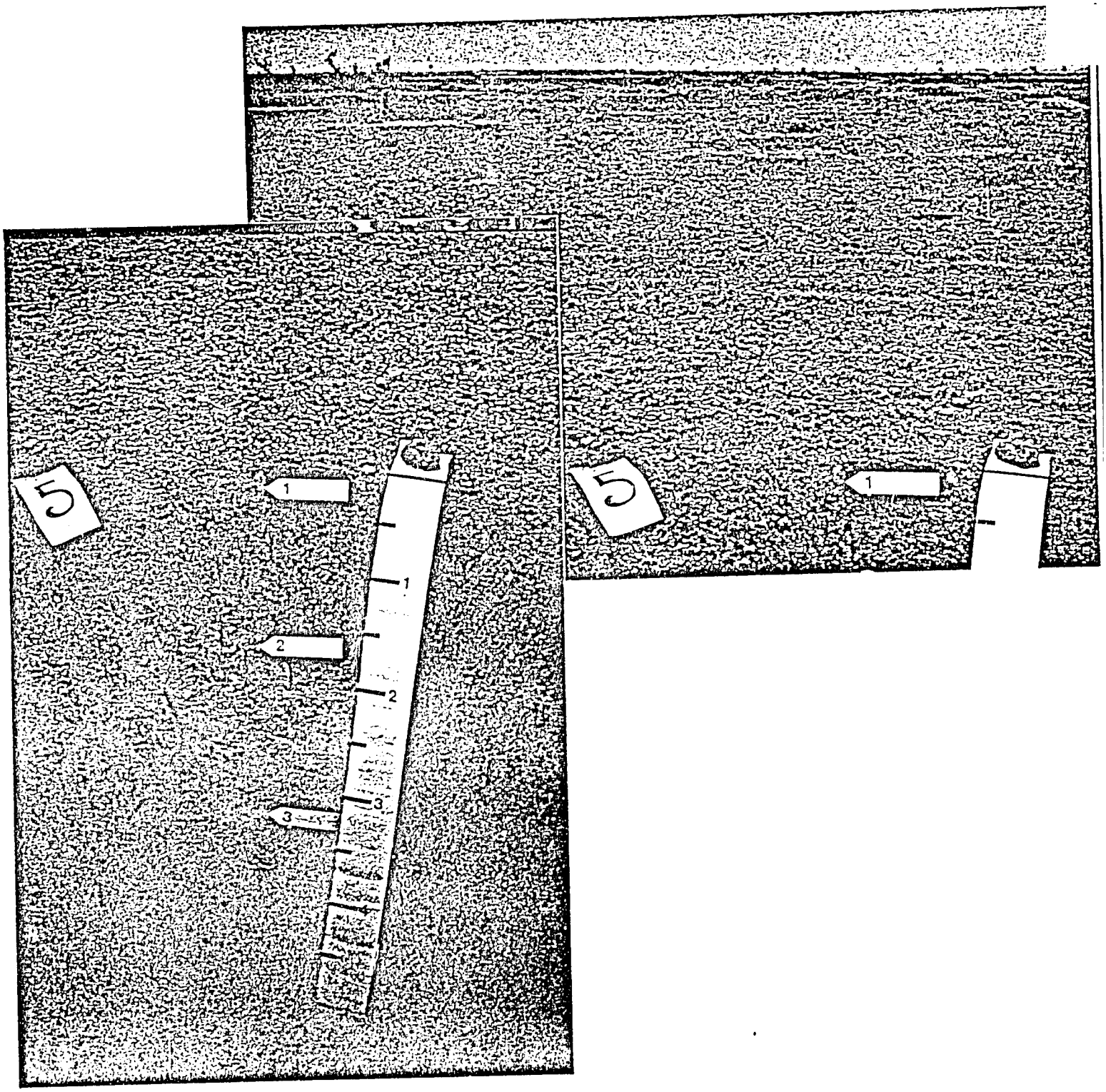
4. Depth of the Ground Water Table: There is an aquifer at about 9 m which has no effect on the soil.

5. Presence of Surface Stones or Rock Outcrops: N

6. Evidence of Erosion: Wind Deposition

7. Presence of Salt or Alkali: None

8. Human Influence: Wood and brush cutting, grazing.



PROFILE V is a Typic Torrifluvent which is referred to locally as a Waka Rouge soil and which will be referred to in the report as a Stony soil. Please note that the unit of measurement on the tape showing the depth of the profile is feet, not meters. The numbered arrows denote boundaries between horizons.

A. INFORMATION ON THE SITE SAMPLED

1. Soil Name: Project Name: Stony
   Traditional Name: Waka Rouge

2. Higher Order Classification: Typic Torrifluvent

3. Date of Examination: April 1, 1987

4. Authors of Description: King, Bamontaga, and Saleck

5. Location: As located on accompanying soils map Halfway between Bagodine and MBahe 300 meters east of point N 17 as located on the accompanying map.

6. Elevation: 11 meters

7. Land Form: a. Physiographic position: Plain
   b. General topography : Flat

8. Slope on Which Profile is Located: Class 1 flat or almost flat 0 - 2%.

9. Vegetation or Land Use: Range

10. Soil Climate: Aridic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Coarse alluvial material from hills in the area and fine alluvial material from the Senegal river.

2. Drainage: Class 3 moderately well drained

3. Moisture Conditions in the Soil: Dry

4. Depth of the Groundwater Table: There is an aquifer at about 6 m which has no effect on the soil. Of primary interest are the Senegal flood waters which cover this area about once a decade and deposit some silt on these soils.

5. Presence of Surface Stones or Rock Outcrops: Class 1 fairly stony

6. Evidence of Erosion: Water deposition; Wind erosion.

7. Presence of Salt or Alkali: None

8. Human Influence: Branch cutting, Grazing

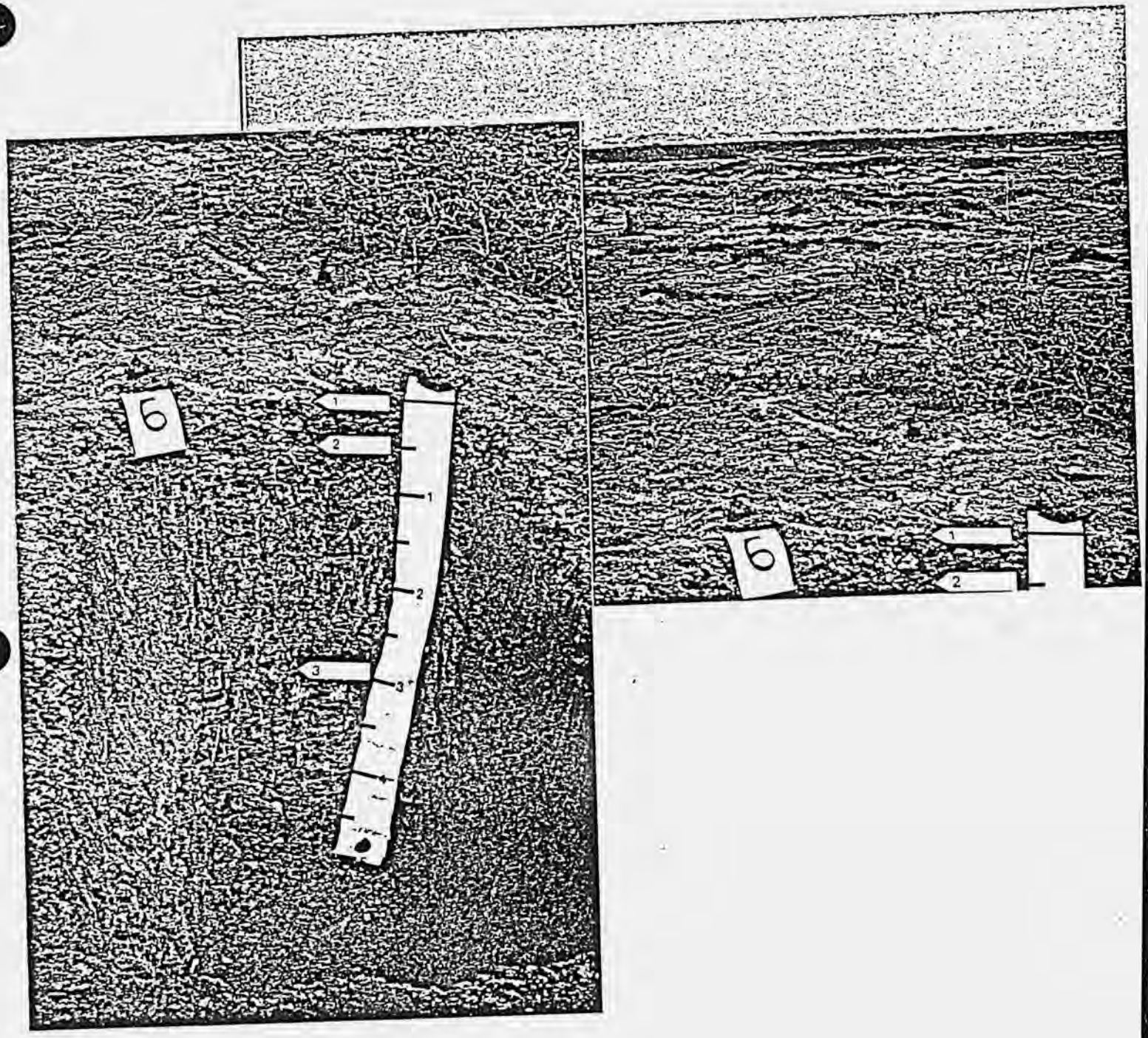
C. DESCRIPTION OF INDIVIDUAL SOIL HORIZONS

1. 0 - 4 cm: 10 YR 6/6 brownish yellow; Gravely sandy clay loam; Weak, very fine, subangular blocky structure; Slightly sticky and slightly plastic when wet; Loose when moist; Loose when dry; Very few fine tubular pores; Very frequent, slightly rounded, quartz and laterite gravel and stones; Very few fine roots; abrupt, smooth boundary to 2.

2. 4 - 47 cm: 10 YR 7/6 yellow; Gravelly silty clay; Moderated medium to coarse subangular blocky structure; Sticky and plastic when wet; Friable when moist; Hard when dry; Very few fine tubular pores; Frequent slightly rounded quartz and laterite gravel; Very few fine roots; Gradual irregular boundary to 3.

3. 47 - 97 cm: 1o YR 6/4 light yellowish brown; Gravelly, silty clay; Strong, massive, prismatic structure; Sticky and plastic when wet; Very frim when moist; Very hard when dry; Frequent slightly rounded quartz and laterite gravel; Gradual, irregular boundary to 4.

4. 97 - 151 cm: 10 YR 7/4 very pale brown; Gravelly silty clay; Strong, massive prismatic structure; Sticky and plastic when wet; Very firm when moist; Very hard when dry; Few slightly rounded quartz and laterite gravel.



PROFILE VI [illegible]

A. INFORMATION ON THE SITE SAMPLED

1. Soil Name: Project Name: Levee
   Traditional Name: Fonde

2. Higher Order Classification: Typic Torrifluvent

3. Date of Examination: April 11, 1987

4. Authors of Description: King, Bamontaga, and Saleck

5. Location: Two hundred meters west of point B 4 between Bagodine and MBahe as located on the accompanying soils map.

7. Elevation: 11 meters

8. Land Form: a. Physiographic Position: Plain
   b. General Topography : Flat

9. Slope on which Profile is Located: Class 1 flat or almost flat 0 - 2%.

10. Vegetation or Land Use: Scattered low shrubs, grazing.

11. Soil Climate: Aridic, Megathermic

B. GENERAL INFORMATION ON THE SOIL

1. Parent Material: Alluvium deposited by flood waters of the Senegal river. Windblown sand.

2. Drainage: Class 3 moderately well drained

3. Moisture Conditions in the Soil: Dry

4. Depth of the Groundwater Table: There is an aquifer at about 6 m which has no effect on the soil. Of primary importance is the fact that the soil is submerged every few years.

5. Presence of Surface Stones or Rock Outcrops: None

6. Evidence of Erosion: Wind erosion

7. Presence of Salt or Alkali: None

8. Human Influence: Brush cutting, Herding

C. DESCRIPTION OF INDIVIDUAL SOIL HORIZONS

1. 0 - 3 cm: 10 YR 5/4 yellowish brown; Sandy clay loam; Weak fine to medium platy to subangular blocky structure; Slightly sticky and plastic when wet; Loose when moist; Loose when dry; Many micro to fine pores; Very few fine roots.

2. 3 - 17 cm: 7.5 YR 5/6 strong brown; 10 YR 6/2 light brownish gray; Few, coarse, distinct, clear mottles; Clay; Moderate, medium, subangular blocky structure; Sticky and plastic when whet; Friable when moist; Slightly hard when dry; Many micro to very fine tubular pores; Very few fine roots.

3. 17 - 88 cm: 7.5 YR 5/8 strong brown; Common, coarse distinct clear mottles; Sandy loam; Strong, massive structure; Non sticky and non plastic when wet; Firm when moist; Hard when dry; many micro to very fine tubular pores; No roots.

4. 88 - 133 cm: 7.5 YR 7/2 pinkish gray; Many coarse, distinct, clear mottles; Sandy clay loam; Strong, massive structure; Non sticky and non plastic when wet; Firm when moist; Hard when dry; many micro to very fine tubular pores; No roots.

APPENDIX II

SOIL TEXTURE

Profile Descriptions

PROFILE	HORIZON	DEPTH CM	SAND %	SILT %	CLAY %	TEXTURE CLASSIFICATION
I	1	0-16	8	40	52	Clay
Basin/	2	16-126	6	40	54	Clay
Hallalde	3	126-176	8	29	63	Clay
II	1	0-5	13	66	21	Silt Loam
Levee/	2	5-26	5	57	38	Silty Clay Loam
Fonde	3	29-77	11	55	34	Silty Clay Loam
	4	77-200	13	62	25	Silt Loam
III	1	0-20	35	14	51	Clay
Sandy	2	20-65	37	12	51	Clay
Clay/	3	65-110	37	19	44	Clay
Wakajiju	4	110-144	46	11	43	Sandy Clay
IV	1	0-21	89	6	5	Loamy Sand
Loamy	2	21-32	83	8	9	Loamy Sand
Sand/	3	32-58	82	8	10	Loamy Sand
Waljo	4	50-94	81	7	12	Loamy Sand
	5	94-128	86	5	9	Loamy Sand
V	1	0-4	48	20	32	Sandy Clay Loam
Stony/	2	4-47	45	11	44	Silty Clay
Waka	3	47-97	42	11	47	Silty Clay
Rouge	4	97-151	47	11	42	Silty Clay
VI	1	0-3	64	15	21	Sandy Clay Loam
Levee/	2	3-17	35	22	43	Clay
Fonde	3	17-88	82	7	11	Sandy Loam
	4	88-133	69	4	27	Sandy Clay Loam

APPENDIX III

SOIL MOISTURE

PROFILE	HORIZON	DEPTH CM	TEXTURE	K CM/H	A M %	A M USUAL RANGE
I	1	0-16	Clay	1.38	8.45	20 - 25
Bassin/	2	16-126	Clay	0.88	10.20	20 - 25
Hallalde	3	126-176	Clay	0.53	9.65	20 - 25
II	1	0-5	Silt Loam	2.16	14.07	15 - 21
Levee/	2	5-26	Silty Clay Loam	3.30	17.26	16 - 22
Fonde	3	26-77	Silty Clay Loam	2.60	11.06	16 - 22
	4	77-200	Silt Loam	1.79	9.88	15 - 21
III	1	0-20	Clay	4.33	7.93	20 - 25
Sandy Clay/	2	20-65	Clay	2.19	7.67	20 - 25
Wakajiju	3	65-110	Clay	1.45	8.06	20 - 25
	4	110-144	Sandy Clay	1.89	7.89	17 - 22
IV	1	0-21	Loamy Sand	15.08	1.23	6 - 10
Loamy Sand/	2	21-32	Loamy Sand	4.49	1.94	6 - 10
Waljo	3	32-58	Loamy Sand	5.77	2.38	6 - 10
	4	58-94	Loamy Sand	5.38	2.57	6 - 10
	5	94-128	Loamy Sand	6.5	1.93	6 - 10
V	1	0-4	Sandy Clay Loam	4.17	6.26	15 - 21
Stony/	2	4-47	Silty Clay	4.61	6.09	18 - 23
Waka Rouge	3	47-97	Silty Clay	2.42	5.91	18 - 23
	4	97-151	Silty Clay	1.70	7.22	18 - 23
VI	1	0-3	Sandy Clay Loam	2.97	3.49	15 - 21
Levee/	2	3-17	Clay	5.62	6.76	20 - 25
Fonde	3	17-88	Sandy Loam	4.85	2.14	9 - 15
	4	88-133	Sandy Clay Loam	3.13	4.02	15 - 21

K = Percolation rate

A M = Available moisture

Usual Range = The SONADER laboratory had trouble with electricity outages while running the available moisture tests. The tests are being done again but the results are not available as of 15/5/87. Since all of the results are very low, the Usual Range for a given texture has been included as a reference.

APPENDIX IV

SOIL CHEMICAL CHARACTERISTICS

PROFILE/ HORIZON	ECe mmhos	PH H20	O M %	* Avail P205 ppm	* Avail K20 ppm	C E C
I/1	.85	7.0	.41	24	279	23
2	1.25	7.1	.41	22	245	23
3	1.15	7.0	.36	23	272	26
II/1	4.1	7.1	.86	45	493	12
2	4.25	5.7	1.03	23	185	18
3	2.23	6.2	.57	11	121	15
4	.88	6.7	.26	5	102	12
III/1	.9	7.3	.28	16	253	22
2	1	7.5	.31	12	176	22
3	7.1	6.6	.26	13	162	22
4	8.9	6.95	.19	5	137	21
IV/1	1.1	7.3	.36	29	49	2
2	.65	7.0	.57	76	66	5
3	.83	7.2	.40	76	49	5
4	1.13	7.3	.27	33	33	5
5	.9	7.25	.22	16	25	4
V/1	2.88	7.8	.72	38	208	14
2	3.4	8.5	.29	1	103	19
3	3.4	8.7	.26	--	121	19
4	5.38	8.7	.26	--	128	19
VI/1	2.43	7.6	.57	35	193	8
2	2.98	6.3	.67	28	210	18
3	.73	7.4	.12	9	25	3
4	.73	7.1	.19	4	308	10

* AVAILABLE P P m

CLASSES	P205	K20
Very Low	<10	<50
Low	10 - 30	50 - 100
Medium	30 - 60	100 - 300
High	60 - 120	300 - 400
Very High	>120	>400

AGRONOMY BIBLIOGRAPHY

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Nouakchott, le 5/5/1986

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RESULTATS DES ANALYSES

BASES ECHANGEABLES ET CAPACITE D'ECHANGE CATIONIQUE
MEQ %

ECHANTILLON		N° LAB	Ca	Mg	Na	K	T	CEC
D.1.	0- 5	4864	6,20	4.19	0,30	1,04	11,73	11,86
	5-26	65	7,94	6,66	0,41	0,40	15,41	17,83
	29-77	66	8,44	4,86	0,31	0,26	13,87	14,73
	77-200	67	6,74	4,46	0,39	0,21	11,80	12,02
N10-1	0- 16	4868	14,12	8,07	0,29	0,60	23,08	22,81
2.	16-126	69	14,49	9,06	0,36	0,52	24,43	23,19
3.	126-176	70	16,93	9,38	0,52	0,58	27,41	26,26
P3 W1 0-10	0- 30	4871	14,04	7,98	0,49	0,54	23,05	22,36
2. 30-60	10- 70	72	13,94	8,00	1,02	0,37	23,33	22,40
3.	65-110	73	14,43	7,99	1,95	0,34	24,71	22,06
4.	110-144	74	19,52	6,42	2,12	0,29	28,35	20,55
P4 J- 1		4875	2,01	0,75	0,10	0,11	2,97	2,11
2		76	3,77	0,89	0,09	0,14	4,89	4,53
3		77	4,53	0,50	0,08	0,11	5,22	4,94
4		78	4,28	0,76	0,10	0,07	5,21	5,14
5		79	2,90	0,75	0,06	0,05	3,76	3,62
P5 WR 1		4880	11,94	2,93	0,23	0,45	15,55	13,51
2		81	19,10	2,70	0,31	0,22	22,33	19,48
3		82	19,47	2,82	0,92	0,26	23,47	19,06
4		83	19,38	3,21	1,85	0,28	24,72	18,89
P6 F 1		4884	6,31	2,27	0,20	0,41	9,19	8,28
2		85	11,55	5,90	0,21	0,45	18,11	18,07
3		86	2,77	1,01	0,10	0,05	3,93	3,42
4		87	6,72	3,17	0,13	0,66	10,68	9,73

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RESULTATS DES ANALYSES

ECHANTILLON		N° LAB	K cm/h	pF % 4.2	3.0	2.5	Eau utile		
D 1	0- 5	4864	2,16	9,07	23,16		14,07		
	5- 26	65	3,30	14,63	31,89		17,26		
	29- 77	66	2,60	13,19	24,25		11,06		
	77-200	67	1,79	11,47	21,35		9,88		
K10 1.	0- 16	4868	1,38	19,15	27,60		8,45		
2.	16-126	69	0,88	19,26	29,46		10,20		
3.	126-176	70	0,53	22,87	32,52		9,65		
F3 W1.0-10	0- 30	4871	4,33	15,33	23,26		7,93		
2.30-60	10-70	72	2,19	15,76	23,43		7,67		
	65-110	73	1,45	17,39	25,45		8,06		
	110-144	74	1,89	13,69	21,58		7,89		
P4 J 1.		4875	15,08	1,37	2,60		1,23		
2		76	4,49	2,67	4,61		1,94		
3.		77	5,77	3,06	5,44		2,38		
4.		78	5,38	3,66	6,23		2,57		
5.		79	6,50	2,92	4,85		1,93		
P5 WR1.		4880	4,17	8,08	14,34		6,26		
2.		81	4,61	10,59	16,68		6,09		
3.		82	2,42	12,25	18,16		5,91		
4.		83	1,70	13,74	20,98		7,22		
P6 F 1.		4884	2,97	5,51	9,00		3,49		
2.		85	5,62	12,83	19,59		6,76		
3.		86	4,85	2,98	5,12		2,14		
4.		87	3,13	8,28	12,30		4,02		

(*) Les analyses ont été perturbées par les coupures tres frequentes d'électricité.

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RESULTATS DES ANALYSES

GRANULOMETRIE

%

ECHANTILLON		N° LAB	A 0,02	L 20	LG 50	SF 200	SG 2000	REFUS >2000	TERRE FINE
D1	0- 5	4864	21,24	16,47	49,81	11,13	0,33		
	5- 26	65	38,47	29,78	26,64	3,87	0,10		
	29- 77	66	34,00	22,60	32,73	9,51	0,19		
	77-200	67	24,82	14,00	48,37	12,30	0,09		
N10 1.	0- 16	4868	51,66	24,43	15,12	6,38	0,34		
2.	16-126	69	54,32	24,22	15,90	4,32	0,29		
3.	126-176	70	63,12	23,31	6,18	4,78	0,63		
P3 W1. 0-10	0- 30	4871	51,28	7,95	6,34	25,20	7,76		
2.30-60	10- 70	72	51,33	6,61	5,54	25,76	9,45		
3.	65-110	73	44,18	14,87	4,01	26,46	10,14		
4.	111-114	74	43,41	6,27	4,96	32,94	11,86		
P4 J 1.		4875	5,12	1,93	3,71	65,76	24,45		
2.		76	9,02	3,47	4,33	51,82	31,57		
3.		77	9,89	2,94	4,83	50,65	30,96	6	94
4.		78	12,41	1,93	4,76	50,72	29,21		
5.		79	8,57	0,57	4,00	51,98	33,93		
P5 WR 1.		4880	31,82	6,55	12,93	31,46	15,61	41	59
2.		81	45,38	6,58	3,72	27,85	15,17	8	92
3.		82	47,05	6,27	5,06	27,10	13,70	8	92
4.		83	46,92	6,42	4,91	27,55	12,31	2	98
P6 F 1.		4884	20,51	4,77	10,12	51,44	11,83		
2.		85	43,21	12,18	9,86	25,47	8,39		
3.		86	11,01	2,56	4,17	57,25	23,25		
4.		87	27,28	3,14	1,27	39,73	28,90		

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RESULTATS DES ANALYSES

ECHANTILLON	N° LAB	Ext 1/5 Cv 25° mmhos	pH H_2O	pH K CL	N %	C %	MO %	P_2O_5 °/oo ass.	P_2O_5 °/oo total	K_2O °/oo ass.	Fe Lib		
D1. 0- 5	4864	0,164	7,1	5,8		0,50	0,86	0,045		0,493			
2. 5- 26	65	0,170	5,7	4,4		0,60	1,03	0,023		0,185			
3. 26- 77	66	0,089	6,2	4,7		0,33	0,57	0,011		0,121			
4. 77-200	67	0,035	6,7	4,9		0,15	0,26	0,005		0,102			
N10 1. 0- 16	4868	0,034	7,0	5,2		0,24	0,41	0,024		0,279			
2. 16-126	69	0,050	7,1	5,3		0,24	0,41	0,022		0,245			
3. 126-176	70	0,046	7,0	5,2		0,21	0,36	0,023		0,272			
P3 W1.0-10 et 0- 30	4871	0,036	7,3	5,2		0,16	0,28	0,016		0,253			
2.30-60 10- 70	72	0,040	7,5	5,2		0,18	0,31	0,012		0,176			
3. 65-110	73	0,283	6,6	5,0		0,15	0,26	0,013		0,162			
4. 110-144	74	1,356	6,95	5,7		0,11	0,19	0,005		0,157			
P4 J 1.	4875	0,043	7,3	6,0		0,21	0,36	0,029		0,049			
2.	76	0,026	7,0	5,6		0,33	0,57	0,076		0,066			
3.	77	0,033	7,2	5,5		0,23	0,40	0,076		0,042			
4.	78	0,045	7,3	5,6		0,16	0,27	0,033		0,033			
5.	79	0,036	7,25	5,7		0,13	0,22	0,016		0,025			
P5 WR 1.	4880	0,115	7,8	6,3		0,42	0,72	0,038		0,208			
2.	81	0,136	8,5	6,8		0,17	0,29	0,001		0,103			
3.	82	0,136	8,7	7,0		0,15	0,26	0,000		0,123			
4.	83	0,215	9,7	7,1		0,15	0,26	0,000		0,12[illegible]			

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RESULTATS DES ANALYSES

ECHANTILLON	Nº LAB	Ext 1/5 Cv 25° mmhos	pH		N %	C %	MO %	P_2O_5 °/oo		K_2O °/oo	Fe Libre		
			H_2O	K CL				ass.	total	ass.			
P6 F 1.	4884	0,097	7,6	6,1		0,33	0,57	0,035		0,193			
2.	85	0,119	6,3	4,9		0,39	0,67	0,028		0,210			
3.	86	0,029	7,4	5,7		0,07	0,12	0,009		0,025			
4.	87	0,029	7,1	5,3		0,11	0,19	0,004		0,308			
1.	4888	0,650											
2.	89	0,051											

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ANNEX D

DIROL PLAIN PROJECT

ECONOMIC ANALYSIS

PROJECT IDENTIFICATION DOCUMENT

Prepared by

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BENEFITS + COSTS SECTION

5B) Rainfall runoff retention structures above the II meter elevation contour.

Costs of rainfall runoff retention per hectare are not known. However the following general relationships provide guidance for investment choices in these structures above the northern plain.

Rainfall water use should be shifted from low elevation lands to high elevation lands as long as the following is true:

$$Yh\ Fh\ Ph - Yl\ Fl\ Pl > Ih - Il + Lh\ Dh - Ll\ Dl$$

Subscript h refers to high elevation land
Subscript l refers to low elevation land

Y = average crop yield in KGs
(not necessarily the same crop)

F = frequency of beneficial inundation of cropland with marginal increments of rainwater runoff

P = price received per KG of crop output in UM
I = costs of rainwater retention system per HA/year

L = number of labor days required per crop per hectare
D = opportunity costs of labor per day during the crop season

We assume the following parameters values for the Dirol Plain, rainfall water use should be shifted to higher elevation when:

$$Il + 4\ 755\ C\ Ih$$

Rainfall water use should be shifted to higher elevations when the price of the higher elevation retention system is less than $66 more expensive per HA per year than the lower elevation retention system.

Yh	= 200	Yl	= 450
Fh	= 1.00	Fl	= 0.10
Ph	= 21	Pl	= 21
Lh	= 70	Ll	= 85
Dh	= 100	Dl	= 100

Determination for the costs of rainfall retention is needed before assessing the economic viability of such structures.

ECONOMIC ANALYSIS ANNEX

TABLE OF CONTENTS

INTRODUCTION

BENEFIT AND COST ANALYSIS METHODOLOGY

SUBCOMPONENTS OF THE DIROL PLAIN DEVELOPMENT PROJECT

ECONOMIC VIABILITY OF PROJECT SUBCOMPONENTS

SENSITIVITY OF ECONOMIC ANALYSIS TO KEY PARAMETERS

OPPURTUNITY COST OF LABOR

SECONDARY NON-FARM INCOME INDUCED BY CONSUMPTION EXPENDITURE

FLOOD PATTERNS FOR ECONOMIC ANALYSIS

INTRODUCTION

The fundamental question to be answered in the economic analysis of the MRVD Project is: what are the incremental benefits and costs of raising potential floodwater retention levels beyond what the Dirol Plain's naturallevee retans without further construction? We can only measure benefits and costs as a function of this potential retention level. Once the benefits of potential water retention are estimated for all possible elevations, the technical and economic problem becomes whether a water retention system can be created that is economically viable given the potential benefits. In a parallel analysis solutions to drainage problems or floodwater access can be incorporated.

The MRVDP includes six potential infrastructure components which could be built. These are: 1) a floodgate at the mouth of the Dirol Creek, 2) water retention dikes in the northern plain, 3) deepened channels, 4) secondary flood gates, 5) water retention structures in the southern plain, and 6) dikes built to protect irrigated perimeters from flood damage. At flood levels below 9.5 meters IGN at the Dirol Creek the six components are separable and can be considered as independent projects. At flood levels above 9.5 meters interactions between the components increase to the point that the components should be considered parts of an interdependent system. The FID analysis is primarily concerned with flood levels below 9.5 meters so the assumption of separability dominates the analytical framework.

Net benefits of floodwater retention systems are very sensitive to crop yield responsiveness to increased inundation, opportunity cost of labor, flood level probabilities, and the duration of the natural flood at different elevations. Other benefits of flood water retention include improved forage, livestock watering, agroforestry, vegetable gardening, and fishing.

This preliminary economic analysis leads to the conclusion that technical, social and economic viability criteria converge to limit construction during the first phase of the MRVDP to a floodgate near the mouth of the Dirol Creek. Further analyses, both during PP preparation and during implementation may justify adding further infrastructure.

Benefit and Cost Analysis Methodology

The preliminary economic analyses of the Dirol Plain project conform to the following methodologies as outlined in AID's Guidelines and Procedures for Planning and Analysis of Water and Related Land Resources Projects January 1982. The following specific points of the Guidelines have been incorporated:

Net present worth is the chosen discounted measure of project worth. For selection among mutually exclusive projects this is the preferred discounted measure. Internal rates of return and benefit cost ratios are also calculated.

Values for sorghum production are set at the GIRM administratively estabished value of 21 UM/KG as per AID Guidelines page 38. An actual market price of 12.5 UM/KG is used for estimation of household consumption induced secondary effects as per AID Guidelines page 41.

Due to the nature of the Mauritanian national economy a regional economic development accounting framework was used for the analysis.

Estimation of flood retention benefits conforms to the AID Guidelines (pages 57-64) on estimation of flood control benefits.

> "Inundation (retention) benefits are measured by the increased income from flood plain use because of the project, based on the premise that this use (sorghum production) is the same with or without the project" Guidelines p.58.

The types of flood retention benefits include:

1) Increased sorghum production and reduced labor costs in direct production of sorghum.
2) Income gains including incremental gain of wages and net profits to business over and above the direct crop production benefits.

Material which conforms to the Guidelines evaluation procedures (p.59) are provided in tables and annexes. Analysis of alternative energy requirements was not possible during the PID stage.

Benefits are based on analysis of the without and with project conditions.

Estimation of Net Cropping Benefits in the Dirol Plain

Net cropping benefits are equal to the change in sorghum output times the price of sorghum per KG less incremental production costs. Under traditional agronomic practices the only additional costs considered are labor costs. Under improved agronomic practices 20% of the incremental crop revenue is assumed to be adequate to pay for additional inputs, primarily fertilizer.

We assume that farmers will plant sorghum on all lands that would have been inundated for 15 days without the project. This is based on extensive interviews with farmers in the plain in February 1986 regarding their practices in the fall of 1985. For these lands it is assumed that there are no additional production costs and that with increased inundation duration total production costs decline due to reduced weeding requirements.

Lands that would have been inundated for 5-15 days without the project are assumed to be inundated for 15-30 days with the project . It is assumed that these lands would not have been planted without the project. The total incremental production costs on these lands with the project are equal to 40 days of labor times the opportunity cost of labor which varies by flood elevation(see Annex on Labor Cost). It is assumed that the crop grown on this land is harvested for forage valued at the value of 100 KG of sorghum on lower lands and 200 KG of sorghum on higher lands (see table of sorghum yields by elevation and inundation duration). Note that elevations and soil types are closely correlated throughout the plain.

The net change in sorghum output is the sum of the change in area cropped times the crop output per unit area. Yields per HA vary by elevation (soil type) and duration of inundation. The net change in sorghum output is calculated by summing the product of the change in area for each elevation/inundation class of land and the yield per hectare for that class.

The change in area cropped by elevation/inundation class was calculated in three steps.

First flood elevations by duration were obtained from the Team Hydrologist based on historical averages for different PWL (peak water levels at the Dirol Creek). These were used as the "without project" scenario for the nonspiked flood patterns. For a discussion of flood patterns and definitions of spiked versus nonspiked see the Annex on Flood Patterns.

Second, flood elevations by duration were estimated for the "with project" scenario using the assumptions listed above. With flood retention structures the flood waters can be held on the land longer than would naturally occur. The basic operating method of a flood retention system with a two way gate is to allow the Dirol Plain to fill with water during the peak flood of the

Senegal River. At peak flood the gates will be closed. After the appropriate period of time (approximately 30-40 days) the flood gates would be opened and the Dirol Plain would be drained. The lands that had been inundated would then be available for planting traditional recessional crops such as sorghum or niebe (cowpea).

While the water is rising to PWL in September, it will not be possible to catch the flood at its exact peak due to the time required to fill the Dirol Plain and management slip. For the purposes of the economic analysis it is assumed that the flood of any elevation can be retained on the Dirol Plain at an elevation equal to the 5 day duration inundation without the project. To allow for seepage, evaporation, and leakage during the 40 days during which the flood is retained it is assumed that the retained water level when the gates are opened is at an elevation equal to the 15 day duration without the project. All lands below this level will have been inundated for at least 45 days.

The third step in calculating the change in area inundated by elevation/inundation class is to subtract the "without project" areas from the "with project" areas. These two sets of areas and the difference between each elevation/inundation class for the with and without project scenarios are presented in Tables(). The areas in each class were estimated using the relationship between flood elevation and surface area inundated in the northern plain (LeBloas 1986:41). Using actual data for past floods the surface area inundated for each inundation/duration class without the project was estimated. Using derived estimates the surface area inundated for each elevation/inundation class with the project was estimated.

With the assumptions used, there can not be any land inundated for a duration of 30-45 days or 5-15 days with the project. This second land class will only include lands across which the retained water receded due to seepage, evaporation, and leakage during the 40 day retention period when the gates are closed.

Change in Sorghum Production due to Project

The change in sorghum production is calculated by summing the products of the change in area for each elevation/inundation class and the yield per hectare for that class. The Team Agronomist estimated sorghum yields by elevation and duration of inundation. Elevation is an important determinant of yield because soil types are correlated with elevation (see Table() and Agronomy Annex ()). The change in surface area inundated for a specific elevation and length of inundation was multiplied times the average sorghum yield for that elevation and inundation. The sum of all sorghum output changes depends on the flood characteristics in a given year. It can be seen in TABLE () that the different land surfaces effected and different sorghum yields

at each elevaton will result in different gross benefits for different flood patterns.

Change in Labor Use due to Project

The major cost of production in recession agriculture is labor. Increased duration of floodwater inundation reduces the labor input per hectare of walo cultivated by reducing weeding requirements (see LeBloas 1986:52).

On walo land that is inundated for less than 45 days it is estimated that two weedings are necessary, requiring a total of 15 days of labor/HA. On lands that are inundated more than 45 days only one lighter weeding is necessary requiring a total of 5 days/HA.

During the August rains, weeds emerge on all lands. If the September/October flood is long enough and deep enough on a certain field, the existing weeds are killed by the flood. When the flood recedes, the farmer plants under relatively weed free conditions. Only one lighter weeding is necessary later in the season. If the floodwater lies on the land for a short period of time (and thus also at a shallower depth) at least two weedings are required. The first weeding at planting is heavy requiring 10 days/HA and subsequent weedings require only 5 days/HA. These estimates are based on informal conversations with a cultivator from the Dirol Plain and total labor requirments reported in the Gannett Fleming report Table F.4-1, page 130. These totals are presented in this report in TABLE ().

The elements above have provided the framework to analyze the economic viability of a number of potential water management and agronomic interventions in the Dirol Plain. Specific characteristics of the northern and southern Dirol Plain impose their own analytical framework on the approach we have taken. These characteristics are discussed in the following section.

Each of the solutions identified for development in the Dirol Plain will be reviewed. Primary emphasis in the economic analysis has been placed on floodwater access/retention systems.

Benefits of a Water Retention System for the Northern Plain

The primary benefits of a water retention system for the northern Dirol Plain are increased sorghum yield levels and reduced labor cost due to reduced weeding requirements on heavily inundated land. Only benefits on recessional agriculture are being considered. Nearly all the additional crop output made possible by the retention system will come from land that would have been planted to sorghum without the system. For the purposes of this economic analysis it is assumed that the project will not change the basic use of land to something other than recessional sorghum production(U.S.A.I.D. Guidelines p58).

There are over 4500 HA of recessional agricultural land in the northern Dirol Plain that can directly benefit from a single retention structure built at the mouth of the Dirol Creek. Yields on part of this land are low due to inadequate inundation duration caused by a rapidly rising and falling Senegal River flood. The floodwater access/retention system envisaged will allow floodwater to fill the plain and be held until all the land has been adequately inundated. In a year such as 1986/87 this means that yields will increase on 2700 HA. In 1986/87 over 900 HA were inundated for at least 45 days even without the project. The project could only have increased yields on the 2700 HA that was inundated for less than 45 days.

Surface area inundated on the northern plain at different elevations, with and without the project, is shown in TABLES below.

The term "Average" in the comment column of these tables marks the examples used based on historical data of floods over the last 84 years. The years listed in the comment column indicates the examples used based on recent flood patterns since 1970. These historical averages are used to represent "nonspiked" floods and the more recent years are used to represent "spiked" floods. The definitions of spiked and nonspiked floods is given in the Annex on Flood Patterns.

The methodology presented on estimation of net cropping benefits is most applicable to the northern plain water retention system. As this methodology has been reviewed in general in the preceding section it will not be reviewed here.

Due to limited information on costs and adoption rates for the improved agronomic practices, the economic analyses of this project are based on the conservative assumption of no improved

practices. Analysis of improved practices is too complex for the PID stage but should be included in the PP stage.

It is important to note that the northern and southern plain are hydrologically separated at elevations below 9.5 meters. At this PID stage the primary emphasis is on analysis of the northern and southern sections of the plain as independent units. In the PP stage a more detailed analysis incorporating the complexities of the entire Dirol Plain as one hydrological unit should be included. If construction during Phase One of the project only incorporates floodwater access/retention structures below 9.5 meters then the current analytical framework is sufficient.

Benefits of a Floodwater Access/Retention System for the southern Dirol Plain

There are over 1500 hectares in the southern Dirol Plain that are not cropped due either to isolation from floods below 9.5 meters or excessive inundation due to poor drainage. These low lying areas are surrounded by higher ground that keeps floods below 9.5 meters out and retains water in the basins once they are filled by higher floods.

The data for surface area inundated in the northern Dirol Plain, which is the primary focus of Phase I MRVDP activities, is summarized in LeBlos as a function of elevation. However, due to the more complicated topography and hydrology of the southern plain available topographic data for the southern plain is not as adequate as available data for the northern plain. Due to this limited availability of information the level of potential benefits to be obtained from access/retention systems are uncertain. Never the less the southern plain also presents potential for agricultural innovation. The available data is summarized below.

TABLE

Southern Dirol Plain Surface Area Inundated by Elevation

PWL Dirol Inundation Creek (meters IGN)	PWL Nere Walo (meters IGN)	Inundation Without System HA	Inundation With System	HA Due to System
8	8.5	50	250	200
8.5	9.0	50	750	700
9.0	9.5	50	1250	1200
9.5	10.0	250	1750	1500
10.0	10.5	1750	1750	0
11.0	11.5	2000	not available	0
12.0	12.5	2500	not available	0

Source: (estimated from LeBloas 1986: 73)

LeBloas (1986: 73) presents data on the total number hectares cultivable on the southern Dirol Plain at different flood levels at the Dirol Creek. It appears he assumes that the southern Plain will be inundated by Senegal River water entering the plain through the Dirol Creek. In the southern plain development system presented in this paper it is assumed that for flood elevations at the Dirol Creek of less than 9.5 meters, water will enter the southern plain <u>only</u> through an artificial channel out on the east end of the plain. This assumption rests on the following argument.

Based on the gradient of the Senegal River it is estimated that flood levels at the Dirol Creek correspond to flood levels 0.5 meters higher at Nere Walo. The proposed flood access channel to the southern plain would be located between Sinthiou Boumaka and the Foret Classe near Djaout. This difference in flood levels is interpreted to mean that with a 9.5 meter flood at the Dirol Creek, a 10 meter flood at Nere Walo would be capable of inundating 1750 HA in the southern plain. LeBloas does not provide data for lower flood levels but the values used for this preliminary analysis are presented in TABLE above. It is not clear whether LeBloas data for "cultivable area" refers to the 15 day or 45 day duration flood.

As shown in TABLE , a floodwater access/retention system causes large changes in the area inundated in the southern plain for low level floods but very minimal changes for floods above 9.5 meters at the Dirol Creek. This is because the southern plain is an isolated basin that has access to the Senegal River only at flood levels above 9.5 meters. At flood levels of 9.5 meters, water begins to enter the southern plain via the Dirol Creek and breaches in the levee separating the northern and southern Dirol Plain. It is believed that floodwater enters the southern plain at other points during flood levels of 10 meters or more. Since floodwater enters the southern plain at 10 meters anyway, a lower elevation access system would not be beneficial during these floods.

The approach taken to estimate benefits to development of the southern plain is based on average benefits per hectare given certain land uses multiplied times the number of hectares in the southern plain that could be brought into production with a specific land use. The benefit of southern plain land use for agroforestry, fishing, and recessional crop production is estimated in the following manner.

ESTIMATION OF AGROFORESTRY BENEFITS PER HECTARE

The gonkier forest, such as the Protecte Forest of Raoufi Aoudi, is the most valuable first type because of its commercial use as firewood or charcoal. Gonakier forests grow on river banks and in depressions inundated during annual floods.

The growth of Acacia SPP trees varies from two to four m3/ha/year.1 A conservative estimate is that under no management an acacia seyal forest produces 1.5 m3/ha/year.2 For purposes of analysis of agroforestry in the southern Dirol Plain, it will be assumed that wood production will be 1.5 m3/ha/year.

An animal-drawn cartload of wood costs between 200 and 500 UM in villages in the Middle Valley of the Senegal River in 1986. Prices vary by distances between the village and fuelwood source. We expect that fuelwood prices will rise in real terms over the life of the project due to increasing scarcity. For the purposes of analysis of agroforestry in the southern Dirol Plain it will be assumed that a cartload of wood is approximately 0.5 m3, and the market price per m3 of wood produced by the project

will be 1000 UM (2 cartloads at 500 UM each). In summary, one hectare of woodland in the southern plain is assumed to be able to produce (1.5CM/Year/HA X 1000UM/CM)/72UM/$US = $21/Year/HA.

1. This section is based on Gannett Fleming Corddry and Carpenter, Inc.

FINAL REPORT - SYNTHESIS 1980? p. 151-157.

2. Taylor, George, and Moustapha Soumane (1983)

"Strategies for Forestry Development in the Semi-Arid Tropics: Lessons from the Sahel"

Paper presented at the International Symposium on Strategies and Designs for Afforestation, Reforestation, and Tree Planting."

Wageningen September 19-23 page 43

Referenced in Eicher, Carl "West Africa's Agrarian Crisis"

3. Frankenberger, Timothy et al

"Farming Systems Research Along the Senegal River Valley: A Dry Season Reconnaissance Survey in Guidimaka, Gorgol, Brakna and Trarza Regions

Mauritanian Agricultural Research Project II

College of Agriculture, University of

Arizona, Tucson, April 1986, pp. 213, 228.

Forests can produce $21 of wood/year/HA. If groundwater availability could be increased through even partial flooding every other year there are 2000 HA in the southern plain that could be exploited for agroforestry. If reforestation efforts in the southern plain are not begun immediately, the existing forests and trees will most likely be totally removed during the life of the project. The development of village level agroforestry in the southern plain could be a profitable and constructive step towards dealing with Mauritania's impending fuelwood crisis.

ESTIMATION OF THE VALUE OF FISH PRODUCTION IN THE SOUTHERN PLAIN

As shown in TABLE below, fish production per hectare of water surface varies between 60 kg/ha and 100 kg/ha. The production levels estimated below are for locations and topography similar to the Dirol Plain. Based on discussions with M. Lin (PCV Fisheries Senegal - Post Gababe (1986-1988)) it is estimated that fish production in the southern plain will be 40 kg/ha inundated. 1987 market price for fish in Kaedi is 50 - 100 um/kg. The local population has a taste preference for river fish and pay a premium to purchase Senegal River fish instead of fish from the Atlantic Ocean. For the analysis of fish production in the southern Dirol Plain it will be assumed that

fish has a market value of 50 UM/KG. Though demand for fish in the Kaedi market is rising, improvements in transportation between Kaedi and Nouakchott will limit the rise in the price of Atlantic Ocean fish available in Kaedi.

In summary, the value of fish production per HA in the southern plain is estimated to be
(40KG/HA/Year X 50UM/KG)/72UM/$US =$28/HA/Year.

TABLE x
Fish Production per Hectare of Water Surface
kg/ha/yr

Lac de Guiers (22,500 ha lake)	100
Lac R'KIZ (16,000 ha lake)	75
Aftout es Sahel (25 hectare ponds)	100
Flood plains	60

Source: Gannett Fleming Corddry and Carpenter, Inc., Assessment of Environ mental Effects of Proposed Developments in the Senegal River Basin - Synthesis for O.M.V.S. and ORGATEC 1980? page 131-136.

ESTIMATION OF RECESSIONAL CROP PRODUCTION ON THE SOUTHERN PLAIN

Value of sorghum production on the southern plain depends on yields and opportunity cost of labor. The value per hectare under traditional agronomic practices is
(300KG/HA X 21UM/KG - 85Days/HA X 50UM/Day)= $28/HA/Year.

Under improved agronomic practices the yields rise to 1000KG/HA and the opportunity cost of labor rises to 100UM/Day. The total value per HA is
(1000KG/HA X 21UM/KG X 0.8) - (85Days/HA X 100UM/Day)/72UM/$US= $115/HA/Year

The development of the southern plain for recession agriculture, fishing, and forestry could occur at lower elevations or more remote locations. This would minimize any impact on the development of irrigated perimeters at higher elevations. The total potential annual benefit from floodwater access/retention

systems for the southern plain could be $84,000 based on 3500 HA. More specific development proposals for the southern plain are discussed as specific subcomponents of the Dirol Plain development project. An illustrative land use plan for 4,495 Ha in the southern plain is given below.

Recession Agriculture and/or Fish Ponds	1500 HA
$42,000 Annual Benefit (1500 HA X $28)	
Agroforestry	2000 HA
$42,000 Annual Benefit (2000 HA X $21)	
Irrigated Perimeters	300 HA
Residual land uses	695 HA

Specific construction and agronomic interventions are proposed in the following section.

TABLE

Northern Dirol Plain Water Retention System Area
Inundated by Duration Without Project

PWL 5 day Duration	5-15 DAYS	15-30 DAYS	30-45 DAYS	45-60 DAYS	>60 DAYS	COMMENT
12.00	100	200	350	950	5200	Average
11.28	50	300	650	1700	3456	1974
11.05	100	200	300	350	5100	Average
11.00	50	300	700	1100	3900	1971
10.50	200	200	350	950	3900	Average
10.40	150	350	1300	650	3150	1975
9.78	300	400	600	900	2400	Average
9.50	300	400	400	900	2200	Average
9.20	100	1000	1700	600	300	1986/87
9.00	200	250	500	650	1700	Average
8.70	150	1200	1200	400	350	1979
8.50	250	100	250	250	1600	Average

TABLE
Northern Dirol Plain Water Retention System Potential Area (HA)
Inundated by Duration with Project

PWL 5 day Duration	5-15 DAYS	15-30 DAYS	30-45 DAYS	45-60 DAYS*	>60 DAYS*	COMMENT	
12.00	0	100	0	550	6150	Average	? historic? NS if so, may not
11.28	0	50	0	950	5156	1974	S
11.05	0	100	0	500	5450	Average	NON SPIKE
11.00	0	50	0	1000	5000	1971	SPIKED
10.50	0	200	0	550	4850	Average	NS
10.40	0	150	0	1650	3800	1975	S
9.78	0	300	0	1000	3300	Average	NS
9.50	0	300	0	800	3100	Average	S
9.20	0	100	0	2700	900	1986/87	NS
9.00	0	200	0	750	2350	Average	S
8.70	0	150	0	2400	750	1979	NS
8.50	0	250	0	350	1850	Average	S

* Depends on management of flood retention system.

300X

TABLE

Northen Dirol Plain Flood Elevation (meters IGN)
by Inundation Duration (days)
Elevation at Dirol Creek

PWL 5 day Duration	5-15 DAYS	15-30 DAYS	30-45 DAYS	45-60 DAYS	COMMENT
12.00	11.85	11.66	11.34	10.10	Average
11.28	11.22	10.75	10.14	9.06	1974
11.05	10.95	10.70	10.31	10.00	Average
11.00	10.98	10.67	9.89	9.29	1971
10.50	10.35	10.10	9.85	9.35	Average
10.40	10.30	9.90	9.20	8.90	1975
9.78	9.68	9.42	9.03	8.50	Average
9.50	9.37	9.15	8.90	8.38	Average
9.20	9.10	8.60	7.40	6.60	1986/87
9.00	8.90	8.75	8.45	8.05	Average
8.70	8.30	7.50	7.10	6.70	1979
8.50	8.40	8.35	8.10	7.85	Average

TABLE

Northen Dirol Plain Water Retention System

Change in Area (HA) Inundated due to Project
by Inundation Duration and Flood PWL
(Potential Area With Project -- Area Without Project)

PWL 5 day Duration	5-15 DAYS	15-30 DAYS	30-45 DAYS	45-60 DAYS	>60 DAYS	COMMENT
12.00	-100	-100	-350	-400	950	Average
11.28	-50	-250	-650	-750	1700	1974
11.05	-100	-100	-300	150	350	Average
11.00	-50	-250	-700	-100	1100	1971
10.50	-200	0	-350	-400	950	Average
10.40	-150	-200	-1300	1000	650	1975
9.78	-300	-100	-600	100	900	Average
9.50	-300	-100	-400	-100	900	Average
9.20	-100	-900	-1700	2100	600	1986/87
9.00	-200	-50	-500	100	650	Average
8.70	-150	-1050	-1200	2000	400	1979
8.50	-250	150	-250	100	250	Average

Subcomponents of the Dirol Plain Development Project

LeBloas (1983, 1984, 1986) and WMS II have proposed eight components for the DPDP (Dirol Plain Development Project). The PID team has used the eight components as as a framework for detailed analysis. They include the following construction components and agronomic components:

CONSTRUCTION COMPONENTS

1) A structure near the mouth of the Dirol Creek. This structure would allow access for Senegal River floodwater to the Dirol Plain and/or retention of Senegal River floodwater and Dirol Creek runoff water. All studies have included this structure.
2) Water Retention Dikes
   A) Three elevations for dikes have been proposed. WMS II OPTION 3 provides a sketch for minimal diking at three points on the southern plain and adjacent to the main Dirol Creek structure. We will refer to this opton as the 9.5 meter retention system.
   B) WMS II OPTION 2A and RBDO OPTION 1B propose diking for an effective retention level of 10 meters. This option is referred to as the 11 meter dike in LeBloas.
   C) An intermediate level of dike, not considered by the previous studies is evaluated by the DAI study. This proposal is for diking to an effective retention level of 11 meters. This option would be comparable to a 12 meter dike in the LeBloas system of dikes.
   D) WMS II OPTION 1 and RBDO OPTION 1B propose diking for an effective retention/protection level of 12 meters. This system is referred to as the 13 meter dike.
3) Deepening of access/drainage channels. Channel deepening has been proposed with three general objectives.
   A) Deepening of thalwegs within the northern plain to improve drainage of water from the large depressions south of Fondu and Ouloum Nere and west of Bagodine in Savalelo. This is section "d" in LeBloas (1986: 47).
   B) Deepening of natural channels between the northern and southern plain. These were included in WMS II OPTION 3.
   C) Deepening of natural channels in the southern Plain, at Djaoul, Nere Walo, or Sinthiou Pomar. These options were considered by DAI but not by earlier studies.
4) Secondary two way gates/dams on mariogots where they enter the Senegal River.
   A) Two way gate/dam at Roufi Aoudi

B) Two way gate/dam at Sinthiou
C) Two way gate/dam at Djaout

5)Other water retention structures for rainfall runoff.

A) A weir/dam on the Dirol Creek at the southwest end of the Lougere depression between Bagodine and Ferrala. This is OPTION 2B in WMS II.

B) Rainfall runoff retention structures above the 11 meter elevation contour in the northern half of the Dirol Plain. Farmers have constructed numerous minor dikes on the northern edge of the plain. The GIRM built a larger structure at ATENE in 1983. (ref. LeBloas 1986:) This structure is currently in need of rehabilitation.

6) Dikes built to protect irrigated perimeters from damage during high floods. A major justification for LeBloas OPTION ONE (13 meter dikes) is protection of irrigation crops and infrastructure during high floods.

AGRONOMIC COMPONENTS

7) Extension and training will helplead to the use of improved agronomic practices which will contribute significantly to the economic visbility of the project (see agronomy and soils annexes to the PID). Adaptive research should be able to identify new varieties of traditional crops as well as introduce well-adapted strains of new crops. This should also contribute significantly to increased cereal production.

8) Irrigated Perimeters

Various options for irrigated perimeters both large and small were proposed by LeBloas. A recent World Bank (1985, pg. 40) document proposes 2 small perimeters at Sinthiou, 8 small perimeters at Nere Walo, and 2 small perimeters at Dawalel (each 20 HA).

LeBloas focuses on larger perimeters such as 60 ha. perimeters along the Senegal River in the southern plain, a 300 ha. perimeter at Dawalel, and two larger perimeters at Ferrala. These options will be referred to in two sections entitled:

A) Small Irrigated perimeters in the Southern Plain

B) Large Irrigated Perimeters in the Northen Plain

9) Other economic activities will also benefit from physical infrastructure in the Dirol Plain. These may include: fisheries, agro-forestry, vegetable gardening, and animal husbandry. Human and animal health should also benefit from effects on the water table.

ECONOMIC VIABILITY OF PROJECT SUBCOMPONENTS

The following economic analysis assumes that all capital costs occur in year one. Construction costs quoted below refer to initial capital cost. Annual maintenance costs begin in year 2 and are assumed to be 2% of the initial cost (see Engineering Analysis) Benefits are assumed to begin in year one for a 25 year project life. Induced consumption benefits are assumed to be equal to 30% of the direct cropping benefits (see Annex on Secondary Nonfarm Income). The annual discount rate used is 7% based on Mauritanian bank deposit rates for small savings accounts. All elevations are measured in meters IGN at the mouth of the Dirol Creek.

All benefits are estimated using highly conservative assumptions including minimal sorghum yield increase due to increased inundation, negligible additional hectarage brought into production, no improved agronomic practices, no value placed on additional forage produced, no benefits to animals from increased water availability, no new crops, and low opportunity cost of labor. As one of the benefits of increased inundation duration is reduced labor requirements a low opportunity cost of labor provides a conservative estimate of benefits. If these assumptions are relaxed then the estimated benefits could increase substantially.

1) The main structure near the mouth of the Dirol Creek has an estimated initial capital cost of $750,000. The NPV (net present value), B/C (benefit to cost ratio), and IRR (internal rate of return) depend critically on the assumed flood pattern. Three flood pattern probabilities are used to present the sensitivity of results to these probabilities. All flood patterns used are based on a spiked flood pattern.

If the Dirol Creek structure had been in place during this past flood year (1986/87) it would have increased sorghum yields on 2900 HA. It would have increased sorghum production by 210,000 KG under traditional agronomic practices and 1,590,000 KG under improved agronomic practices. The combination of improved agronomic practices and the water retention structure could have produced an additional $322,000
(1,590,000-210,000)KG X 21UM/KG/(72UM/$US) X 0.8 (for fertilizer)

dollars of additional net crop benefit during this past crop year. This incremental net crop benefit is in addition to the crop benefits used for the economic analysis of the project under traditional practices. If improved agronomic practices can be adopted in the near future then the NPV of the project under all flood patterns would increase substantially.

The economic analysis shows that this structure provides a very favorable economic return under controlled flood patterns even with traditional agronomic practices. Construction of this

structure does not preclude any other types of development foreseen on the Dirol Plain. As immediate construction provides total future flexibility and substantial economic return, it is suggested that this structure be built immediately. The economic analysis of this structure by flood pattern is shown below.

Historical Flood Pattern

The proposed Dirol Creek structure will provide a NPV of -$483,055 under the historical flood pattern. Annual average cropping benefits are $29,743 which implies a B/C of 0.48 and an IRR of -0.01.

Drought Flood Pattern

The proposed Dirol Creek structure will provide a NPV of $1,137 under the drought flood pattern. Annual cropping benefits will average $62,549 which includes an annual average of $17,500 of crop benefit from retention of rainwater from the Dirol Creek during low flood years. These benefits imply a B/C of 1.00 and an IRR of 7%.

The rainwater retention benefit in low flood years is given by 1500HA X 400KG/HA X21UM/KG X 0.10(probability)/72UM/$US.
In low flood years the opportunity cost of labor is zero so the gross revenue is equal to the net cropping benefit. This rainwater retention benefit is included only in the drought flood scenario because all lands that could be inundated by retained rainwater would also be inundated by Senegal River water every year with the other flood patterns.

Controlled Flood Pattern

The proposed Dirol Creek structure will provide a NPV of $708,135 under the controlled flood pattern. Annual average cropping benefits are $110,451 which implies a B/C of 1.77 and an IRR of 18%.

2A) The 9.5 meter effective retention level dike

Based on the 1986/87 flood, and extensive interviews with farmers in the plain it appears that a single structure (DAI OPTION 1) will retain floodwater to at least a 9.5 meter elevation and possibly higher. Furthur topographical work is needed o determine whether any diking is needed to retain floodwater at the 9.5 meter level. At this elevation an additional 0.5 meter of retention level provides on average about $10,000 worth of annual cropping benefits. As the diking needed to assure a 9.5

meter retention level is very minimal if there is any diking needed, this option should be explored. The economic value of this diking is slightly higher than the diking discussed under DAI OPTION 2B below (see OPTION 2B for estimates of NPV, B/C, and IRR).

2B) The 10 meter effective retention level dike

Increasing the effective retention level of the Dirol Creek Dam from 9.5 to 10 meters would require roughly 4-5 KM of dike with an average height of 0.5 meters. It is possible that local farmer groups could construct these dikes with technical assistance and minimal provision of material (bags for sandbags for example). This diking would cost at least $100,000 for the simplest unprotected structure (no rip-rap). It should be noted that this dike construction would not be to the same standard as in DAI OPTION 2C and 2D. The additional cropping benefits from this OPTION 2B diking alone (not from the Dirol Creek Dam) are estimated to average $10,000/year. The NPV of this constuction is $24,654 which implies a B/C of 1.2 and an IRR of 9%.

It should be noted that these incremental benefits are very sensitive to the topography of the plain between 9.5 and 10.0 meters elevation. Additional topographic analysis could show that costs or benefits for this option are quite different than those estimated here. These estimate are for a flood pattern between the drought pattern and the historic pattern. Under a controlled flood pattern there is no benefit of this additional diking.

2C) The 11 meter effective retention level dike

Increasing the effective retention level of the Dirol Creek Dam from 9.5 to 11.0 meters would require extensive diking. Under the most favorable conditions (the historical flood pattern) this extra diking is expected to provide $19,000 of average annual crop benefits. The initial cost of this structure is estimated at $3,555,000 which would require annual maintenance costs that are higher than the annual benefits. The net benefit stream for this structure is negative for every year of the project life. Economic rates of return for this net benefit stream are negative.

This benefit estimate does not include flood protection for irrigated perimeters. If, in the future, sufficient irrigation infrastructure is built (below 11 meters) in the Dirol Plain to justify over $300,000 of "flood protection" annually then this dike should be considered. At the present time recession agricultural benefits and flood protection of irrigated perimeters do not justify the cost of this structure. In any case the lands best suited to irrigation are above the 11 meter contour.

2D) The 12 meter effective retention level dike

Increasing the effective retention level of the Dirol Creek Dam from 9.5 to 12.0 meters would require very extensive diking. Under the most favorable conditions (the historical flood pattern) this extra diking is expected to provide $22,000 of average annual crop benefits. The initial cost of this structure is estimated at $5,285,700 which would require annual maintenance costs that are higher than the annual benefits. The net benefit stream for this structure is negative for every year of the project life. Economic rates of return for this net benefit stream are negative.

This benefit estimate does not include flood protection for irrigated perimeters. If, in the future, sufficient irrigation-infrastructure is built (below 12 meters) in the Dirol Plain to justify over $400,000 of "flood protection" annually then this dike should be considered. At the present time recession agricultural benefits and flood protection of irrigated perimeters do not justify the cost of this structure.

3A) Deepening channels within the northern plain

There is no available evidence that the Savalelo depression west of Bagodine has a drainage problem. It is possible, though unlikely, that the Lougere depression, which is larger than Savalelo, does have a drainage problem though it is planted every year. The Team Engineer estimated the cost for a drainage channel from the Lougere depression (200 HA) to the mouth of the Dirol Creek to be $290,000. For this channel to pay for itself (B/C=1) would require crop benefits of $120/HA in the Lougere depression. The economic benefit of reduced inundation on these low soils is not known at this time. As major portions of the lower elevation project lands could have inundation increased past the optimum duration it is extremely important that this issue be addressed during the PP stage. Under traditional agronomic practices the maximum benefit per HA from drainage is (450KG X 21UM/KG -85Days X 50UM/Day)/72UM/$US

Under improved agronomic practices the maximum benefit per HA from drainage is (1200KG X 21UM/KG -85Days X 100UM/Day).

3B) The DAI team was not able to determine from available data what benefit, if any, was obtained by deepening the natural breach in the levee between the northern and southern plain as proposed by WMSII OPTION 3. However, a channel between the

depression south of Ouloum Nere and the Kofel depression in the southern plain could in most years add 400 HA of recession agriculture. In addition there could be drainage benefits in the depression on the northern end of the channel. The initial cost of this channel is estimated at $150,000 which for 400 HA would require a net benefit of $30/HA/Year in order to break even (B/C = 1). This general level of net benefit is obtainable from fishing, sorghum production, and well managed agroforestry. This channel could be a good investment but needs additional analysis including topographical work.

3C) Deepening of floodwater access/drainage channels
Based on available hydrological data, the Team Hydrologist estimated that there is a difference in water elevation of 0.5 meters between Sinthiou and the mouth of the Dirol Creek. This means that the September 1986 flood level of 9.5 meters at the Dirol Creek had a flood level of 10.0 meters at Sinthiou. Due to this gradient in river level between the east end and west end of the Dirol Plain it is best to build water access channels at the east end of the southern plain rather than at Roufi Aoudi on the west end.

Deepening of the existing channel to a bottom elevation of 9.5 meters between the Senegal River (at Djout) and the Faram Kabir depression would allow inundation of 320 HA with a Dirol Creek flood elevation above 9.0 meters. This newly inundated land would produce between $28 and $115/Year in net benefits from fishing or sorghum production. Value of sorghum production in the southern plain with traditional agronomic practices is given by
(300KG/HA X 21UM/KG - 85Days/HA X 50UM/Day)/72UM/$US= $28/HA/Year

Value of sorghum production in the southern plain with improved agronomic practices is given by
(1000KG/HA X 21UM/KG X 0.80 - 85Days/HA X 100UM/Day)/72UM/$US=
$115/HA/Year.

Value of fish production on flood plains is given by
(40KG/HA X 50UM/KG) = $28/HA/Year

In addition this inundation would provide agroforestry benefits on a surrounding 1000 HA. The average annual agroforestry benefit would be $21,000/Year.
Value of wood production in the southern plain is given by
(1.5CM/year/HA X 1000UM/CM)/72UM/$US =$21/HA/Year

Total average annual benefits could include $21,000 from agroforestry and over $9,000 in benefits from the 340 inundated HA. The estimated cost of this channel is $290,000. This would provide a NPV of $86,256, a B/C of 1.24, and an IRR of 11%.

4A) Two way gate/dam where the Roufi Aoudi marigot enters the Senegal River.

As explained in OPTION 3C it would be better to locate any two way gate for the southern plain at the east end of the plain rather than at the west end near Roufi Aoudi. The $250,000 two way gate/dam at Roufi Aoudi was not considered beyond this point in the project analysis.

4B) Two way gate/dam at Sinthiou between the Rouss depression and the Senegal River.

Based on topographical maps, it appears that for floods below the Dirol Creek elevation of 9.5 meters a two way gate/dam at Sinthiou would only provide benefits in the Rouss depression which is relatively small The channel between the Senegal River and the Rouss depression was not found to be a significant feature during fieldwork in the plain. A two way gate at Sinthiou (estimated cost of $250,000) was not considered beyond this point in the project analysis. However, this is where farmers have tried to deepen the channel themselves, so special attention should be given to this option during a second phase of the project.

4C) Two way gate/dam at Djaout between the Faram Kabir depression and the Senegal River.

If the marigot at this location is deepened and future flood levels are higher than the past ten years a very small water retention gate could be built in this mariogot. Limited field time and topographical information make a detailed analysis of the benefits of this option impossible at this time.

5A) A weir/dam on the Dirol Creek at the southwest end of the Lougere depression between Bagodine and Ferrala is expected to cost $100,000. The average annual net cropping benefits are $6,563.
(450KG/HA X 500HA X 21UM/KG X 0.10 (1 in 10 years))/72UM/$US

This construction provides a NPV of -$26,074, B/C is 0.79, and an IRR of 5%. Anyway, this structure is superseded by the Dirol Creek Dam which would provide the same low flood years benefits. This option is not economically feasible even though this is where farmers have built their own structure in the past few years.

5B) Rainfall runoff retention above the 11 meter contour in the northern plain.

6) Dikes to protect pump irrigated perimeters from damage during

high floods should only be considered when the potential loss of infrastructure and crops reaches $300,000 to $400,000 per year. (see OPTION 2C and 2D)

BENEFITS + COSTS SECTION

5B) Rainfall runoff retention structures above the II meter elevation contour.

Costs of rainfall runoff retention per hectare are not known. However the following general relationships provide guidance for investment choices in these structures above the northern plain.

Rainfall water use should be shifted from low elevation lands to high elevation lands as long as the following is true:

$$Yh\ Fh\ Ph - Yl\ Fl\ Pl > Ih - Il + Lh\ Dh - Ll\ Dl$$

Subscript h refers to high elevation land
Subscript l refers to low elevation land

Y = average crop yield in KGs
(not necessarily the same crop)

F = frequency of beneficial inundation of cropland with marginal increments of rainwater runoff

P = price received per KG of crop output in UM
I = costs of rainwater retention system per HA/year

L = number of labor days required per crop per hectare
O = opportunity costs of labor per day during the crop season

We assume the following parameters values for the Dirol Plain, rainfall water use should be shifted to higher elevation when:

$$Il + 4\ 755\ C\ Ih$$

Rainfall water use should be shifted to higher elevations when the price of the higher elevation retention system is less than $66 more expensive per HA per year than the lower elevation retention system.

Yh	=	200	Yl	=	450
Fh	=	1.00	Fl	=	0.10
Ph	=	21	Pl	=	21
Lh	=	70	Ll	=	85
Dh	=	100	Dl	=	100

Determination for the costs of rainfall retention is needed before assessing the economic viability of such structures.

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Expected Benefit of Flood Retention System Northern Dirol Plain
By Effective Retention Level and by Flood Pattern (1000s UM/year)
with Traditional Agronomic Practices

Effective Retention Level	FLOOD PATTERN HISTORICAL SPIKED	HISTORICAL NONSPIKED	DROUGHT SPIKED	DROUGHT NONSPIKED	CONTROLLED SPIKED	CONTROLLED NONSPIKED
12 meters	3712	2280	5938	2555	7953	3096
11 meters	3505	2079	5731	2354	7953	3096
9.5 meters	2142	563	5004	1127	7953	3096

See Annexes on Flood Patterns

This table is calculated from the Table estimated Sorghum Crop Benefits from Flood Retention in the Northern Dirol Plain by PWL Flood Probabilities and Spiked versus non spiked Flodd Patterns.

MAINTENANCE COSTS

Options	No. of men.	Rate	Days/m	mo.	Total	"T"
1	2	$5/day	22	12	2,640	
	5	$5/day	22	3	1,650	
	Materials, Equip, Supplies				4,000	= 8,29
2A	14	$5/day	22	4	6,160x1.2*=	7,40
2B	28 (30)	$5/day	22	4	13,200x1.2 =	15,80
2C	28 (30)	$5/day	22	4	13,200x1.2 =	15,80
2D	28 (30)	$5/day	22	4	13,200x1.2 =	15,80
3A	2	$5/day	22	12	2,640x1.2 =	3,20
3B	2	$5/day	22	12	2,640x1.2 =	3,20
3C	2	$5/day	22	12	2,640x1.2 =	3,20
4A	4	$5/day	22	4	2,640x1.2 =	3,20
4B	4	$5/day	22	4	1,760x1.2 =	2,10
4C	6	$5/day	24	4	2,640x1.2 =	3,20
5A	1	$5/day	22	4	440x1.2 =	1,00
5B	1	$5/day	22	4	440x1.2 =	1,00

* 1.2 for equip, supplies, materials

"T" = Labor + Equip, Materials, supplies

GFW
5/11/87

Option (No.)	Description				Cost ($)	
1.	<u>Dirol Creek Flood gate</u>				750,000	
2.	<u>Dikes</u>					
	Flood Level	Dike Tup				
A.	9.5 m - 10m	Dike - No Structures			250,000	14.76Km à 0.5m high
B.	10.	11	H=1.25m	2 Gates	2,350,000	14,76Km
C.	11	12	H=2.25	2 Gates	3,555,000	14,76Km
D.	12	13	H=3.25	2 Gates	4,940,000	14,76Km
					2,613,300	
					3,828,400	
					5,285,700	
3.	<u>Gate/Dam = Flood gate</u>					
A.	Rouli Audi on Senegal				250,000	
B.	Sinthiou Pomar				250,000	
C.	Diaouf				250,000	
4.	<u>Deepening Channels</u>					
A.	In Northern Plain (One location)				290,000* two = 580,000	
B.	Northern Plain to Southern				150,000	
C.	Southern Plain				290,000	
5.	W----/Dams					
A.	Tween Bagoine/Ferrala				100,000	
B.	Rainfall/Runoff Structures:				100,000	
6.	Irrigated Perimeters					
A.						
B.						
7.	Dikes to Protect Perimeters:					
8.	Agro Forestry, Fish, Improved. Agro Practices					

4.0 Sensitivity of Economic Analysis to Key Parameters

There are seven key parameters that the project economic analysis is relatively sensitive to. These are each discussed below.

4.1 Flood Patterns

Preliminary sensitivity analysis shows that net project benefits, optimal phasing of subcomponent construction, and choice of optimal project design are critically sensitive to flood peak water levels, flood probabilities, and whether the flood is spiked. Refined flood pattern sensitivity analysis should be conducted after the release of the Gibb (May 1987) report on future flood patterns of the Senegal River.

4.2 Base Yields for Recessional Agriculture

Benefits of floodwater access/retention systems in the southern plain are very sensitive to base yield levels. Location specific yields by soil type, elevation, and inundation duration should be obtained. Preliminary estimates were used for the PID analysis. Better information on weeding practices and labor requirements should be obtained for the PP analysis.

4.3 Crop Yield Responsiveness

Project net benefits are critically sensitive to sorghum yield response to soil inundation duration and improved agronomic practices. Realistic estimates of yield response must be obtained for PP estimation of benefits. Project benefits are also sensitive to when, during the life of the project, yields are expected to increase due to improved agronomic practices.

4.4 Opportunity Cost of Labor

Improved estimates of opportunity costs of labor and capital should be obtained through a sample household survey and analysis of labor market/land tenure arrangements in the plain. Estimates used in the PID analysis are based on secondary data for the central valley rather than data specific to the Dirol Plain. Estimates used are minimums. If these values were increased the net benefits of the project would increase.

4.5 Surface Area Inundated as a Function of Elevation

Area/elevation estimates used for the PID analysis are based on the graphic chart in LeBloas (1986:41). The original integer tables upon which this chart was based should be obtained for the PP analysis. Optimal structure elevations and net benefits critically depend on the non-linearities in this surface area to elevation relationship. An area/elevation chart for the southern plain was not available during the PID analysis.

4.6 Prices

The PID analysis is based on price information obtained through informal conversations with villagers and merchants in Bagodine and Kaedi. Part of the household survey during the PP stage should more accurately measure prices and price variation.

Information should also be obtained from government sources on projected sorghum prices (price support levels) and future efforts to help isolated villages market their surplus grain.

4.7 Capital Costs for Construction and Maintenance Costs
The tradeoff between initial construction and future maintenance costs should be analyzed in more detail. Better estimates of maintenance costs will be possible only after a design is completed in the PP stage.

5.0 Regional Economic Organization and Constraints

5.1 Marketing and Terms of Trade

Preliminary investigation indicates that the principal villages of Niabina, Bagodine, and Fondu have competetive access to traded goods imported into the region. These include primarily rice, sugar, tea, and other frequently purchased retail items.

Due to administrative structures and trucking patterns these principal villages appear to have inadequate access to markets for marketed sorghum produced in the plain. Post harvest prices received for sorghum in these villages is 12.5 UM/KG due to village level price support efforts. Preharvest and unsupported posthervest prices fall to under 10 UM/KG. This is in contrast to an official CSA support price of 21 UM/KG. A price differential of 25% between official support prices and village market prices is not uncommon. In 1985 household consumption surveys in the Department of Boghe household reported selling paddy rice at 25 - 40% below the government official support price of 14 UM/KG.

In the spring of 1986 the CSA provided a truck to transport sorghum from Bagodine to the administrative center in Mbagne. During the campaign Bagodine sold 15 tonnes of sorghum. In the spring of 1987 the CSA has not to date provided village level pick up of grain. As of May 9, 1987 only 230 KG of sorghum has been sold the CSA Mbagne office from residents of Bagodine. No sorghum sales from Bagodine residents were recorded at the CSA office in Kaedi during 1986 or through May 11,1987. According to the village chief in Bagodine one of the main reasons for this is inadequate transport. The spring 1987 harvest was larger than the 1986 harvest. The Bagodine village chief estimates that there are 20 tonnes in Bagodine at the present time that are ready to be sold to the CSA. Over the next few months this sorghum may be marketed through other channels at prices lower than the official CSA support price.

More detailed analysis of the local grain marketing system and access to imported goods in other villages in the plain should be done in the PP stage using data from the proposed household survey.

5.2 Credit and Capital Markets

Due to the lack of household survey data, analysis of local credit and capital markets was not possible. Initial observation suggest that credit access may be a marketing constraint and a limitation to adoption of improved agronomic practices in the near future.

It is suggested that any technical assistance or establishment of credit institutions be structured around existing organizations within the plain. A preliminary analysis should be conducted with the assistance of the World Council of Credit Unions in Madison, Wisconsin. This proposed analysis would meet PP needs.

5.3 Price Policy, Food Aid, and Nutrition

The Dirol Plain is a relatively unique micro region within Mauritania in that it has villages dependent on irrigated agriculture, villages dependent on recessional agriculture, and villages dependent on nonfarm income. Donors of food aid to Mauritania are concerned with how increases in the market price of grains will reduce 1) the food aid bill, 2) counterpart fund generation, 3) nutritional standards, and 4) Mauritania's dependence on imported cereals through increased domestic production. These policy issues are closely related to efforts to increase agricultural production in the Dirol Plain. The proposed PP stage household survey in combination with earlier detailed Mauritanian household consumption functions estimated by Rogers (1986) should be used for analysis of the impact of price policy and food aid on production and consumption in the Dirol Plain.

SORGHUM YIELDS (KG/HA)
by Inundation Duration and Soil Elevation

Traditional and Improved Agronomic Practices

Soil	Elevation	Days of Effective Inundation 5-15	15-30	30-45	45-60	>60
Hallalde 6-5-9	Trad.	-	100	400	450	450
	Imp.		100	800	1200	1200
Wakajiju 9-10	Trad.	-	100	300	300	300
	Imp.		100	600	1000	1000
			If irregularly flooded			
Fonde 2/3 10-13	Trad.	-	200	400	400	400
	Imp.	-	200	600	1500	1500
					Also higher value diverse crops	
Waka Rouge 1/3 10-13	Trad.	-	-	-	-	0
	Imp.		200	500	1200	1200
					Also higher value diverse crops	

Estimated Sorghum Crop Benefits from Flood Retention
in the Northern Dirol Plain
by Peak Water Level, Flood Probabilities, and
SPIKED versus NON SPIKED Flood Patterns
FOR TRADITIONAL AGRONOMIC PRACTICES
(Benefits include crop output and Farm Labor costs)
(1,000s of UM)

FLOOD P W L 5 Day duration	HISTORICAL PWL Prob. SPIKED	HISTORICAL PWL Prob. NON SPIKED	DROUGHT PWL Prob. SPIKED	DROUGHT PWL Prob. NON SPIKED	CONTROLLED PWL Prob. SPIKED	CONTROLLED PWL Prob. NON SPIKED
12.00		2,010 (10)		2,010 (10)		
11.28	2,070 (.10)		2,070 (10)		2,070 0	
11.05		2,060 (35)		2,060 (10)		2,060 0
11.00	2,020 (35)		2,020 (10)			
10.50		2,830 (25)		2,830 (20)		
10.40	2,625 (25)		2,625 (20)			
9.78						
9.50						3,410 (50)
9.20	5,510 (20)		5,510 (40)		5,510 50	
9.00		2,772 (20)		2,772 (40)		2,772 (50)
8.70	10,395 (10)		10,395 (.20)		10,395 (50)	
8.50		1,512 (10)		1,512 (20)		
TOTAL WEIGHTED AVERAGE	(Numbers in parentheses are probability weights used for each flood level and flood patterns).					

Potential Benefit From Water Retention
in the Northern Dirol Plain
by Flood Peak Water Level at the Dirol Creek
(Elevation measured in meters IGN)
(Benefit measured in 1000s of UM)

(Historical Average is the Non Spiked Flood Pattern)

PWL 5 Day Duration		SORGHUM IMPROVED PRACTICES	PRODUCTION TRADITIONAL PRACTICES	CHANGE IN LABOR COST	TOTAL BENEFIT LABOR & SORGHUM TRADITIONAL PRACTICES
12.00	non spiked	12,495	1,260	750	2,010
11.28	spiked	20,685	1,470	600	2,070
11.05	non spiked	11,550	1,260	800	2,060
11.00	spiked	21,630	1,470	550	2,020
10.50	non spiked	12,915	1,680	1,150	2,830
10.40	spiked	34,755	2,100	525	2,625
9.78	non spiked	13,230	2,310	1,000	3,310
9.50	non spiked	13,650	2,310	1,100	3,410
9.20	spiked	33,390	4,410	1,100	5,510
9.00	non spiked	10,395	2,772	0	2,772
8.70	spiked	38,115	10,395	0	10,395
8.50	non spiked	4,935	1,512	0	1,512

OPPORTUNITY COST OF LABOR (1)

There are six major uses of labor for residents of the Dirol Plain. These are recessional agriculture, irrigated agriculture, vegetable garden agriculture, non-farm sector self-employment, wage employment, and leisure.

For recession agriculture it is estimated that one hectare of sorghum on optimally inundated walo soils requires 85 days of labor for a yield of 450 kg valued at 21 UM/KG. This implies a return to labor of 111 UM/day if there are no other costs of production. This is the return for a landowner cropping his own field. For a sharecropper who receives only half the harvest, the daily return for to labor would be approximately 56 UM/day.

Farmers also frequently crop dieri soils which provide yields of approximately 250 KG/HA. Dieri fields need 70 days of labor/HA (Gannett FLeming, Ref. #5, p. 130, see Table next page). This implies a return to labor of 75 UM/day for dieri agriculture.

In the past few years, some farmers have unsuccessfully sought to obtain walo land which they could sharecrop. During these years the opportunity cost of labor is even lower, approaching a zero or negative value. If the current village price of sorghum at 12.5 UM/KG is used instead of the official price then theimputed opportunity cost of labor is also lower by 40%.

Improved agronomic practices might increase yields to 1000

to 2000 KG/HA but would increase purchased inputs to roughly 20% of crop revenue. Under these circumstances return to labor rises to between 200 and 400 UM/day if the number of days worked remains at 85. If the number of days worked increases substantially then the return per day may not rise substantially above the return per day in traditional agriculture. In this case the benefits to the farmer are more days of employment at the existing rate of return rather than an increase in the return for a day of labor. Under these circumstances increase in output will be dependent on the existence of unemployed labor resources in the local labor market rather than an additional effort on the part of existing farmers. This labor seems to be available according to PID team studies.

Opportunity Cost of Labor in Irrigated Agriculture

It has been estimated [Ref. #3 - Annex 4] that daily returns to labor vary by crop yield and crop choice for the small irrigated perimeters along the Senegal River Valley. During the PID fieldwork it was not possible to obtain recent yield data for the small perimeters in the Dirol Plain. It is believed that yields are between 2000 and 3000 KG/HA for sorghum which implies a daily imputed wage of between 33 and 266 UM.

IMPUTED WAGE IN IRRIGATED AGRICULTURE

BY CROP AND YIELD LEVEL

UM/DAY

YIELD KG/HA	PADDY	SORGHO	MAIS
1500	- 122	- 84	- 95
2000	- 44	33	22
2500	33	150	139
3000	110	266	255
3500	187	383	372
4000	264	500	489
4500	341	616	605
5000	418	733	722

Note: Averages should be adjusted for mean-variance equivalence. Yield modes rather then "means" should be used.

Opportunity Cost of Labor in Kaedi Wage Employment

People seeking to be hired as wage labor can find opportunities both in villages and in larger urban centers such as Kaedi. In Kaedi, SONADER is a well known source of employment. The wage at SONADER is 19.1 UM/hour or

approximately 150 UM/day. However it is only during the March/April harvest season that the SONADER has trouble finding enough workers. The rest of the year there is surplus labor available. (Personal discussions with Mohammed El Hadj Moktar, Head of Personnel-SONADER/Kaedi) For the rest of the year the expected wage (daily rate multiplied times the probability of employment) is lower than 150 UM/day. This same pattern holds in the local private labor market as well. During peak labor times of the year farmers hire labor at up to 200UM/day. However most of these laborers can only find this type of employment for a few days a year. During most of the year the opportunity cost is much lower.

Leisure is purchased by households when they pay for labor intensive activities that they could do themselves. Examples of such activities are pounding grain instead of paying to have it ground, walking instead of paying for transport, and carrying water by hand or collecting firewood instead of hiring someone.

Pounding grain by hand requires one hour for every two KG REF #1 =(AGRES II FSR in SRV Dry Season Survey p.244). The cost of mechanical milling is 10 UM per 2 kilos which does not include the cost of transporting the grain to the mill. This suggests an opportunity cost of women's time of roughly 10 UM/hour or 80 UM/day. For families that are too poor to pay for milling (Total Value of Consumption less than 1000 UM/month) the opportunity cost of labor is revealed to be less than 80 UM/day. [Source: ROGERS 1986] In several of the villages in the Dirol Plain there are numerous families too poor to pay for grain milling.

If estimates of expense per hour of labor saved in other activities could be made then the implicit value of a person's own time could be estimated.

For some very poor villages where malnutrition seriously limits the ability of individuals to work, the real opportunity cost of labor may be negative.

Opportunity Cost of Labor - Summary

	Return per Day of Labor UM/Day
Small Perimeter Irrigated Rice	110 - 264
Small Perimeter Irrigated Sorghum/Maize	33 - 266
WALO Recession Agriculture - Sorghum	66 - 111
Sharecropper WALO Recession Sorghum (Retaining 66% of Harvest)	44 - 73
Women Pounding Grain by Hand	80
Dieri Rainfed Farming - Sorghum	45 - 75

Under conditions of full employment the above rates of return to labor would be equivalent to the opportunity cost of labor. However, in very low flood years (8.5 meters at Dirol Creek (such as in 1985)) there is surplus labor due to an extreme shortage of cultivable walo lands. Under these conditions the opportunity cost of labor will be estimated as zero. In medium flood years (9.5 meters at Dirol Creek, as in 1986) a fair amount of walo land is cultivable (roughly 3700 HA), though not all land poor families desiring to obtain share cropping contracts can do so. Under these conditions the opportunity cost of labor will be

estimated as 50 UM/day. Under above average flood conditions (10.5 meter elevation at Dirol Creek) it is estimated that most available labor can be productively employed in WALO recession agriculture. (see the sociologist report on labor availability) Though the return to labor in WALO recession agriculture is over 66 UM/day and over 100 UM/day in irrigated agriculture, the opportunity cost of labor in villages without irrigated perimeters is probably somewhat lower. In villages with irrigated perimeters such as in the southern plain, the opportunity cost of labor will be estimated at 100 UM/day averaged over the Walo recession growing period.

Summary

Opportunity Cost of Labor by Flood Elevation

Flood Level	Southern Plain Opportunity Cost	Northern Plain Opportunity Cost
8 - 9	50	0
9 - 10	50	50
> 10	100	100

The opportunity cost of labor for use of improved agronomic practices is estimated at 100UM/day.

Labor Requirements per Hectare of Walo Cultivation

TASK	Days/HA
Cleaning, preparation, seeding	15
Weeding	15 - 20
Crop Watching	48
Harvest	7
TOTAL	85 - 90

Source: Gannett Fleming
Partial Report for Socioeconomics
Table F. 4-1 p. 130

Labor Cost Per Hectare of Recessional Sorghum

	5-15	15-30	30-45	>45	>60
Low Flood 6-9 meters	0	0	0	0	0
Medium Flood 9-10 meters	0	50 x 40	50 x 85	50 x 75	50 x 75
High Flood > 10 meters	0	100 x 40	100 x 85	100 x 75	100 x 75

(Um x dump)

Source: estimated by author

Crop Labor Requirements per Hectare Estimates Used for Economic Analysis

With 45 days inundation	75 days
With 30 - 45 days inundation	85 days
With 15 - 30 days inundation (harvested for forage)	40 days
Dieri	70 days
Small perimeter (2 seasons)	170 days
Large perimeter (2 seasons)	132 days

Source: ~~Gannett Fleming~~ Estimated ~~for~~ by author using information in Gannett Fleming and from informal interviews in Kaedi

Secondary Non-farm Income Induced by Consumption Expenditure

Using the modeling framework developed by Rogers (1986), a preliminary estimate of the secondary income induced via consumption linkages is in the range of 20 to 80 UM for every 100 UM of additional crop revenue. It should be noted that farmers in Bagodine may receive 12.5 UM/KG for their grain rather than 21 UM which is the official support price. In that case, as incremental sorghum production has been valued at the national price of 21 UM/KG, it would be necessary to reduce the estimated household consumption multiplier by a factor of 12.5/2.5 = .6. Using these most conservative assumptions about price, is expected that induced benefits per 100 UM of incremental crop value produced will be between 12 and 48 UM. A mean value of 30 UM will be used for this preliminary analysis. This represents the additional income generated in the local region of the Dirol Plain as a result of households spending their additional income generated by the project. It is asumed that both capital and labor for the local non-farm sector come from outside the local region and that their oppurtunity costs can be calculated as such.

3.7 Flood Patterns used for Sensitivity Analysis

There are three types of variables concerning Flood Patterns important to the Dirol Plain project. These variables are 1) PWL (peak water level of the flood at the mouth of the Dirol Creek). 2) probabilities of different PWLs and 3) spiked versus nonspiked duration of the flood. Each of these types of variables are described below.

3.7.1. Peak Water Levels (PWL)

The elevation capacity of (LeBloas 1986:41) reveals that the relationship is not linear. This is of crucial importance for flood retention structures. For elevations between 8 and 10 meters relatively small increments in elevation correspond to large changes inundated surface areas. For elevation above 10 meters and below 8 meters, relatively large increments or decreases in elevation correspond to small changes in flooded surface area. As the major benefit from flood retention is holding water on a large surface area, the benefit of an incremental height of flood retention above 10 meters or below 8 meters is much less than for elevations between 8 and 10 meters. In summary, regardless of cost considerations, the potential benefit from incremental flood retention is highest between 8 and 10 meters IGN PWL. This fundamental topographic feature is a major determinant of the pattern of potential benefits identified in this study. In addition, crop yield response is lower at higher elevations due to soil characteristics. These two factors influenced by elevation lead to sharply diminished net benefits from incremental additions to flood retention at higher elevations.

3.7.2. Probabilities of Different Peak Water Levels (PWL)

The basic risks of different PWL are that low elevation structures are useless with high floods and most of the investment in high elevation retention structures is wasted with low floods. As future flood patterns are unknown this economic analysis can only compare returns to specific project infrastructure under a full range of "assumed" future flood patterns. Sensitivity analysis shows that net project benefits are so sensitive to unpredictable flood patterns that benefits of each project option are calculated for three different flood probability scenarios. The three probability scenarios are:

A) Historic (based on date since 1903)
B) Drought (based on data since 1970)
C) Controlled (estimated conditions after Manantali closes) Manantali Dam is schedules to operate in 1988

The probabilities used for each of the scenarios above are included in TABLE ().

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Estimation of the "Controlled" Flood Pattern

It was necessary to estimate PWLs and probabilities for these PWLs during the transition phase of the Manantali Dam. Surface area inundated in the Central Middle Valley (Matam-Boghe) of the Senegal River is reported in the Gannet Fleming. Final Report-Synthesis (p. 34-35) for the historical flood (scenario one) and the near future (after 1988) transition phase (scenario three). Using historical data on the once-in-5-year high flood, average flood, and once-in-5-year low flood, a ratio between total area inundated in the Dirol Plain and the Central Middle Valley was calculated. For the once-in-5-year high flood this ratio is historically 1:33. For the other two floods it is historically 1:35. Using these ratios area inundated in the Dirol Plain under Manantali transition conditions was calculated from the reported total area for the Central Middle Valley. Using the relationship between surface area and elevation for the Dirol Plain (LeBloas 1986:41) approximate Dirol Plain PWL flood elevations were calculated for each of the three floods shown below.

Once in 5 year high flood	9.75 meters IGN
Average flood	9.00 meters IGN
Once in 5 year low flood	8.75 meters IGN

Based on these calculations it was concluded that the best guess of the "controlled" flood pattern would be a 50% chance of a flood at 9 meters IGN and 50% chance of a flood at 9.5 meters IGN. These point estimates were used to simplify calculation of potential benefits from different components of the Dirol Plain development project. These estimates are similar to the conclusion drawn in the Gannett Fleming report (Synthesis-Final Report Table C.1-5 page 37) that PWLs are expected to fall 1.1 meters lower due to development of the river basin.

3.7.3. Spiked versus Nonspiked Floods

The degree to which a flood has a spiked hydrograph in a single flood year is an important determinant of project net benefits. The hydrograph is a plot of flood elevation on the vertical axis and number of days on the horizontal axis. A spiked flood rises and falls quickly with only a short duration at high elevations. A nonspiked flood stays at a higher elevation for long durations. For two floods of the same PWL a spiked flood inundates the surface briefly and a nonspiked flood inundates most of the surface for a long duration. A water retention structure is very beneficial in combination with a spiked flood becaus the reservoir can fill in any cases but only with the structure can water be retained on the land long enough to obtain full crop yields. A water retention structure is less useful with nonspiked floods because the flood level is high for a sufficienctly long period that most of the land inundated can provide full yields even without the retention structure.

To examine the importance of spiked floods, several different floods of the same PWL will be compared. The Team Hydrologist selected 1971 as an example of a nonspiked flood and 1974 as an example of a spiked flood. Both had a PWL of slightly above 11 meters. Comparison of the potential benefits of a water retention system with each flood reveals only negligible differences. However compared to the average hydrograph for the floods in the last 83 years, the 1971 and 1974 floods were spiked. It appears that floods in the last 16 years have been more spiked than the historical average. This appears to be true for above average floods (such as 1971 and 1974) as well as low floods. The Olivry (1983 Figure 6 page 14) indicates that lower PWL floods tend to be more spiked than high PWL floods. However the comparisons being made here are for floods with the same PWL.

Floods could be increasingly spiked because of deforestation in the Senegal River watershed and a greater proportion of the flood plains being isolated from inundation with dikes. For the analysis of benefits from flood retention structures in the Dirol, the historical average hydrograph will be referred to as "nonspiked" and the pattern during floods since 970 will be referred to as "spiked".

3.7

Flood Patterns Used for Economic Analysis

Flood PWL Dirol Creek (meters IGN)	Probabilities of Flood PWL Within the Elevation Range		
	Historic Pattern	Drought Pattern	Controlled Pattern
8.25 - 8.75	0.02	0.10	0.00
8.75 - 9.25	0.03	0.30	0.50
9.25 - 9.75	0.05	0.20	0.50
9.75 - 10.25	0.20	0.10	0.00
10.25 - 10.75	0.25	0.10	0.00
10.75 - 11.25	0.35	0.10	0.00
> 11.25	0.10	0.10	0.00

ANNEX E

DIROL PLAIN PROJECT

SOCIAL SOUNDNESS ANALYSIS

PROJECT IDENTIFICATION DOCUMENT

Prepared by

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draft Dirol Plain PID, 4/30/87

SUMMARY SOCIAL ANALYSIS

DIROL PLAIN PROJECT

The Dirol flood plain is inhabited by Pulaar and haratine Moor farmers whose traditional combination of rainfed and flood recessional farming systems has been crippled by drought over the last two decades. The plain is also used for pasturing livestock and fishing. A flood retention dam, with phased additional diking as necessary has the potential to increase its cultivable area threefold or more, depending on flood height. The plain's problems are urgent, because in addition to the climatic degradation of recent years, the completion of the Manantali Dam in 1988 will probably force abrupt new changes in agriculture. If the villagers in this area are already organized into associations and working with extension personnel at that time, they will be far better able to adapt to forced changes and take advantage of new opportunities for irrigated agriculture that may occur as the Manantali reservoir begins filling and operating.

The farmers interviewed are well aware of the crisis and highly motivated to develop new techniques of water control to improve production and revalorize their lands. Having watched many pump-irrigated development projects in the valley, however, they want to avoid the political struggles over land distribution and water management that have handicapped many of them. Dirol plain Pulaar community leaders have set conditions to their participation in any project: (1) land rights must be retained by current owners, (2) local residents should have first rights to any jobs created for which they are qualified, and should be paid according to SONADER norms (for manual labor, 150-200 UM = $US 2.08-2.78 per day), and (3)farmers retain the right to plant crops of their own choosing on their fields. These concerns are clearly related to problems encountered in other parts of the country when the SONADER has installed pump-irrigated perimeters.

The key social questions related to the Dirol plain project are: (1) how effectively can villagers organize themselves to manage water and maintain water-control structures? (2) Will they have sufficiently improved revenues to afford the recurrent costs of infrastructure operations and maintenance, and even if they do, will they have effective legal authority? (3) Can traditional communal land tenure retain its economic viability in the changing legal and agricultural situation? Will the GIRM, having passed a new land law in 1984 making traditional communal tenure legally invalid, nevertheless agree to maintain it on the Dirol plain? (4) Can a modus-vivendi be worked out between villagers and SONADER, which has the legal mandate over all development of lands in the valley? (5) How do male out-

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migration, women's roles, and traditional forms of clientship affect labor supply and equity?

The possibility of rainfed and recessional cropping, plus rich flood recession pastures, fishing and trade opportunities made the middle Senegal River Valley the most valuable land in the western Sahel from ancient times (Tekrur, 4th-11th century) until the twentieth century. The construction of the Dakar-Bamako railroad, completed in 1923, and the establishment of Dakar as the capital of French West Africa in 1903 moved the locus of economic activity south, and left the river region an economic and political backwater. Agriculture continued to be productive, but as it was isolated on the periphery of the cash economy to the south, it became a subsistence activity. Male outmigration in search of salaried jobs swelled from the fifties on, and older men, along with women, and children were left to tend the farms.

Climatic and ecological changes since 1968 have reduced the productivity even of subsistence agriculture around Kaedi. Rainfall has become so erratic that in some years it has totalled less than 200 mm. compared to a historic mean of nearly 400mm. There has been little or no harvest from rainfed fields during this period. Flood volume is the critical index for the flood recession crop, as it best reflects the land area that stays flooded long enough to be cultivable. Since the great Sahelian drought began in 1968 the flood volume has averaged half what it was for the first half of the twentieth century. (AID, Senegal River Basin Project Paper, vol. 1, 1982) According to village interviews, since 1971 only the two big low-lying basins on the northern plain, and one small area of the southern plain have been flooded long enough to crop. This seems to correspond to floods at about the 8.5 m. to 9 m. IGN elevation on the Dirol Plain. This implies small cultivable areas in most years, somewhere between what LeBloas/SONADER consider an average year, 1500 ha., and a poor year, 100-200 ha.(LeBloas: 1986, 36-37)

Floods peaked, however, near or above the 10 m. IGN level in all but three of the years since 1971. (WMS II, 1985, 13) With a flood retention dam at the mouth of the Dirol Creek, water could be held near the peak level for the extra month needed to make the 8-9.5 m. IGN lands cultivable (assuming 0.5-1 m. would evaporate or infiltrate even with the dam). This would multiply several times the cultivable hectarage of the two big walo areas on the northern portion of the plain, raising it to about the 4500 ha. optimum. The southern plain, which has had very little cultivation in recent years, would gain significant cultivable hectares only in high flood years, with a peak over 10 m. IGN.

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Social Structure and Land Tenure

Thirty-nine villages have use-rights to the Dirol Plain, counting those listed by Andr{ L{ricollais and Yveline Diallo (1980), the agricultural census of 1984, and the land tenure study by Thomas Park, Glenn Rogers and Tidiane Ngaid{ (1986). Their total population in 1987 can be estimated at 96,000.1 The prefeasibility study designates twelve villages directly on the plain, with a 1987 population of 14,353 as directly concerned by the project. (LeBloas: 1986, 33, updated) This narrow geographic delineation of participants is inappropriate, as some of the villages included own no land on the plain, and many holders of traditional use-rights living at a greater radius are arbitrarily excluded. , including those in Senegal In particular, project organizers should be careful not to discriminate against pastoralists. The villages on the Mauritanian bank own far more land on the Senegalese side than vice-versa in this particular zone, so they would be net losers if each side decided to exclude the other.

Four main Pulaar lineages, the Hebeyabe, Nerenabe, Irlabe, and Bosseabe, each with several liniols or sub-lineages, dominate the plain politically and in terms of land tenure. The political center for the Hebeyabe is at Bagodine on the northern branch of the Dirol, whereas the Nerenabe of Woloum Nere and Nere Walo dominate the eastern part of the northern plain and the southern plain. The Irlabe center is Niabina, and the Bosseabe are concentrated at Sinthiou Boumaka. Peulh herders with a traditional symbiotic relationship to the Tukulor farmers live all around the plain on the higher *diori* land, sometimes many kilometers away. Some families move down to the plain to cultivate small plots during the rains and flood season, and the livestock are brought down as soon as the harvest is taken in. Fishermen live in villages along the main channel, but also fish in the ponds that form on the plain and do some flood recession agriculture.

1The 1977 population excluding three small villages on the Senegalese bank and two hamlets on the Mauritanian side was 71,179. When some of those same villages were counted for the 1984 agricultural census, they claimed a much larger population, but most observers believe that this is exaggerated, as food distribution at the time was being based on household counts. The figures villagers gave in 1984 would have amounted to an average of 5.0% annual population increase since 1977. Using a more conservative, but still probably too large 3.0% rate, and rounding upward, which allows 341 for the missed villages, the estimated 1987 population is 96,000.

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Pulaar society has a caste structure, which is gradually eroding under the influence of outmigration, modern education, new ideas of equality, trade unionism, and the outlawing of discriminatory aspects of caste. It nevertheless influences access to land and work roles. The main categories are:

Noble or Freeborn:	Torodbe:	Clerics and scholars; the ruling class since they led a revolution in 1776-1803. 2,450 families of 4,204 enumerated =	58% 2
	Jawanbe:	Secular allies of the Torodbe,	0.7%
	Sebbe:	The pre-revolutionary political class and crown slaves.	3.3%
	Fulbe:	Secular nobles and herders, called Peulh in French, (sometimes considered a separate ethnic group from the others, who are collectively known as Tukulor.)	2.2%
	Subalbe:	Fishermen	5.4%
Nienbe:	Mabube:	Weavers	2.3%
(artisan	Wailube:	Blacksmiths and jewelers	0.5%
castes)	Laobe:	Carvers	0.4%
	Awlube:	Griots, bards and musicians	----%
Ex-slaves:	Macube	(declared free in 1905, 1960, 1970 and 1981)	7.4%

Land holdings were originally based on the facts of conquest and were allocated by the major Torodbe lineages. Any household, regardless of social status, could request and receive unlimited access to rainfed dieri fields. Individual title accrued to the clearer of the land, and was patrilineally inheritable. However, the more valuable walo flood recession lands were mainly kept as communal (diowral) lineage land. Some plots over the years have been given to individuals or families of any social origin, usually as a reward for service, and remain heritable private property. Subalbe fishermen tend to live on the river bank, and have much of the valuable falo land (the steep banks of channels) which is used to grow vegetables with flood recession techniques. The artisan castes, and ex-slaves, however, rarely have primary ownership rights to walo land. The more fortunate are jom jambere, jom jaingol, or jom lewre, which means they have an inalienable use-right subject only to payment of the assakal. Less fortunate are the samba remorou, whose use-right is secure, but subject to sharecropping agreements, and the jom jalo, who sharecrop on a year to year basis at the pleasure of the land owner.

2Household census of the fifteen main villages, conducted by Tidiane Ngaidé, March-April 1987.

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There are no individual large land owners, as private holdings are fragmented. Families and lineages reallocate their commonly owned diowre land each year according to the amount flooded and the number and seniority of households present. In 1970-71 when the last good flood came, L(ricollais estimated that 6094 farmers cultivated 2000 ha. of walo land in Hebeyabe area, the western basin of the northern plain, an average of .25 ha. per farmer.3 In latter years there have been 700 or less hectares cultivated in that area, which would leave only 8 ares or less per family. On the eastern half of the basin, the heart of Nerenabe territory, in the optimum 1970-71 year 3285 ha. were cultivated by 4373 farmers, an average of 0.75 ha. apiece. The area flooded there has been 1500 ha. or less since then, which leaves only 34 ares per family in an average year.

With so little land available, the insistence of farmers that there be no "land reform" is understandable. The fact that some families have no walo land is regrettable, but no economic or social purpose would be accomplished by trying to redistribute by force the small walo fields held by existing owners. The best hope for land distribution to the landpoor is if pumped irrigation opens up relatively vast fonds lands a decade hence. Over 10,000 ha. of the plain are irrigable, but only a quarter of that has been flood recession land in the last 16 years. If cooperative water management proves successful for flood recession agriculture, the transition to pumped irrigation should be much easier. If the GIRM is willing to make a commitment not to touch the communal tenure on Dirol plain walo lands, it could do so in exchange for a commitment from lineage heads to provide for land allocation to poor families if and when pumped irrigation opens up new lands. In the meantime, the landpoor class will have the time to consolidate political gains that they are currently making.

The authority of the lineage heads is already under challenge by the recently created elected quasi-party organization called the SEM (Structure de base pour l'Education des masses). The elected representatives in Bagodine are from land-poor families. Whenever project matters are discussed there is a quarrel over who can speak for the people. Government

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3This should be interpreted as a farm household averaging 5 to 6 persons. The average household size for Dirol Plain villages in the 1977 census was 5.9 persons; in Ngaide's 1987 count the average for selected villages was 5.3 persons. Wives and children usually help the head of household with specific tasks if he is present, and are not considered independent cultivators. This was evident from the raw questionnaires of the agricultural census, and is somewhat reflected in Table 6.2.

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orders are that the SEM zone representative is local spokesman, but when the discussion turns to land development, the lineage heads take the floor. In most other villages, the SEM representatives and traditional chiefs are either the same, or relatives, or otherwise cooperate with one another better than in Bagodine.

Moor social structure distinguished between:
--Beidane (White Moors), who were subdivided into warrior and clerical tribes, of Arab and Berber origin,
--Haratine (Black Moors), who were collectively subject to Beidani families, but were distinguished from
--Abid, individually owned slaves.

The three haratine villages on the plain, Debayel Doubel, Boubou Aoudi, and Hijaj were all settled by tribes liberated before moving there, and thus there are no beidani claiming any share of their crop. The few beidani living on the plain are traders or clerics with no land claims. Two villages, however, Debayel-Doubel and Boubou Aoudi have been in constant conflict with the Pulaar Hebeyabe of Bagodine. The founders of Debayel Doubel settled on the plain in the latter nineteenth century, in a period when harassment by Brakna Moor warriors had driven the Hebeyabe to seek refuge on the Senegalese bank. When raiding stopped due to the colonial conquest, the Hebeyabe came back and gradually reclaimed the land the haratine had claimed (Park, et al., 1986). The power struggle has continued until the present. Haratine often share-crop or rent land from the Poulaar. However, certain groups of Haratine have enough walo land to rent portions of it to Poulaar farmers. Both men and women of the haratine do paid labor for the Pulaar. Their bargaining power on the labor market has eroded in recent years with the influx of desperately poor Moors, of haratine and freed slave origin, coming down from the north due to the drought. The haratine function as independent households, with a village chief and elders, but no lineage organization comparable to that of the Pulaar.

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SOCIAL ORGANIZATION

There are two groups that are interested by the project: the Pulaar and the Maures.

I- THE PULAAR SOCIAL ORGANIZATION.

The Pulaar group is composed of three subgroups:the Nerenabe, the Hebiyabe, and the Irlabe. As all the other Pulaar societies these subgroups are a caste system which results generally in an inegalitarian access to the means of production (mainly land) and narrow control of the decision making process for the artisans (Nienbe) and the slaves (maccube) castes. This group counts for 80% of the total households living in the eighteen villages interested by the Dirol plain project.

1. CASTE SYSTEM.

In general, the Pulaar society living in the Dirol plain can be divided in to threee main classes: the nobles (Rimbe), the artisans (Nienbe), and the slaves (Jiabe).

1.1) The nobles (Rimbe). This class composed of four castes (Torobe, Jawanbe, Cebbe, and Subalbe) constitutes the nobilityof the Pulaar society. They control almostall the means of production (land) and take all the decision making at the expenses of the other castes. The table below shows the different activities of these castes in the Pulaar society. The majority of the population living interested by the Dirol plain project is from this class. Indeed, 2847 households which represents 68% of the total polpulation is from this class. If we just consider the Pulaar interested by the project, this class represents 86% of the total Pulaar households.

1.2) The artisans (Nienbe). This class includes all the artisan castes. They are free men but as they depend on the nobles to have access to the land in many cases, they are considered as lower in the society. Among the 18 villages interested by the project, we found that only 135 households are from this caste which represents only 3% of the total households and only 4% of d all the Pulaar households. The important finding is that the major artisan caste living in the Dirol plain is the caste of the weavers (Mabube). These Mabube living essentially in Mbahe and Niabina, represent 71% of all the artisan households. These weavers are also land owners and they participe in the decision making of the society. So given the fact that allthe 71% of theartsan caste owned land, it is very diffcult to assert in th region an narrow accesss to land for these polpulation

The important thing to notice while consulting the table (...) is the absence of two artisan castes in the whole plain, the leather workers (Sakkebe) and the griots (Awlube). This is very important because it is different from the other pulaaqr societies living in the Senegal river basin.

1.3) The slaves (Jiabe). This class of slaves is considered to be at the bottom of the society. Traditionnally they served their masters both nobles and artisans. What maintain them in this position is the subjectif aspect of the caste system because even if it happens that slave buy himself back and become freed-slave (galunke) he is still seen as someone who is low. Usually, tghey do not own land and they are people ho have lesser ownership rights. In the Dirol plain, there 314 households of freed slaves (galunkobe) which represents 8% of the total households and 10% of the Pulaar households.

The caste system is a very rigide system where each individual stays in his caste of birth. An individual may have a new status but he will remain always in his caste. The slave for example, even when freed stays in the same caste of the slaves but have a new status which differs h9m from the other people in his caste. However, in general, the caste system that we find in the Dirol plain is not that constraining because the proportion of the lower caste is very small 11% of the total households among which 3% are land owners.

2. Leggi/leniol.

The leniol (lineage or groups having the same history, origine or being in the same organization) is a very important segment of the Pulaar society. Every individual indifies himself into a leniol. This determine his status and at the same time his importance whitin society. The leniol in the Dirol plain can be seen into three different levels: (1) Leniol a composition of different lineages. (2) Leniol as a lineage. and (3) leniol as defining once origin.

2.1 Leniol as a composition of different lineages.

This type of groups are very important in the Dirol plain because they represent 64% of the total households. Also, these groups are the one that control the land in the Dirol plain and are organized into a omplex system of management of both land and labor. They can also be reduced to essentvially two main groups: the Nerenabe. and the Hebiyabe.

2.1.1 The Nerenabe.

The Nerenabe group (17% of the total households) includes three groups : Basbe. Wantianbe. and Hirnangue-Nere. These groups re composed of different lineages. Among the Basbe for example we find four lineages: Kanebaebe. Ndiayebe. Sorobe. and the Bababe. These different lineages constitute a separate group because they have the same share ("kambe dendi feccere"). meaning that they got the same lands that they own together.

These three groups eventhough each of them have different land claims, they have only one type of structure. Hence, the oldset person of those groups does not heve a real power because he is just elected because of his age.

The real political power among the Nerenabe is the Elimane who is elected by these three groups. He is not a religious figure like the Elimane among the Bonenabe and Pourinabe in the Boghe area(1). His function is just based in trust and when the people who elected him feel that the Elimane is not conducting properly his duties, he is dismissed of his title of Elimane. The Elimane play a secondary role because his function is just to collect taxes and resolve land tenure conflicts. There are two lineages among the Nerenabe from which the Elimane is elected and those are the Diagobe and the Ndiayebe. Recently, the Elimane is loosing out his role because of the drought and the introduction of the SEM (Structures d'Education des Masses)(2). This was worsened because of the division of all the commonly owned lands into family holdings. It is on those fields that the Elimane used to collect land rents.

The Nerenabe have also a Jagaraf who assisted the Elimane in land taxes collection. He is from the Cebbe caste and his election is based on trust. As tghe Elimane, the Jagaraf can be dismissed if he does not carry well his activities.

So to conserve their importance whithin society, they are involved in the SEM. That is why there is no conflicts between the traditional institutions of the Nerenabe and the SEM because the former were able to adjust to the newly created structures. In other cases for example, the transition aws very difficult (see example of Bagodine).

2.1.2 The Hebbiyabe. This group is very important in the Dirol plain because it represents 43% of the total households. This group is composed of nine leniol defined as a composition of different lineages: Dekle, Harlaw, Maloum, Thiaskone Diamel, THiaskone Perlel, Niokoul, Fokol, Boguel, Haatar.

There are three leggi (sing:leniol), Dekle, Harlaw, and Maloum residing in Bagodine eseentially who control all the different lineages among the Hebiyabe. Each of these groups have their own lands and have a taxe collector. However, the Satigui

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1. Tidiane Ngaido: Socio-economic implications of irrigation systems in Mauritania: The Boghe and Foum-Gleita irrigation projects. December 1986. 1

2. The "Structures d'Education des Masses" were implemnted by the Military regime rto carry out the policies of the Mauritanian government. These structures were meant to replace the traditional political and social organizations because the State felt that those traditional institutions were hindereing the development process of Mauritania. They were conceived min away that the lower levels of the societies can formulate their needs and at the same time participate on the different decisions undertaken by the government.

Hebbiyabe (tax collector for the Hebbiyabe) is the major political power. He is chosen from Maloum or Harlaw. The Satigui as among the Nerenabe is assisted by a Jagaraf who himself appoint. The Deklenabe (lineages of Dekle) are the one who elect the Satigui Hebbiyabe and at the same time control his work. In the case where the Satigui Hebiyabe does not correctly perform his duties he is dismissed and at that time it is the Mawdo Dekle (oldest person of Dekle who is the chief of the Dekle village) who replaces the the Satigui Hebbiyabe. That is why we find among the Hebbiyabe two Satigui:Satigui Hebbiyabe and Satigui Dekle. They do not exist at the same period because the latter replace only the former so that land rents can be collected before another Satigui Hebbiyabe is elected.

2.2 Leniol as lineage.
These are the groups that take the patronym of a lineage for identification:sisibe, Bababe, Lidoube, etc... They represent 7% of the total population. The table (...) shows that thosetypes of lineages are essentially found i three villages, two fishermen villages (Roufi-Awdi and Dawalel) and Dioke. These lineages are not very important in the decision making because they do not have an organization like the previous type of Leniol.

2.3 Leniol as origine identification.
These types of groups represents around 8% of the total households and are located essentially in one village,Niabina. Those are the group called Irlabe. It is a concentration of different people with diffent origin. They are not organized as the previous ones and at the same time they only have secondary ownership rights on the lands controlled by the Hebbiyabe and the Nerenabe. They depends on these groups and as they ownership right is secondary, they do not have a structure like among the other grioups to levy taxes. All the power structure is confined at the household level.

The leniol is very important at the macro level to understand how the society function as a whole. However, for the project, it is not the leniol which is the primary target but the households on those lineages. One important aspect of the Pulaar society is the family (galle). The galle is the most important unit because it is found under different forms according to the relationship between galle and land. This determine the relations between members of the same family and betwen members of that family and other families.

3. The family or Galle.
The Galle has different features: a) it can include different households (foyre/Poyye), and (b) the Galle can represent a single household. These features of the Galle result from the relation between the Galle and it land holdings and the form underwhich the land is held (common lands and privat lands). Thus we can distinguish two types of Galle: theland owning Galle and the landless Galle.

3.1 The landowning Galle. The landowning families whether nuclear or composed of many households constitute the basis of the leniol because they are the one who have claim to land at at the same time participate in all the activities of the society. However, given the fact that in some cases the land holding is divided, we will distinguish two levels of galle: 1) Galle with common lands and (2) Galle without common lands.

3.1.1 The landowning Galle with common lands.
Among these families, the lands are commonly owned by the different members of the family. The important feature of thios type of organization is the fact that the land is under the authority of the olsdest person of the family called Mawdo. The Mawdo is the gardian of the family holdings. He is the only one who can rent out the land. Each year, depending on the flood level, the Mawdo reallocates land to the different heads of households. This give a certain security to the different members of the family. In exchange, each member of the family who cultivate gives his Assakal to the Mawdo of the Galle. He resolve all the problems in the family and is the representant of the family at the lineage level.

3.1.2 The landowning Galle without common lands.
In this case, the household is the important because it holds his own share of land and have its own decision making. As the lands are divided betwen different right holders, the Mawdo of the Galle does not play anymore his allocative role. THis usually increases the risk of the farmers of being landshort in low flood levels. To avoid that, the division of land goes only to one step which is the division between half brothers. Brothers with the same mother hold their lands together. In general, this is very rare because the farmers says that"any division of land between brothers leads to the division of the blood relations and an introduction of the feeling of competition." The important fearture is that the Mawdo of this Type of Galle does not receive Assakal and cannot rent out other family members' fields. The head of household can give his Assakal to whoever he wants.

3.2 The landless Galle.
Among the landless Galle, each head of household has his own decision making because he finds land undependantly from the Mawdo. In certain cases, different members have different fields and pay different land rents. In effect, the Mawdo of the Galle is reduced to a social person whose primary role is to help sovially the different members of the galle. In general, this type of household do not leave in the same compound. They try to be independant from one another. This the case for some artisants and slaves castes who tend more to individualization.

II- SOCIAL ORGANIZATION AMONG THE MAURES.

This group which represents 19% of the total households is

composed of two groups: the Beidanes (Arabo-Berber type) and the Haratines (black freed slaves of the Beidanes).
The main social organization that we find in this region is the tribe. We count in this region three tribes: Toumoudeck, Hijaj, and Touabir. The important thing to kep in mind is that the Haratines are the majority of the Maures living in this region. Yhey represent 98% of the total maure households. Other than the four beidane households living in the villages of Boubou Awdi and Debaye Doubel, the other Beidanes found in the Dirol plain are there as merchants.

The Haratine social system is more egalitarian than the Pulaars. Because they are from the same origin, there is no castes or distinction among them. The cpoheion is very important among the Haratines.

LAND TENURE SYSTEM AMONG THE POPULATION IN THE DIROL PLAIN.

I DEFINITION OF OWNERSHIP RIGHTS.

The definition of land ownership on the Dirol plain is very complex, with many individuals having claims to any given piece of land. This was the result of the historical evolution of the groups that have lived on and claimed rights to those lands over the centuries. To begin to understand the patterns of ownership rights, we distinguish common ownership (Diowre) and individual ownership. We must also separate land inherited from the father's side and those received from the mother's side (yumam ndewmi).

a) Private ownership rights:

The private ownership right arise in two situations. If a person clears a piece of land, he is entitled to this lan. This is the case on the Dieri lands where ownership rights are solely based on the capacity of the claimant to develop the land. The second type of private ownership right is obtained through inheritance. This is the case of the Walo lands. Private individual ownership rights on the walo lands are very rare though the common property of

on family (Galle) or lineage (Leniol) can be seen from the outeside as the private property of that Galle or that Leniol. All Walo lands are already owned. A person can have private ownership only on fields inherited from his father. However this presupposes that the father had private ownership right. Inherited land of this type is usually divided among all surviving heirs.

a) Common ownership rights (Diowre):

Diowre lands are commonly owned by all members of a Galle, a Leniol, or other groups because of the role this group played in getting the lands. This is why it is important to distinguish two level of common ownership: (1) common lands of the family and (2) the common lands of the lineage.

b.1) The Diowre of the Galle.

The Diowre land of the Galle are those lands held by members of the Galle. As the Galle is composed of several nuclear families (Foyre), the heads of households have only use rights on those lands. They cannot alienate those lands. The oldest person of the Galle (Mawdo Galle) is the only person who can rent(Cioggu), lend (Dokal) the common lands. He also grants the usufruct rights to the different foyre heads of his Galle each year. This type of organization has several implications:

- It avoids the division of family fields into tiny, non viable plots. When small fields occur, they are generally the result of the women asking their share of the land because according to the Muslim religion, women have the right to half of a man's share. So those Yumam-Ndewmi (inherited from the mother) fields are considered too small to be divided, "ene biti, fetiotako." Among the Nerenabe for example, they are run on a system of rotation where the share holders have a right to cultivate the field in one year of several.

- It guaranties the welfare of the unborn by ensuring that all members of a family have access to land. Even if a person happens is born elsewhere, he is still entitled to a piece of land in his family holding. Whenever he expresses his desire to cultivate a field, the Mawdo Galle can grant him one.

- It also strenghens the cohesion among the different family. This aspect will be discussed under social organization.

- It provides a certain flexibility in the distribution of fields because as the level of the flood is very uncertain, there is a shift each year on the amount of walo land that is available to the family. The

system, thereby, gananties to every household a proportional share of land to cultivate.

b.2) The Diowre Leniol.

The Diowre leniol are the lands held by all the different families of the Leniol or lineage. In the case of the Dirol Plain those are the Baiti lands. The4 baiti lands are those landsthat the colonial government took from the population and decided that it should be under the management of the colonial administration. This was currrent practice during El hadj Omar Tall war Jihad (1859). As Elhadj Omar raised a lot of popularity among the Pulaar who went to support him, the lands of those people were considered as Baiti. Besides the Baiti lands, there are no Leniol common lands. These lands are the lands where lesser tenure rights such as the rights of the Samba-Remorou are granted. For example, the Collengal of Sawalelo which is a baiti administratif was cultivated by the Petenabe on the 1900's. The Petenabe had a usufruct rights on those fields and they paid the different tithes paid by Samba -Remorou (This will be discussed later.) (lettre du 22 mars 1932. No 15 cf/ terrain de Savalelo)

However, among the Nerenabe and the Hatarnabe, the Baiti lands are already divided between the different lineages. There still some Diowre lands but only at the Galle level as in the case of the Diagobe of Ali Djika.

Nevertheless, the Diowre leniol is a common form of land holding among the Hebiyabe where the baiti lands constitutes the majority of their holdings.

II LAND RIGHTS IN THE DIROL PLAIN.

In general we can distinguish three types of land rights in this region: (1) Primary ownership right, (2) Secondary ownership right, and (3) lesser tenure rights.

1) Primary ownership right:

Primary ownership rights are granted to freeborn families (galle) which are members of the lineage (leniol) that controls the land. The individual with primary ownership rights are those considered as landowners (Jom-leydi) because they do not pay any fees for the use of the land. In general, in families with Diowre lands, the differents heads of households (foyre) give 1/10 of their production (the assakal) to the oldest head member of the galle (Mawdo Galle). But if the lands are not Diowre, then the primary rights holder does not give the Assakal to the Mawdo. In the latter case the Assakal is given to a responsable person chosen by the holder of the primary rights. Thus, the Assakal is considered as a religious contribution and not as a land tax.

2) Secondary ownership right:

Secondary ownership rights are granted to families (galle) by a Lenïol other than their own that holds primary ownership rights on lands they wish to farm. The secondary right holder, (Jom-Jambere, Jom-Jeingol, and Jom-lewre), is subjected to the payment of the Assakal (1/10 of the production) to the lineage which granted him that right. In the case of the Hebiyabe, all the secondary right holders give their Assakal to the Satigui of the Hebiyabe. These secondary right holders cannot be pushed out of their lands; but, at the same, they cannot alienate the land by granting lesser tenure rights in their turn. Secondary ownership rights are inheritable. Lately, with the drought and consequent poverty in the villages, the secondary rights holders are beginning to be considered as primary ownership rights holders because they have not paid their Assakal and are still cultivating their fields.

These two types of ownership rights are the most important ones and may sometimes lead to confusion. Indeed, there are cases where the secondary right holder can reject all the claims of the primary right holder by not giving Assakal, as happened during the drought. This might be the reason why these secondary rights are not often granted to houscholds at this time.

3) Lesser ownership rights:

We can distinguish two principle types of lesser ownership rights: (a) Samba-Remorou, and (b) Jom-jalo.

a.3) The Samba-Remorou.

The Samba-Remorou are contract farmers. They do not have either primary ownership right or secondary ownership rights. They can be considered as people with usufruct rights becasue they are subject to the payment of different land rents: Assakal (1/10 of the production), Ndioldi (access fee on the walo land), and Ciottigu (repurchase). An interesting case of the Samba-remorou is the case of the Toumoudeck Haratine who claim the ownership of the collengal Savalelo (on the Eastern part of the plain, near Niabina).

The Haratines were considered as Samba remorou by the Hebbiyabe but were not subject to the payment of the Ndioldi and the Ciottigu. Thus, the issue of ownership arose between them. The letter dated March 22 1932 from the commandant de cercle du Brakna to the Governor of Mauritania (No 15) confirmed that the Hebiyabe had owned this land, even before 1900. The problem arose from the fact that as the haratines did not pay the Ndioldi and the ciottigu and thus could be assimilated to the status of those who have primary ownership rights.

The conflict sprang from the fact that the Haratines felt

they had secondary ownership right becase they paid only the Assakal. Tis feeeling is reinforced by Haratine tradition. The Haratines paid the Achour or the Bah (1/10 of the production) only to their former Beidane masters for protection and not for property rights in land. Thus, since they are not subject to the payment of the other land rents that the Samba_remorou must pay, the Haratines can be assimilated to the category of secondary right holders (Jom-Jambere or Jom-Jeingol).

Lately, the Samba-Remorou have paid fewer land rents to the owners of the fields they work. The different Samba-Remorou I interwieved this year affirmed that they are paying only the Assakal to the owners of the fields thay are cultivating.

b.3) Sharecroppers (Jom-Jalo).

Jom-Jalo means "the owner of the hoe." He is an individidual who does not own land but has access to land only through share-cropping contracts. He is not subject to the payment of the different land rents paid by the Samba-Remorou because he does not have any security of tenure. His contract is for one year and can be terminated by the landowner if the latter feels that the Jom-Jalo is not working the field properly. However, the Jom-Jalo have a portion of the field called Botari which is his food if the land owner does not provide him food.

The status of Jom-Jalo is not specific to any caste or group of people. It includes all those who lack sufficient land to cultivate or whose feilds were not adequately flooded. However, members of the lower castes of the society are often forced to share-crop fields.

The case of the Toumoudeck Haratines considered as Jom-Jalo is very original because from the survey I carried out, I found that some Toumoudeck Haratines are renting out their fields to the people of Niabina under a specific type of contract Cioggu for a year or two(see below). When they plant their rainfed (Dieri) fields, they sometimes run out of cash to feed their families. In order to alleviate the problem, they rent their walo field in exchange for cash.

III TYPES OF CONTRACTS.

Pulaar society has a complex system of contracts to control access to land, labor availability, and production. These types of contract only give access to land to the sharecropper(Jom-Jalo), whether he is a landless person or a land-short person. The type contract clause is determined by the productivity or value of land, and by social relations and labor availability. They help

to reinforce social relations and at the same time preserve traditional ownership rights.

1) Rem-petien or "cultivate and we share."

This contract is widely used between the Pulaar and the haratines and often landless people of this region. This contract takes different forms:

a.1.) Didabal or Bi-nuss or Half. Under this contract, the sharecropper will give half of his production to the land owner less a part of the field considered as his food reserve (Botari). This type of contract usually arises when there is shortage of cultivable land. The contract sometimes includes providing a day or two of free labor to the owner of the field (doftal). This type of contract prevails in the Nerenabe lands located in the eastern part of their holdings (Funange-Nere). These are fertile lands and are not subject to predators. The western part of their holdings (Hirnange-Nere) is located near Kanyadi's forest reserve which endangers the crops even though the land is fertile. The prevailing form of contract is the Tatabal (see below) because there is a high risk of crp losses by birds and animals.

b.1) Tatabal or one third. Under this contract the sharecropper will give to the land owner one third of the harverst. In this case the land owner does not provide

inputs, nor the Botari, but does get Assakal from the field.

c.1) Nayabal or one fourth. Under this contract, the sharecropper will give to the land owner one fourth of his production and the Assakal.

d.1) Joyabal or one fifth. Under this contract, the sharecropper will give to the landlord one fifth of his production.

The latter three types of arrangements require from the sharecropper some days of work on the landowner's field. They are dissapearing in the Dirol plain because of the shortage of walo land.

2) Loubal or loan.

In this case, the land owner loans his field to someone for a definite period, which usually has a limit of five years. The person who receives this type of contract must pay the Assakal and the contract can be terminated in any moment. After five years, the contract has to be renewed so that the landlord can reaffirm his ownership right.

3) Dokal or gift.

In this case, the landowner gives the field to someone to cultivate for a year. This type of contract arises when

the landowner cannot farm the field and one of his relatives does not have a field. The latter will give Assakal to the land owner.

4) Cioggu or rent.

In this type of contract, the landowner evaluates the productivity of the field and sets an annual price. For example, the Haratines in Debaye Doubel said that a field that can be planted with 4 kgs of sorghum seed can be sold at 1000 UM. This also depends on the availability of land and the relations between the landowner and the buyer. This is a one or two years contract.

5) Rem-Ita-Guie or cultivate and take out the thorns.

This type of contract arise when a field is left fallow for some years and has become overgrown with weeds. To prevent another person from clearing the land and claiming secondary ownership right (Jom-Jambere, Jom-Jeingol), the landowner leases the field to a farmer for a certain amount of time which can be up to 5-7 years. The contracter gives only the Assakal each year to the owner of the field.

6) Rem-Nawa or cultivate and take.

This is a lesser form of Dokal. It only arises on Walo land because of a labor shortage. The landowner can give the field to a person to cultivate for that year free of

charge. This done because the land owner does want to leave the field idle.

7) Guessa-Dawol (field of work).

This is a very rare type of contract which consists of a field given in exchange for work days. The land owner will delimit a field for the sharecropper who will, in return, work on the land owner's fields. The number of days that he will work on the land owner's field depends on the quality of the land and the size of the field. The farmers I interviewed said that this type of contract does not exist anymore due to the land shortage and to the drought.

These different types of contracts are the mechanisms by which the landowners were able to control their land and at the same time exploit the availability of labor. This is a type of risk aversion technique where in every type of situation there are mecanisms to encourage maximal production.

IV LAND RENTS.

There are essentially four types of land rents:

1) Assakal or one tenth. This tithe is paid by almost

all the farmers. The heads of the nuclear families (foyre) give the Assakal to their household (Galle) head. The Secondary rights holders give Assakal to the primary right holders. The Samba-remorou pays the Assakal as well as other land rents. The sharecroppers give Assakal to the owner of the field that they are cultivating.

2) Ndioldi or access fee. This fee is only paid by the Samba-Remorou. If the Samba-Remorou fails to give the Ndioldi, the owner can take back the field and his user right.

3) Ciottigu or repurchase. This a type of licence to cultivate. Indeed, when the Samba-Remorou dies, his heirs have to pay the Ciottigu in order to be able to use the field. In a sense they purchase the user rights on the field left by their father. The ciottigu is a one time payment.

4) Ndodi or contribution. This is a fee of contribution of all the Samba-Remorou to support the election of one of the Collengal authorities (see the part in the social organization). Indeed, as some of the functions like the Satigui are not inherited but elected, the Ndodi helps to support his election. And as the relations between the Samba -Remorou and the Collengal authorities is very important, the Samba-remorou do their best to heve their man elected.

THE MRVDP AND LAND TENURE

The aim of the MRVDP is to construct a floodgate capable of reducing the risks inherent to recessional agriculture, by extending the duration of the Senegal River's annual inundation to an agronomically optimal period of 40 to 50 days in areas where water retention is inadequate in most years. This approach to the improvement of recessional agriculture fits nicely with the farming system of the people of the Dirol Plain because their traditional land tenure system is based on risk aversion. The base is fixed and has already been appropriated by specific lineages, sub-lineages and families. Each piece of land has its owners. So to adjust to this constraint of limited land combined with uncertainty about the level of the annual Senegal River flood, the traditional system maintains a good deal of flexibility as it manages land, labor, and agro-pastoral production.

1. Flexibility in the traditional system.

The traditional Pulaar land tenure system manages land, labor, and agro-pastoral production by creating a complex system of rights determining access to land, mechanisms for labor mobilization, and for annual redistribution of walo fields. It avoids leaving any optimally flooded area fallow, and defines the interactions between herding and farming.

1.1 Mechanisms to control Interactions between herding and farming.

Herders and farmers are often in conflict because they compete to use the same land for different purposes. The herder wants access to water and land on which to graze his cattle. The farmer, once he cultivates a piece of land, considers it as his property and does not want anybody to destroy his field. However, in Pulaar society, cattle herding is a common practice. Among the Haratine Moors of the Dirol Plain, it is quite rare.

Most farmers exploit both fields and herds as integrated activities, and there are traditional mechanism to control the interaction between them. The most important of these is called Hadde. The Hadde is a custom which defines a period of time during which cattle are not allowed on or around cultivated fields. This period extends from planting to harvesting. If a herder fails to respect the rights of the farmer at this time, the farmer can seize his animals. He must then pay a fine to get them back. This system is still used in the villages of the Dirol

HADDE FINES

Cattle	100UM/Head
Sheep and goats	200UM/Herd
Camel	400UM/Camel
Donkey	50UM/Donkey

Once the Hadde period is over, the fields become grazing land. All the herders can have access to the fields and crop residues without paying anything. Customarily, the herders gave a milk cow to the head of the land-owning unit on whose lands his herd was grazing.

To further minimize the possibilties of conflict, the herders of the Dirol Plain have chosen to live in Dieri villages like Tampidaro, Belel Gawde, Athene, and Lewe, all of which are removed from the walo lands. However, it is important to note that most of the people living in those villages are walo landowners who migrated only because of their cattle. They come back during the recessional season to cultivate their fields.

The introduction of new institutions that have the power to decide when to harvest and when the cattle should enter the fields can disturb the relations between herders and farmers. For example, there is an animosity in this region against camel herding because GIRM administrative authorities sometimes try to dictate when the farmers should harvest. Occasionally, they let the camels in even before the fields are ripe. Farmers whose fields have ripened late or who have not mustered sufficient labor for a quick harvest may see their crop eaten.

1.2 Mechanisms for labor mobilization and production control.

The Pulaar have a set of customary rules which they use to mobilize labor and to ensure maximal production from their fields. These rules evolve around setting the Tiwande, the date at which begins the harvest period.

1.2.1 Labor mobilization: hen the proper time comes, the lineage or extended family leaders make an announcement that on a certain date all the fields will be havested. As this will be a time of high labor demand, all the farmers can prepare and mobilize the necessary labor for the harvest. At this time, Haratines and other groups from other regions come to seek work on the Dirol Plain. The Tiwande was a very effective mechanism because it signalled the end of the Hadde (field protection time). Soon the cattle would enter the fields and eat whatever the late harvesters left behind.

1.2.2 Production control: The Tiwande is also used as a device

to share production risks among all the farmers in a given area. Without the Tiwande, any farmer could harvest whenever he wanted to do so. He would then no longer have to help his colleagues to defend the fields against birds and predators, including wandering herds of domestic animals. Thus, to allow those farmers whose fields could not be planted early because of flood conditions or labor shortage planters to feed themselves, the Tiwande is set when all the fields are ripe This assures good results for everyone. Finally, the Tiwandepermits the lineage and household heads who act as collectors of land use fees to observe the production and levy their taxes fairly.

2. Redistribution and disperion of fields as risk management devices.

2.1 Redistribution.

Redistribution of walo fields is done at the level of the lineage or sub-lineage and at that of the extended family, to assure a certain margin of security to all land rights holders if confronted with the problem of low or high floods.

- At the lineage level, the land management authorities (Satigui among the Hebbiyabe and Elimane among the Nerenabe) redistribute land to the lesser ownership rights holders (Samba-Remorou) on the commonly owned lnd that was inundated optimally. This assures the lesser ownership rights holders of a field to cultivate even during low flood years.

- At the extended family (Galle) level, it is the oldest person of the Galle (Mawdo Galle) who redistributes land each year to the household members. This is the case only among families whose lands are commonly owned. If the land is already divided into individually held private plots, the farmers do not benefit from redistribution at the family level. However, at the lineage level he can have access to land as a sharecropper.

2.2 Dispersion.

The farmers of the Dirol plain have their land holdings scattered on lands of various types and elevations. This dimishes the risk of them being landless or land short during low or high flood seasons. The dispersion assures the farmer of having a field to cultivate somewhere, whatever the flood level in any given year.

3. Access to land through leser tenure rights.

Lesser right-holders can have access to fields even during periods of drought. During the survey, the Haratines of Debaye Doubel said that it was possible to get a field that produces

around 90 mouds (360 kgs) for a fee of 900 UM. The farmer thus can earn around 7560 UM while paying only 900 UM. The lesser right-holders can even rent out their land and get another, cheaper field to cultivate. The Tmoudeck Haratines have done this in the past.

These different mechanism built into the traditional system are not in contradiction with the goals and methods of the MRVDP. Rather they have contributed positively to the project's conception and design. Moreover, using locally internalized concepts is far more effective than imposing something unknown. This will permit the project to avoid many social and tenure problems, as well as the infrastructure maintenance problems that have plagued agricultural development projects in Mauritania in the past. Adopting the strategy of making the beneficiaries responsible for the project and at the same time using their own mechanisms of control will permit the people who are implementing the project to see the reactions of the farmers to project activities and thus adapt their implementation tactics to those reactions.

How effectively can villagers organize themselves to manage water and maintain water-control structures? Can traditional communal land tenure retain its economic viability?

At the household and up to the lineage level the social organization on the plain is far more effective and better suited to organize land, labor and water resources than on the big pumped irrigation projects. The farmers already are experts at flood recession agriculture, and will be able to quickly evaluate and adopt viable research and extension advice. The annual reallocation of land prevents fragmentation, allows plots for all households present, and precludes absentee landlordship. It also reinforces family solidarity and provides for the welfare of the unborn. Discipline is enforced in the agricultural calendar. Walo fields are not left uncultivated, both because the land is too valuable to leave unproductive and because a neglected field might attract pests. At the farm level, this project is far simpler and more socially viable than pumped irrigation schemes that require farmers to organize into cooperative work groups, use unfamiliar techniques and crops, and manage hitherto unknown sums of cash.

It will be a challenge, however, to work out an overall water management authority responsible for operating and maintaining the structures that are built. The problem has been posed by the design team to villagers, and they are considering how they should organize themselves. Since land ownership marks the distinction between potential primary beneficiaries and secondary beneficiaries, the financial responsibility for maintenance should logically be based primarily on the extent to which a family owns lands that benefit from improved flooding. Yet this would require land survey, registration and assessment procedures that are too complex and expensive to be justified for the project. It would be far easier to identify those responsible if everyone who cultivated in a given year had to contribute. If this solution is adopted, a preliminary base-line study of land rent and share-cropping should be conducted, and a follow-up study five to seven years later should evaluate the equity impact of the project top make sure that share-croppers are not absorbing an unfair portion of costs.

Legal, bureaucratic, accounting and banking procedures will require technical assistance, as they are unfamiliar and cumbersome (e.g. it takes a day's trip by charette to go to the bank in Kaedi, or contact the local SONADER office). If it is technically feasible to allocate responsibility for operating and maintenance costs between the natural basins of the plain, this would probably simplify cooperation between villages, as the

lineage organizations tend to oversee individual basins already.

Technical and economic considerations will largely determine the effectiveness of local organization. The higher the maintenance costs relative to farm returns, the harder it will be. This implies that infrastructure should ideally start with the minimum flood retention gate, and little or no diking, so that total initial costs are low. We estimated that a $5 million project with major dike structures would have annual operating costs of 2 to 5%, which makes $100,000 to $250,000. On the other hand the Dirol Creek floodgate alone would cost less than $750,000 which would bring recurrent costs to a scale sustainable by local inhabitants. Diking would serve primarily to protect future pump-irrigated projects on the plain, which the major lineages are now opposing. Unless the economics of the factors of production changes in the meantime, the recurrent costs of future pumped irrigation would have to be subsidized.

The approach of project developers will also be critical to the success of local management. It takes many months to organize a cooperative, get it legal recognition and work out a modus vivendi with SONADER. If that work begins now, so that local inhabitants form an association capable of being the grantee, or at least participating in the letting of the construction contract, villagers will have a vested interest and a much higher likelihood of continuing maintenance. If, on the other hand, AID procedures, SONADER's prerogatives, the great difficulties of communicating with villages, and the economics of construction delays result in an outside contractor and funding agency building a dam first and then trying to turn it over to locals, the prospects for good water management and infrastructure maintenance are far poorer.

LAND TAX COLLECTION.

The collection of the taxes necessary to maintain the MRVDP floodgate will pose relatively few problems because the farmers already have institutions that are adapted to this task.

Afetr much discussion with the PID team and then among themselves, the farmers of the Dirol plain decided to stay at the family level to collect the maintenance fees. Each field cultivated in family holding will pay a fixed amount, which will be collected by the head of the extended household, and thereafter given to the DPWUA. This innovation is important because as the Laniol authorities are gradually losing their traditional powers because of land disputes among certain lineages, the extended household family offers a sounder basis for this work. Moreover, the aim of the project is not to give back authority to the traditional chiefs but rather to arrive to at a more equitable organization in which the head of the household will retain the decision-making power for his family's fields to encourage the adoption of improved practices in the agricultural system.

Using the above system will ease the collection of land taxes, because the farmers will not deal with outside institutions but rather with themselves. This will be an incentive for them to contribute to the maintanance of the floodgate.

The farmers on the Dirol plain will participate in the maintenance of the floodgate. They recognize its value and want to get the most out of their lands, cultivating on them what they want. This will lead them to participate because it is said "Whoever builds a fenge has to maintain it. If not and it happens that is someone else maintains it, then it is that someone who makes the decisions about who comes in."

LABOR AVAILABILITY.

One of the main potential constraints on agricultural development in many parts of the SRB is labor shortage due to high out-migration. The Dirol Plain is also confronted with this pattern of outmigration. However, does this mean that the development of the Dirol Plain will be constrained by lack of labor?

The survey that we conducted in the eighteen villages that cultivate directly on the Dirol plain showed that 40% of the heads of household were not present during the interview period. However, among those 1702 absent heads of household, 1351 heads of household (79.5% of those absent) are in other regions of Mauritania or in Senegal (41.8%). The data show that the people in Sengal are there temporarily doing menial jobs. They have left their families in the villages to which they return during the recessional season to cultivate and assure a certain food security to the household. There seem to be at least 711 heads of household who come back to farm each year.

Moreover, in many cases it is just the heads of households who are gone, leaving other family members behind. Thus, while it seems that there are more than enough people in the villages of the plain to cultivate all available land, we must also investigate the issue of labor quality. This aspect of theproblem will have to be dealt with during the PP phase to determine the age structure of the population in the villages.

In conclusion there seems to be no labor constraint but rather there may be periodic labor shortages at key periods in the agricultutral cycle. However, land shortage is a much more crucial issue. During these years of drought many farmers who have the bulk of their lands above 10 meters have not been able to cultivate. For example, among the 223 land-owning households of the village of Dawalel, only four farmers had access to walo land in 1986. This usual in many villages in the SRB.

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WOMEN AND THE MRVDP

More and more, women are playing an important role in the destinity of the SRB. The males are going away and all the power of decision within households is transfered to women who sustain their families and help their migrant husbands.

In many Pulaar areas, women rarely have access to land. On the Dirol Plain, however, numerous people claim ownership of land through inheritance from their mother (Yumam-ndewmi). Women among the Hebbiyabe, Nerensbe, Irlabe, and Tmoudek inherit land and can farm their own share if they want to.

These fields inherited from the mother pose certain problems because they tend to be fragmented into small plots that are not economically viable. To avoid this fragmentation, the different rights holders use the field in a system of one year rotations. These fields are important. For example, all the Irlabe living in the village of Niabina, have inherited their land rights through their mothers.

In recent years, women in this region have begun involved village gardening projects, which provide a useful complement to their family diet as well as a source of income. These village garden are run by women and are running very well.

Table 6.1. List of Villages Traditionally Using the Dirol Plain

Name	Location	Houshlds '77	Houshlds '87	Pop. 1977	Cultiv.	Herders
Farming northern plain:						
Bagoudine	Plain/N	328	474	1843	248	9
Debaye Doubel	Plain/N	145	236	877	221	6
Davalel	RBank/NW	143	223	764	135	1
Feralla	Plain/NW	167	291	1194	278	12
Fonndu	Plain/N	242		1432	305	8
Hameidat	Plain/SW	130		697	116	7
Hijaj	Plain/N	62	187	416	102	13
Mbahe	Plain/NW	183	340	914	164	3
Niabina	Plain/NW	164	278	1043	144	17
Ouloum Hater	Plain/N	73		438	77	15
Roufi Audi	RBank/C	26	62	146	27	2
Mourtogal Gare	Dieri/W	19*		67	18*	
Tempi Daro	Dieri/NW	14		102	16	10
Atene	Dieri/NW	60		323	91	2
Belel Gaoudi	Dieri/NW	63		310	80	24
Boubou Aoudi	Dieri/NW	119		699	156	14
Gourel Thioga	Dieri/NW	39*		161	37*	
Gourel Selle	Dieri/N	20*		167	16*	
Bourgoudouma	Dieri/NW	77*		280	76*	
Diavaldi Boulil	Dieri/NW	70*		283	64*	6*
Lewe Demba Gouro2	Dieri/NW	71		456	81	21
Mbagne	SW Val	312		2081	217	12
Mboto	West Val					
Sintiou AmaduMairam	SenBank					
Farming southern plain:						
Bellinabe	Plain/NE	185		1158	211	4
Dioke-Ndiafane	Plain/NE	133	2444	826	81	8
Nere-Walo	RBank/SE	102	230	661	61	3
Nereyel3	Plain/N	56	105	418	90	4
Ouloum Nere	Plain/N	185	434	1045	213	10
Rindiaou Bellimode	Plain/NE	138		865	83	16
Silla Rindiao	RBank/NE	117		750	101	7
Sintiou Boumaka	RBank/C	103		664	219	4
Gongane	RBank/NE					
Diawout	RBank/SE		14*	37	8*	11*
Dabbe	RBank/SE		180*	602	156*	
Diorbivol Pecheur	SenBank					
Diogvel	SenBank					
Diafane Beltindi	SenBank					
TOTAL 1977 POPULATION				211794		

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Notes to Table 6.1.

1Also called NDiawaldi Manbe, or NDiawaldi Mango.

2Also called Diawaldi Sinketebe

3Also called Nereyel Kognadi

4No figures are available for the villages on the Senegalese bank of the river, nor for two small hamlets on the Mauritanian side.

*Starred household figures are from the 1984 agricultural census; the 1977 figures were not available.

Sources: Thomas K. Park, Glenn Rogers, Tidiane Ngaide, "Preliminary Land Tenure Study of the Dirol Plain," USAID contract Land Tenure Center, University of Wisconsin, Madison, June 1986; Andre Lericollais and Yveline Diallo, Peuplement et cultures de saison seche dans la vallee du Senegal, (Paris: Orstom, 1980). All figures are from the 1977 Population Census except our April 1987 household count.

Phillips/draft inventories/May 1987

Inventory of Transport and Communications Infrastructure

Road travel:1	Distance	Road type	Cost
Bagodine-Mbagne	12 km.	seasonal track	100UM/pers 120UM/100k
		Charette rent	200 UM
Bagodine-Kaidi	23 km.	gravel rd.	200UM/pers 100UM/100k
		Charette rent	200 UM
Bagodine-Boghe	78 km.	gravel road	300UM/pers 100UM/100k
		Charette rent	n.a.
Kaidi-Nouakchott	426 km.	Paved from Boghe on	1250/pers 200/100k
Kaidi-Podor (Sen.)	210 km.	Paved on Sen. side	700UM/pers 150UM/100k
Kaidi-Dakar (Sen.)	700 km.	Paved on Sen. side	1200/pers 100UM/100k

Air travel: Air Mauritania, Wed. NKC-Kaidi-Selibaby=Kaidi-NKC
Fri. NKC-Kaidi-Aioun-Nima-Kaidi-NKC
Kaidi-Nouakchott roundtrip fare: 6460 UM

Air Senegal: Thurs. Dakar-St. Louis-Richard Toll-Podor-Kaidi-Ourosogue/Matam-Bakel and back.
Kaidi-Dakar roundtrip fare 11360 UM.

River: Locally navigable only, canoes important for local travel in flood season.

Communications: Post Office, takes about a week for a letter to Nouakchott. Has a telegraphe and telephone, but both can involve long delays as there is only one line. The Post office also has a telex link with Nouakchott, but cannot send international telexes.

Most projects and local agencies have two-way radio link to Nouakchott headquarters. These include: the Governorate (RAC network), Gendarmerie, Customs Service, FAO, AGRES II, and the Agricultural Inspectorate.

1N.B. Each village profile indicates the number and type of vehicles available, and the distance and cost of local transport.

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Table 6.2

FARM LABOR ON THE DIROL PLAIN: DISTRIBUTION OF TASKS*

Village Persons	Clear	Hoe	Sow	Weed	Pesti-cide	Harvest	Trans-port	Total Person-tasks	Proportion
PREDOMINANTLY PULAAR VILLAGES									
Bagodine									
Men	6	6	6	6	2	6	6	38	47.5%
Women	1	0	6	0	0	4	1	12	15.0%
Sons	1	1	2	3	0	3	3	13	16.3%
Daughters	0	0	1	0	0	1	1	3	3.8%
Relatives	0	0	5	1	0	4	1	11	13.8%
Villagers	0	0	0	0	0	0	3	3	3.8%
Diavaldi Gauli (also called Diavaldi Manguo)									
Men	3	3	3	3	0	3	3	18	34.0%
Women	1	1	3	2	0	3	3	13	24.5%
Sons	2	2	2	2	0	3	3	14	26.4%
Daughters	0	0	0	0	0	0	0	0	0.0%
Relatives	1	1	2	0	0	2	2	8	15.1%
Villagers	0	0	0	0	0	0	0	0	0.0%
Gourel Sele									
Men	4	4	4	4	0	4	4	24	63.2%
Women	0	0	2	1	0	0	0	3	7.9%
Sons	1	1	2	1	0	2	2	9	23.7%
Daughters	0	0	2	0	0	0	0	2	5.3%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%
Fonndu (Fondou)									
Men	5	5	5	5	0	5	5	30	48.4%
Women	1	1	5	1	0	6	6	20	32.3%
Sons	0	0	1	0	0	1	1	3	4.8%
Daughters	0	0	1	0	0	1	1	3	4.8%
Relatives	1	1	1	1	0	1	1	6	9.7%
Villagers	0	0	0	0	0	0	0	0	0.0%
Belel Gaoudi									
Men	6	6	6	6	0	6	6	36	59.0%
Women	1	1	4	2	0	4	4	16	26.2%
Sons	1	1	1	1	0	1	1	6	9.8%
Daughters	0	0	1	0	0	1	1	3	4.9%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%
Ferala									
Men	5	5	5	5	0	5	5	30	41.7%
Women	1	1	6	1	0	5	6	20	35.1%
Sons	1	1	3	1	0	2	3	11	19.3%
Daughters	0	0	3	0	0	2	3	8	14.0%
Relatives	0	0	0	0	0	1	2	3	5.3%
Villagers	0	0	0	0	0	0	0	0	0.0%
Gourel Thiega									
Men	3	3	3	3	0	3	3	18	31.6%
Women	1	1	4	2	0	4	4	16	28.1%
Sons	2	2	3	2	0	3	3	15	26.3%
Daughters	0	0	3	1	0	2	2	8	14.0%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%

Village Persons	Clear	Hoe	Sow	Weed	Pesti-cide	Harvest	Trans-port	Total Person-tasks	Proportion
Diawaldi Sinketebe									
Men	3	3	3	3	0	3	3	18	50.0%
Women	1	1	2	1	0	2	2	9	25.0%
Sons	1	1	1	1	0	1	1	6	16.7%
Daughters	0	0	0	1	0	1	1	3	8.3%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%
SUBTOTAL PULAAR VILLAGES	53	52	101	60	2	95	96	459	
PREDOMINANTLY HARATINE VILLAGES									
Haimdat (Haimedatte)									
Men	5	5	5	5	0	5	5	30	41.7%
Women	1	1	3	1	0	3	3	12	16.7%
Sons	2	3	3	3	0	3	3	17	23.6%
Daughters	0	0	4	0	3	3	3	13	18.1%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%
Boubou Aoudi									
Men	3	5	5	5	0	5	5	28	34.6%
Women	1	1	5	1	0	6	6	20	24.7%
Sons	3	3	3	3	0	3	3	18	22.2%
Daughters	1	1	4	1	0	4	4	15	18.5%
Relatives	0	0	0	0	0	0	0	0	0.0%
Villagers	0	0	0	0	0	0	0	0	0.0%
SUBTOTAL HARATINE VILLAGE	16	19	32	19	3	32	32	153	
TOTAL, ALL VILLAGES	69	71	133	79	5	127	128	612	
TOTAL PERSON TASKS, BY ROLE									Overall Proportion
Men	43	45	45	45	2	45	45	270	44.1%
Women	9	8	40	12	0	37	35	141	23.0%
Sons	14	15	21	17	0	22	23	112	18.3%
Daughters	4	4	22	6	3	18	19	76	12.4%
Relatives	2	2	8	2	0	8	6	28	4.6%
Villagers	0	0	0	0	0	0	3	3	0.5%

*Source: R.I.M., Ministère de l'Agriculture, Statistiques Agricoles, RECENSEMENT AGRICOLE, 1984. N.B. The raw data in the village tables represent the small household sample done in selected villages

Table 6.1. List of Villages Traditionally Using the Dirol Plain

Name	Location	Houshlds '77	Houshlds '87	Pop. 1977	Cultiv.	Herders
Farming northern plain:						
Bagoudine	Plain/N	328	474	1843	248	9
Debaye Doubel	Plain/N	145	236	877	221	6
Davalel	RBank/NW	143	223	764	135	1
Feralla	Plain/NW	167	291	1194	278	12
Fonndu	Plain/N	242		1432	305	8
Hameidat	Plain/SW	130		697	116	7
Hijaj	Plain/N	62	187	416	102	13
Mbahe	Plain/NW	183	340	914	164	3
Niabina	Plain/NW	164	278	1043	144	17
Ouloum Hatar	Plain/N	73		438	77	15
Roufi Audi	RBank/C	26	62	146	27	2
Mourtogal Gare	Dieri/W	19*		67	18*	
Tempi Daro	Dieri/NW	14		102	16	10
Atene	Dieri/NW	60		323	91	2
Belel Gaoudi	Dieri/NW	63		310	80	24
Boubou Aoudi	Dieri/NW	119		699	156	14
Gourel Thioga	Dieri/NW	39*		161	37*	
Gourel Selle	Dieri/N	20*		167	16*	
Bourgoudouma	Dieri/NW	77*		280	76*	
Diavaldi Bouli[1]	Dieri/NW	70*		283	64*	6*
Lewe Demba Gouro[2]	Dieri/NW	71		456	81	21
Mbagne	SW Val	312		2081	217	12
Mboto	West Val					
Sintiou AmaduMairam	SenBank					
Farming southern plain:						
Bellinabe	Plain/NE	185		1158	211	4
Dioke-Ndiafane	Plain/NE	133	2444	826	81	8
Nere-Walo	RBank/SE	102	230	661	61	3
Nereyel[3]	Plain/N	56	105	418	90	4
Ouloum Nere	Plain/N	185	434	1045	213	10
Rindiaou Bellimode	Plain/NE	138		865	83	16
Silla Rindiao	RBank/NE	117		750	101	7
Sintiou Boumaka	RBank/C	103		664	219	4
Gongane	RBank/NE					
Diawout	RBank/SE		14*	37	8*	11*
Dabbe	RBank/SE		180*	602	156*	
Diorbivol Pecheur	SenBank					
Dioguel	SenBank					
Diafane Beltindi	SenBank					
TOTAL 1977 POPULATION		[illegible]		21179[4]		

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Notes to Table 1.

[1]Also called NDiawaldi Manbe, or NDiawaldi Mango.

[2]Also called Diawaldi Sinketebe

[3]Also called Nereyel Kognadi

[4]No figures are available for the villages on the Senegalese bank of the river, nor for two small hamlets on the Mauritanian side.

*Starred household figures are from the 1984 agricultural census; the 1977 figures were not available.

Sources: Thomas K. Park, Glenn Rogers, Tidiane Ngaide, "Preliminary Land Tenure Study of the Dirol Plain," USAID contract Land Tenure Center, University of Wisconsin, Madison, June 1986; Andre Lericollais and Yveline Diallo, Peuplement et cultures de saison seche dans la vallee du Senegal, (Paris: Orstom, 1980). All figures are from the 1977 Population Census except our April 1987 household count.

During the PP Phase, a village profile will be assembled for the 18 principle communities affected by the MRVDP. The sample below is preliminary and incomplete but gives an idea of the usefulness of the information we propose to gather.

Village Profile

Name: Bagodine

		Type & no.:
Infrastructure:	Market every day	
	Shops/artisans (list),	5 genl; 3 blacksmiths; 2 carvers, 1 mechanic/electrician
	Mosques	3
	% families w. radio	
	Wells,	5 public, 10 private (all cement)
	Health facility,	dispensary w. 2 nurses, 1 nurse midwife, but no medicines for 1 yr. Prescriptions are taken to Kaedi.
	School,	1 French, 1 Arabic, 6 grades in each
	Charettes,	many.
	Mot. veh.	1 car, 1 tractor.
	Other:	2 story house for rent (for project?)

Population total: 1977: 1843 No. of households: 328 in 1977, 318 on Ngaide's list in 1987; SEM say 474; land owners claim 600+

Ethnic grps:

Maure:	Beidane	1
	Haratine	1
Wolof:		0
Pulaar:	Liniols:	
	Hebeyabe (Harlaw, 136 hh; Dekle, 123 hh.; Maloum, 59 hh.)	
Castes:		
Freeborn:	Torodbe (Torodo)	229
	Jawannbe (Jawanndo)	25
	Sebbe (Ceddo)	29
	Subalbe(Cubbalo)	0
	Fulbe (Pulo)	2
Nienbe:	Mabube (Mabo)	0
	Wailube(Bailo)	5
	Laobe (Labo)	4

	Awlube (Gaolo)/Wambabe (Bambado)	0
	Sakebe (Sake)	0
Exalave:	Macubbe (Maccudo)	24

Proportion of HH absent 81/318=25%
in Brakna/Gorgol 5 Oth. Maur. 47 in Sen/gam 20 overseas 4

Occupations of absent household heads:

commercant	16
fonctionnaire	11
manoeuvre	7
cuisinier	5
employe SNIM	7
enseignant	4
garde	5
planton	3
chauffeur	2
employe hotel	2
tailleur	2
administrateur	2
restaurateur	1
ferailleur	1
eleve	1
chomeur	1
professeur	1
gendarme	1
soldat	1
assistant-elevage	1
forestier	1
retraite	1
elimane manque?	1

Occupations of HH present

paysan	196
fontionnaire	3
forgeron	5
macon	1
eleveur	1
retraite	17
chomeur	1
surveillant ecole	1
infirmier	1
instituteur arabe	1
paysan marabout	1

Authorities and their relationships to one another and to land:

Name	Title	Functions
<u>Traditional</u>		
Ngam, Djibi*	Mawdu Wouro	Village Chief (for Bagodine&Mbahe)
Ba, Hamadi Boubou	Batigui Hebeyabe	Lineage head for all Hebeyabe on the plain

Kane, Oumar ____	Satigui Dekle	Lineage head for Dekle (e Hebeyabe liniol)
Djibi, Mama	Elimane	Prayer leader, Consultant on Islamic law
Samba Demba Yaro	Jagaraf Hebeyabe (lives at Mbahe)	Exec. asst. to SH (incl. assakal collection)
<u>Modern</u>		
Ba, Oumar Demba	Resp. de Zone, for 5 Quartiers at Bagodine + 2 Mbahe	Structure de base pour l'educ. des masses (SEM)

*1984 Recensement agricole listed Sow, Amadou Samba as vill. chief.

Links to other villages: Mbahe is considered part of Bagodine in both the traditional and modern structures. The Hebeyabe lineage chief's authority extends directly to the Hebeyabe living in Mbahe and Ferala, and indirectly to the two other major Hebeyabe centers, Woloum Hatar and Fonndu, on which depend in turn Niabina, Boubou Aoudi, Belil Gawdi, Roufi Aoudi, and Lewe. Dependants of the Hebeyabe, of herder, fisherman, artisan caste, slave or Haratine origin (all generally land-poor) live in Haimedat, Dabbe, Atene, Gourel Selle, Dawelel, and Hijaj. The Tmoudek haratine of Debaye Doubel, near Bagodine, have a century old land claim that they dispute with Bagodine, but basically they have lost control of most of the land to Bagodine. They end up working as share croppers or renting fields from Bagodine landlords, and both men and women from Debaye Doubel do paid labor for Bagodine.

Types of land tenure (trad. and modern)

Types and levels of taxation (trad. and modern):

Suggestions for organization of a water management authority:

They originally thought that the funding agency would take care of the work and maintenance. We explained that if they really wanted it to be maintained, and if they wanted the project to be under their control rather than run by an outside agency of the government, they would have to consider how to organize themselves to manage water and dike maintenance. The problem of what level and type of taxes could be levied for this purpose was broached. They understood the issue and asked to discuss it

among themselves. Requested that we return in one week.

(NB: During our meeting in the village Sunday April 19, the SEM zone leader began as village spokesman, as etiquet has required since 1984 or 1985, and he responded to our first questions about village facilities, but when it came to project ideas, the land owners wanted the two SEM men to leave the meeting. In this village the SEM leaders are landpoor men of low origin, which makes their leadership positions a challenge to traditional authority. The land owners are determined to keep control of their lands and everything having to do with them. The land owners will absolutely refuse to have a project if there is any discussion of land distribution to the poor, as was done by SONADER with the Gorgol irrigated perimeter. The land owners have been assured by Joe Guardiano, Tidiane Ngaide and other AID representatives that no one will touch their lands to attempt land reform. We did not, however, feel that the SEM reps should be excluded from the discussion, so we waited until cooler heads prevailed. Discussion resumed after 40 minutes, with the lineage heads and landowners now serving as spokesmen.)

What additional taxes could support dike maintenance?

On harvest? Who would be responsible?

On all cultivable land? Who would be responsible?

Labor patterns:

Normally, who does which tasks?

Pers*	Clearland	Hoe	Seed	Weed	Pesticide	Harvest	Transport
Men	6	6	6	6	2	6	6
Women	1		6			4	1
Sons	1	1	2	3		3	3
Daughters			1			1	1
Relatives help			5	1		4	1
Village help							3
Total	8	7	20	10	2	18	15

Source: RIM, Min. de l'Agriculture, Statistiques agricoles, Recensement Agricole, 1984. This represents a sample of only seven households, one of which was headed by a women.

Is it easy or hard to find agricultural labor? What tasks are people hired for?

In a good flood year what happens?

Women's activities: in the household on the farm inthevillage

Women's groups: Leaders names Activities
Women's garden cooperative, President Boy Ba; V-P Diga Mamadou Ba; Secr. Keli Ramatou Mamour and Aissatu Ba; Treasurer Mali Sirey Kane. Started in 1985 with 35 members. The other women in the village were not interested. Each member had to get 10 posts for the fence and bags to fill in between them. After two years more women began to join. The Red Crescent gave them a well, fencing, shovels, rakes, hoes, and hole cutters. From that time on each new member had to pay 500 UM to join. For the last five years each new members pays 1000 UM. The Confederal Organization gave them a second well. Now there are 450 members, divided into 45 cells of 10 women each. EAch cell has a mawdu (representative). Last year they harvested:

40 T cabbage @ 40 UM/k
6T potatoes @ 40 UM/k
500K carrots @ 80 UM/k
500 k beets @ 50 UM/k
50 k turnips @ 30 UM/k
2 T onions @ 70 UM/k
30 k eggplant @ 20 UM/k
550 k sweet potato @ 80 UM/k

niebe for home consumption, and kainje and bissap during the rainy season (if they grow them in the dry season, they have found that it causes a disease among the other vegetables.)

The fields are divided into individual plots, for which each member pays 100 UM each year for seed, fertilizer, and upkeep. If she does not pay here 100 UM, she has to share her harvest 50:50 with the coop, and cannot feed her family from the plot until it is harvested. In previous years everyone gave 50% of the harvest to the coop--the 100 UM system just began this year. Last year the treasury took in 31,000 UM from the harvest share (half of 62,000 proceeds). This year it took in 26,000 UM from the 100 UM contributions. EAch woman's benefit is whatever her family eats from the plot, plus 600 or 700 UM cash. Expenses included: 15,000 UM for seeds (until last year, these were donated by the Red Crescent), plus fertilizer. The treasury now has 70,000 UM (ca. $1000, not in the bank because it is too far and complicated). The women are considering buying a charette to go to Mbagne and Kaedi, so that they will not have vegetables perishing while they wait for transportation.

When communal work has to be done in the garden, they pay a village crier (40 UM) to announce it to all women. If a woman does not come, she pays 100 UM fine. The main problems the women have had were quarrels between members. They solved that by imposing a 200 UM fine on anyone who quarrels.

They celebrated their success this year when a Red Crescent delegation came by throwing a feast. From the treasury they bought 11 lambs at Kaedi, plus lots of chickens. All the villagers from all around couldn't finish the food. They

received a medal and 12,000 UM reward.

Existing water control efforts?
Describe, including who decided, who benefitted

Distance to Kaedi: 28km. Veh. Cost _200_UM/pers. _160__UM/100k.
Cost of charette to Kaedi__200___UM/

284x

EMIGRATION DESTINATION

	Brakna & Gorgol	Other Regions in MTN	Senegal & Gambia	African Countries & Overseas	Total absent Households	Total Households from the village	% Absent/ Present
Bagodine	7	57	25	11	100	332	30 %
Fondu	2	19	58	56	135	311	43 %
Dawalel	1	9	11	0	21	223	9 %
Ferralla	3	25	30	2	60	292	21 %
MBahe	4	50	112	17	183	346	53 %
Woloum Hatar	2	13	27	14	56	160	35 %
Athene	5	8	47	12	72	150	48 %
Belel Gawdi	1	2	58	14	75	163	46 %
Lewe	0	10	60	1	71	134	53 %
Roufi Awdi	0	3	21	13	37	62	60 %
Woloum Nere	8	38	77	21	144	429	33 %
Nere Walo	14	79	31	11	135	229	59 %
Kaguadi	0	11	12	22	45	105	43 %
Dioke	10	35	36	48	129	244	53 %
Debaye Doubel	1	70	29	0	100	234	43 %
Boubou Awdi	6	58	37	6	107	251	43 %
Hijaj	0	67	2	0	69	187	37 %
Niabina	1	87	38	37	163	378	43 %
	65	641	711	285	1,702	4,230	40 %
	3,8 %	37,7 %	41,8 %	16,7 %			
		79.5					

"CASTE DISTRIBUTION BY VILLAGE INCLUDING NON POULAR GROUPS"

pe of lar te	Bagodine	Fondu	Dawalel	Ferrala	MBahe	Woloum Hatar	Athene	Belel Gawdi	Lewe	Woloum Nere	Nere Walo	Dioke	Roufi Awdi	Kagnadi	Debaye Doubel	Boubou Awdi	Hijaj	Niabina	
LES																			
DDO	235	239	0	162	206	77	107	130	119	343	173	199	15	96	0	58	0	291	2,450
3 %																			86 %
ANBE	25			4															29
BE	29	8		45	31					10	12					3			138
ALBE			189		1						1		39						230
	289	247	189	211	238	77	107	130	119	353	186	199	54	96	0	61	0	291	2,847
ISANS																			68 %
LUBE	5	6		7		2												1	21
KIBE																			0
UBE			1		71	1					1	3						19	96
BE	4		2				12												16
UBE																			0
	9	6	3	7	71	3	12	0	0	0	1	3	0	0	0	0	0	20	135
TIVES																			3 %
CUBE	18	37	24	44	34	7	4	0	0	43	22	34	2	8		3		34	314
																			6 %
ER TRIBAL GROUPS																			
DANES	5	2				1	1	3		5	2				2	2			23
ATINES	9	11	1	28	3	30	25	33	15	20	2	0	5	0	231	183	187	33	816
AL RS	14	13	1	28	3	31	26	36	15	25	4	0	5	0	233	185	187	33	839
																			19 %
OF			1				1								1				3
INKE												1							1
LHS	2	8	5	2		42				8	16	7	1	1		2			94
																			2 %
	332	311	223	292	346	160	150	166	134	429	229	244	62	105	234	251	187	378	4,233

286x

Distribution of Sub-Lineages by Village Showing where these Kinship units have replaced lineols (lineages) as effective land and labor management entities

'ILLAGE/	Bago-dine	Fon-du	Dawa-lel	Feral-la	MBahe	Wolour Atar	Athe-ne	Belel Gawdi	Lewe	Roufi Awdi	Nere Walo	Dioke	Wolour Nere	Kagna-di	Debaye Doubel	Boubou Awdi	Hijaj	Niabi-na
BODJBE			6															
DIAYBE			38							4								
UEYGEYBE			2															
IACGNABE			30							11								
ISIBE			28									18						
ARRO			24							4								
IADIAHO			8							4								
IOBO			13															
HIAMO			5							2								
ABAHO			3							1								
IDO			1															
ALTALHO			3									38						
ENEME			1															
ARRY			1															
IAW			1							2								
AMARA										1								
ANE HANBE											9							
EM DEMBE											7							
ALBE												3						
AO RINDIA												5						
IIANG												2						
IIANGO																		
ADOU			1							12								
IBAYO			8															
GAY GAYO			1															
SOUMARE			1															

"DISTRIBUTION OF LINEOLS AS AUTONOMOUS ENTITIES"

LAGE/ EOL	Bago-dine	Fon-du	Dawa-lel	Feral-la	MBahe	Woloum Atar	Athe-ne	Belel Gawdi	Lewe	Roufi Awdi	Nere Walo	Dioke	Woloum Nere	Kagna-di	Debaye Doubel	Boubou Awdi	Hijaj	Niabi-na	
LAW	137	2					4	5	4							29		2	18
LE	122			13	17														15
OUM	59			16			7	35	15							28			16
DIAMEL		87		1		1	32	50	32										20
PEILEL		69					62	29	22	5						8			19
NEL		1		8	201		6											9	22
OL				121	125														24
KOUL			14	98															11
BE											104	55	190						34
TIANBE											89	3	140						23
-NERE											35	13	75						12
AAR		141				116	15	9	45										32
HANKOBE																		59	5
EYEL									1	10				104					11
DUDEK (RATINE)	9	11	1	2	3	30			15	5	2				233	135		19	51
AJ (RATINE)																	187	2	18
JABIR (RATINE)							19	33										12	6
LAUBE				1															
MANKOBE				26															2
	327	311	15	286	346	147	145	161	134	20	230	71	405	104	233	250	187	103	3,47

288x

FN: NEREYEL KOGNADI

NEREYEL KOGNADI

Activités	Chefs de ménage absents Nombres
Commerçant	31
Courtier	1
Elève	2
Enseignant	1
Ouvrier	5
Chauffeur	1
Retraité	1
Manoeuvre	4
Soldat	1
Tailleur	1
Total	48

NEREYEL KOGNADI

Chefs de ménage présents

Activités	Nombres
Paysan	51
Marabout	1
Retraité	2
Berger	1
Veuve	1
Sans Activité	1
Total	57

390x

NEREYEL KAGNADI

N°	Nom	Lenol	Caste	Activité	Lieu
64	Saidou Samba Thioulal	Nereyel	Torodo	Ch.Vil.	Vieux Nereyel
65	Adama Saidou	"	"	Paysan	"
68	Abdoulaye Saidou	"	"	"	"
71	Abdoul Hamady	"	"	"	"
73	Abou Abdoul	"	"	"	"
74	Djiby Abdoul	"	"	"	"
75	Hamady Rintayel	"	"	"	"
76	Samba Amar	"	"	"	"
79	Dia Sidy Ndiaye	"	"	"	"
80	Mamadou Sidy	"	"	"	"
81	Oumar Sidy	"	"	"	"
82	Ibrahima Cere	"	"	"	"
83	Thierno Issa Cere	"	"	"	"
84	Thierno Abou Cere	"	"	"	"
85	Thierno Sileymane Cere	"	"	"	"
86	Samba Hamdiata	"	"	"	"
87	Yero Hamdiata	"	"	"	"
90	Moustapha Yero	"	"	"	"
96	Dia Sidy Barka	"	"	Thierno	"
97	Samba Barka	"	"	Retraité	"
99	Kane Sileymane	"	"	Paysan	"
100	Kadiata Moussa	"	"	Veuve	"
102	Yero Mody	"	"	Paysan	"
104	Oumar Yero	"	"	"	"
106	Mohamadou Yero	"	"	"	"
108	Bocar Mamadou	"	"	"	"
111	Hamidou Samba	"	"	"	"
113	Mamadou Demba	"	"	"	"
114	Amadou Yero	"	"	"	"
115	Saidou Moussa	"	"	"	"
117	Moussa Saidou	"	"	"	"
118	Aly Demba	"	"	"	"
119	Mamadou Aly	"	"	"	"
123	Moussa Samba	"	"	"	"
125	Mamadou Moussa	"	"	"	"
130	Samba Demba	"	"	"	"
131	Abou Samba	"	"	"	"
133	Amadou Samba Houmel	"	"	"	"
134	Diop Bocar	"	"	Retraité	"
140	Gormo Dabel	"	Torodo	Paysan	"
141	Maimouna Dieynaba	"	"	"	"
142	Hamady Macam	"	Maccudo	"	"
143	Mamoudou Hamady	"	"	"	"
145	Samba Demba	"	"	"	"
147	Haure Kothiorel	"	"	"	"
148	Dickel Mairam	"	"	"	"
152	Amadou Demba	"	Torodo	"	"
153	Saidou Samba	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
155	Mairam Touman	Nereyel	Maccudo	Paysan	Nereyel
156	Mamadou Samba	"	Torodo	"	"
158	Hamidou Mamadou	"	"	"	"
165	Amadou Saidou	"	"	"	"
166	Youssouf Demba	"	"	"	"
167	Mamadou Sonadou	"	"	"	"
168	Demba Ponlo	"	Peulh	Berger	"

292

FN: ROUFI AWDI

ROUFI AWDI

Chefs de ménage présents

Activités	Nombres
Pêcheurs	16
Retraité	1
Eleveur	1
Paysans	12
Marabout	1
Total	31

ROUFI AWDI

Chefs de ménage absents

Activités	Nombres
Commerce	20
Tailleur	2
Ouvrier	2
Manoeuvre	1
Boy	3
Pêcheur	1
Retraité	2
Total	31

294

ROUFI AWDI

N°	Nom	Lenol	Caste	Activité	Lieu
1	Abou Hamady	Wadou	Cubballo	P.Pecheur	Roufi Awdi
7	Hawo Tacko	Diaw diawo	"	"	"
8	Djiby Samba	"	"	"	"
11	Adama Baydi	Diagno	"	"	"
17	Abdoulaye Hamady	"	"	"	"
20	Ibrahima Abou Sy	Maure	Haratine	"	"
25	Djengui Hainame	Wadou	Cubballo	"	"
27	Abou Guelaye Wadou	"	"	"	"
28	Jaltabe Guelago	"	"	"	"
32	Alassane Ba	Thaskone	Torodo	Retraité	"
36	Fatoumata Haidou	"	"	P.P.	"
37	Abou Salli Niass	Niass	Cubballo	"	"
38	Faty Kotowo Thiam	Thiam	"	"	"
34	Samba Bagna Dia	Diadiaho	"	"	"
41	Abou Samba	Wadou	"	"	"
42	Ramata Kamara	Camara	Kordo	"	"
43	Aissata Ba	Babaho	"	"	"
44	Moussa Alassane	Ndiayo	Cubballo	"	"
46	Abou Samba Ndiaye	"	"	"	"
46	Dieynaba Kagne	Diadiaho	"	"	"
49	Djiby Kory Dia	"	Peuhl	Eleveur	"
50	Moussa Sileye	Sarr	Cubballo	P.P.	"
51	Abou Sileye	"	"	" chant.	"
53	Hamdou Sileye	"	"	"	"
54	Abou Fondou Diop	Nereyel	Torodo	Paysan	" (France
56	Thiemo Ousmane Dia	"	"	Thierno	"
57	Abdou Samba	"	"	Paysan	"
58	Abou Abdoul	"	"	"	"
59	Moussa Mamadou Dia	"	Torodo	"	"

FN: BELEL GAWDI

BELEL GAWDI

Activités	Chefs de ménage présents Nombres
Paysan-Eleveur	43
Paysans	28
Berger paysan	3
Berger	6
Tresseuse	2
Eleveur	2
Commerçant	2
Total	86

296

BELEL GAWDI

Activités	Chefs de ménage absents Nombres
Commerce	66
Retraité	2
Ouvrier	3
Employé SNIM	1
Manoeuvre	4
	Total 76

FN: ATHENE

ATHENE

Activités	Chefs de ménage présents Nombres
Paysan-Eleveur	4
Paysans	65
Boulanger	1
Briquier	1
Sculpteur	5
Total	76

ATHENE

Chefs de ménage absents

Activités	Nombres
Commerçant	61
Fonctionnaire	1
Ouvrier	3
Menuisier	1
Employe SONADER	2
Almudo	1
Manoeuvre	2
Retraité	1
Employé SNIM	2
Total	74

FN: FONNDU

FONNDU

Chefs de ménage présents

Activités	Nombres
Paysan	131
Fonctionnaire	1
Forgeron	10
Eleveur	2
Berger	1
Retraite	8
Mendiant	1
Commerçant	2
Thierno	14
Surveillant puits	1
Veuve	5
Total	176

300 X

FONNDU

Chefs de ménage absents

Activités	Nombres
Commerçant	92
Retraité	4
Fonctionnaire	3
Percepteur	3
Cuisinier	3
Manoeuvre	8
Tailleur	2
Ouvrier	9
Douanier	1
Garde	1
Employé SONIMEX	1
Gardien	1
Employé SONELEC	1
Militaire	1
Thierno	5
Total	135

FONNDU

N°	Nom	Lenol	Caste	Activité	Lieu
1	Dia Samba Kadar	Thiaskone	Torodo	Paysan	Fonndu
5	MBaye Demba Hassane	"	Ceddo	"	"
6	Sy Moussa Mana	Nerenabe	Bailo	Forgeron	"
7	Sy Salif Mama	"	"	"	"
10	Ba Therno Boudi	Tiaskone	Torodo	Therno	"
13	Therno Ousmane	"	"	"	"
20	War Amadou Malal	"	"	Paysan	"
24	Ba Demba Alpha	"	"	"	"
25	Ba Hamidou Boydi		"	"	"
26	Wone Samba Maimouna	"	"	"	"
27	Ba Amadou Hamidou	"	"	"	"
28	Dia Samba Mamadou	"	"	"	"
31	Alassane Abou	"	"	"	"
33	Moussa Malal Dia	"	"	Therno	"
34	Hamady Diougal	Perlel	"	Paysan	"
36	Mali Penda Gawdel	Thiast-Dian	"	"	"
37	Korka Thiekora	"	Maccudo	Retraité.	"
38	Saada Thiekora	"	"	"	"
39	" "	"	"	Therno	"
46	Amnata Moussa	Perlel	Torodo	Paysan	"
47	Demba Hamat Lam	Katar	"	"	"
49	Samba Hamady (Diaba)	Thiast Dian	"	"	"
51	Mamadou Amadou	"	"	"	"
52	Malick Diamel	"	Maccudo	"	"
54	Djibrirou Samba	"	Torodo	Retraité	"
56	Sileye Hamady Dia	"	"	"	"
59	Fatmata Oumou	Perlel	"	Paysan	"
64	Amadou Mamadou Sileye	Thiast-Dian	"	"	"
69	Bomel Aissatourou	"	"	"	"
72	Samba Aldiouma	"	Maccudo	"	"
73	Mamadou Aldiouma	"	"	"	"
74	Idy Aldiouma	"	"	"	"
75	Abdoulaye Aldiouma	"	"	"	"
76	Amadou Aldiouma	"	"	"	"
79	Aissata Gomo Ba	"	Torodo	"	"
82		"	"	"	"
87	Mali Guilel Ba	"	"	"	"
92	Farmata Korka	"	"	Veuve	"
93	Aly Lamine Man	"	Perlel	Paysan	"
94	Samba Ceerno	Perlel	Torodo	Ceerno	"
96	Aissatou Oumar Dia	"	"	Paysane	"
97	Alassane Hamady	Hatar	"	"	"
99	Bayal Sow	"	"	"	"
100	Ousmane Malick Sow	"	"	"	"
104	Oumar Baidy	"	"	"	"
106	Hamady Como Sow	"	"	"	"
107	Mody Diouly Sow	"	"	"	"
110	Pendo Moussa Sow	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
111	Ibrahima Elimane Sy	Hatar	Torodo	Paysan	Fonndu
112	Samba Lamine NDiaye	"	"	"	"
113	Samba Boudy NDiaye	"	"	"	"
116	Mamadou Saidou Kane	"	"	"	"
117	Amadou Saidou Kane	"	"	"	"
119	Mody OuolaLy	"	"	"	"
123	Daouda Yero Ba	Peulh	"	Eleveur	"
126	Tonndu Coumba Ly	Hatar	"	Paysan	"
127	Mamadou Fondu	"	"	"	"
130	Yero Habare Dia	"	"	"	"
131	Moustapha Dia	"	"	"	"
136	MBaydari NDiaye	"	"	"	"
137	Amadou Teybou Ly	"	"	"	"
140	Mika Maladel Sow	"	Maccudo	"	"
142	Abdoulaye Younouss	"	Ceddo	"	"
143	MBomel Jagaraf	"	"	"	"
146	Houraye Malik Sow	"	Torodo	"	"
147	Coumba Ouloum Dia	"	"	"	"
148	Kardiata Yero Sow	"	"	"	"
149	Houleye Dia	"	"	"	"
150	Coumba Jagaraf	"	Ceddo	"	"
151	Abdoulaye Boubou Thiam	"	Baylo	Forgeron	"
152	Samba Doubel Sy	"	"	"	"
153	Coumba Doubel Sy	"	"	"	"
154	Boubou Dangel Sarr	"	Maccudo	Paysan	"
156	Mamoudou Therno Diop	"	Torodo	"	"
157	Abou Mamoudou War	"	"	"	"
158	Cire Dakel Kane	"	"	"	"
159	Mamoudou HDickou Sow	"	"	"	"
160	Amadou Hamady	Haatou	"	"	"
161	Souadou Mody Diop (F)	"	"	"	"
162	Yero Hamady NDiaye	"	Maccudo	"	"
166	Hamady Aly Diaw	"	Torodo	"	"
168	Abou Asset Ba	"	"	Elev. Ben	"
169	Amadou Hamady Ba	"	"	Paysan	"
170	Mamadou Banal Sy	"	Maccudo	"	"
172	Alpha Yero Ba	"	Torodo	Thierno	"
173	Saidou Tacko Ba	"	"	"	"
178	Alassane Doulo	"	"	Paysan	"
179	Abou Galy Kamara	"	Ceddo	"	"
180	Amadou Fode NDiaye	"	"	"	"
181	Alassane Samba	"	Torodo	"	"
183	NDiengoudi Dia	"	"	"	"
184	Diamel Cire NDiaye	"	"	"	"
185	Saidou Amadou NDiaye	"	"	"	"
186	Mamadou Boubou Dia	"	Haratine	"	"
189	Baidy Boubou NDiaye	"	"	"	"
191	Samba Yero Padel	"	Torodo	"	"
192	Coumba Boko	"	"	"	"
196	Mamadou Diougal Dia	Thasken P	"	"	"
199	Samba Moussa Dia	Diamel	"	Retraité	"
200	Abdoulaye Mody Dia	"	"	Paysan	"

N°	Nom	Lenol	Caste	Activité	Lieu
202	Demba Cire Diallo	Diamel	Torodo	Surveil.	Fonndu
204	Aissata Mal	"	"	Paysan	"
205	Samba Kadiata	"	"	"	"
207	Mamadou Boudi Dia	"	"	"	"
208	Mali Penda Bongal	"	"	"	"
209	Mali Ibra Yero	"	"	"	"
210	Amadou Demba Bolo	"	"	"	"
211	Daya Boidy	"	"	"	"
212	Coumba Fonndu Dia	"	"	"	"
216	Mali Ouoro	"	"	"	"
217	Cheikh Dicko	Perlel	Haratine	Berger	"
218	Ali Cherif Aw	Thaskone D	Torodo	Paysan	"
219	Abou Abdoulaye Aw	"	"	"	"
220	Younouss Daoudo Dia	"	"	"	"
221	Ali Samba Ba	Perlel	"	"	"
222	Ibra Samba Ba	"	"	"	"
223	Samba Moussa Dia	Caskon Per	Maccudo	"	"
224	Tijane Alpha Ba	Caskon Dia	Torodo	"	"
225	Joubmane	"	Beydane	Commerç.	"
226	Oumar Abdoulaye Dia	"	Torodo	Paysan	"
228	Selly Hamady Ba (F)	"	"	"	"
229	Alassane Cire Dia	"	"	"	"
231	Thierno Moussa Wone	"	"	Thierno	"
232	Nebe Couba Dia	"	Kordo	Paysan	"
233	Mamoudou Moussa Dia	"	Maccudo	"	"
234	Faty Kadiata Dia	"	Torodo	"	"
235	Coumba Cire Dia	"	"	"	"
236	Pennda Malado Dia	"	"	"	"
239	Yero Aly Ba	"	"	"	"
242	Yaya Kadul War	"	"	"	"
244	Demba Cire Dia	Perlel	"	"	"
249	Hamady Moussa Sow	"	"	"	"
250	Penda Boubacar Dia	"	"	"	"
251	Binta Coumba Dia	"	"	"	"
252	Mali Boudi Ba	Diamel	"	"	"
254	Tacko Louco	Perlell	"	"	"
255	Moussa Abdoulaye Dia	Hatar	"	"	"
256	Ahmadou Ibra NDongo	Maure	Haratine	"	"
257	Alassa Ibra NDongo	"	"	Retraité	"
258	Abou Ibra NDongo	"	"	Paysan	"
259	Samba Amadou Diallo	Hatarul	Torodo	"	"
263	Mohamed Lemine	Maure	Beydane	Commerç.	"
264	Alassane Niang	Hatar	Torodo	Paysan	"
265	Fatoumata Idy Niang	"	"	"	"
266	Yero Sow	"	Ceddo	"	"
268	Cerno S. Ablaye Diallo	"	Torodo	ceerno	"
270	Khardjirata Diamel Sy	Caskon D	"	Paysan	"
272	Abdoulaye Aly Niang	Harlaw	"	"	"
274	Yero Abdoulaye Diallo	Hatar	"	"	"
276	Bamou Abdoulaye	"	"	Retraité	"
278	Mountaga Abdoulaye	"	"	Paysan	"
280	Mali Bini Diau	Caskon P	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
281	Demba Yero Ba	Haatar	Torodo	Paysan	Fonndu
282	Malal Demba Dia	H. Diamel	"	"	"
284	Salif Mamadou Diop	Haatar	"	"	"
287	Mohamed Safietou Dia	"	"	"	"
288	Mahamadou Oumar Sow	"	"	"	"
289	Amadou Samba Ba	Maure	Haratine	"	"
290	Amadou Hamady Fall	"	"	Mendiant	"
295	Alhassa Ibra Ly	Boguel	Torodo	Ceerno	"
297	Abou Yesta Ly	Haatar	"	"	"
298	Ibrahima Soro Dia	"	"	"	"
299	Djeynaba Saidou Kane	"	"	Veuve	"
300	Aissata Mali Coumba	"	"	"	"
302	Bolo Moussa Dia	Caskon Per	Kordo	Paysan	"
306	Sadio Cire Dia	Haat. Perl	Torodo	"	"
308	Samba Galo	"	"	Retraité	"

FN: HIJAJ

HIJAJ

Chefs de ménage présents

Activités	Nombres
Paysans	114
Maçons	3
Enseignant	1
Total	118

306x

HIJAJ

Activités	Chefs de ménage absents Nombres
Manoeuvre	44
Ferailleur	2
Peintre	3
Cuisinier	2
Jardinier	2
Garde	3
Gardien	1
Militaire	1
Chauffeur	2
Employé à la SNIM	1
Soudeur	1
Maçon	1
Agent SONIMEX	1
Boulanger	1
Elève	2
Boy	1
Ménagère	1
Total	69

HIJAJ

N°	Nom	Lenol	Caste	Activité	Lieu
1	Boubou O/ El Hayma	Hijaj	Haratine	Paysan	Hijaj
2	Housseynou O/ Bilal	"	"	"	"
3	Brahim O/ Bilal	"	"	"	"
4	Tamin O/ Bilal	"	"	"	"
5	Teib O/ Mouhoume	"	"	"	"
7	Cheybany O/ Massoub	"	"	"	"
8	Hamsata O/ Abeydi	"	"	"	"
9	Med Val O/ El Hayma	"	"	"	"
10	Sidi O/ Mahmoud	"	"	"	"
11	Val O/ Baladji	"	"	"	"
12	Omar O/ Baladji	"	"	"	"
14	Taleb O/ Baladji	"	"	"	"
16	Lemine O/ Baladji	"	"	"	"
17	Sabou O/ Souweyloum	"	"	"	"
20	Alioune O/ Mahmoud	"	"	"	"
21	Leantry O/ Yarga	"	"	"	"
24	Aichata M/ MBarack	"	"	"	"
25	Sidya O/ MBarack	"	"	"	"
26	Sidina O/ Hamady	"	"	Pay. maç.	"
27	Khadijatou M/ Abdi	"	"	Paysan	"
30	Aly O/ Yarga	"	"	"	"
32	Bawo O/ Yarga	"	"	"	"
33	Ntebig O/ Djibaba	"	"	"	"
35	AlMoulabass O/ Bassou	"	"	"	"
36	Djibril O/ Bassou	"	"	"	"
40	Djibril O/ MBareck	"	"	"	"
42	Mama M/ Amar	"	"	"	"
45	Mohamed O/ Massa	"	"	"	"
46	Nansoure O/ Yargue	"	"	"	"
47	Sanad O/ Rlewih	"	"	"	"
48	Mariama M/ Yarg	"	"	"	"
50	Sjibril O/ Amar	"	"	Pays. Maç	"
53	Cheikh O/ Tlamidi	"	"	Paysan	"
54	Mairam M/ Abeid	"	"	"	"
55	Moctar O/ Abd	"	"	"	"
57	Mohamed Nava O/ MBoina	"	"	"	"
58	Mami O/ Toumani	"	"	"	"
59	Ely O/ Toumani	"	"	"	"
60	Hamara O/ Toumani	"	"	"	"
61	Taleb O/ Toumani	"	"	"	"
62	Barad O/ Sambeit	"	"	"	"
64	Djibril O/ Ramadan	"	"	"	"
66	LaDriano O/ Yarg	"	"	"	MBagne
67	Ismael O/ Yarg	"	"	"	Hijaj
68	Za Iha O/ Toumani	"	"	"	"
70	Djibril O/ Abdalahi	"	"	"	"
71	Mohamed O/ Abdalahi	"	"	"	"
72	Oumar O/ MBoirick	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
74	Anouda M/ Souweyloum	Hijaj	Haratine	Paysan	Hijaj
75	Fatimettou M/ Yarga	"	"	"	"
77	Ahaimar O/ Alkhamair	"	"	"	"
78	Hamady O/ Alkhamair	"	"	"	"
79	Djeri O/ Sambeita	"	"	"	"
80	Deyib O/ Souad Amar	"	"	"	"
81	Mahama M/ Toumani	"	"	"	"
82	Alioune O/ Abeid	"	"	"	"
85	Ababacar O/ Magha	"	"	"	"
86	Daouda O/ Brahim	"	"	"	"
88	Alioune O/ Maghar	"	"	"	"
89	Mariam M/ Zameg	"	"	"	"
94	Ngaibila M/ Salmoum	"	"	"	"
95	Harbou M/ Sambeini	"	"	"	"
96	Zeinabou M/ Tlamid	"	"	"	"
97	Oumar O/ Mahmoud	"	"	"	"
98	Sambiri O/ Marsa	"	"	"	"
99	Alioune O/ Mdine	"	"	Maçon	"
101	Khadijetou M/ Massa	"	"	Paysan	"
102	Id O/ Sambeinaar	"	"	"	"
103	Ahmed Ali O/ Marsa	"	"	"	"
107	Sidy Amar O/ Moussa	"	"	"	"
108	Khouna O/ Med Abd	"	"	"	"
109	Salem O/ Med Abd	"	"	"	"
110	Daouda O/ Med Abd	"	"	"	"
116	MBareick O/ Kebira	"	"	"	"
117	Oumar O/ Boilil	"	"	"	"
118	Saloum O/ Haimed	"	"	"	"
119	MBaha O/ Haimedou	"	"	"	"
121	Gamatt O/ Hamar	"	"	"	"
122	Mohamadel Maht O/ Amed	"	"	"	"
123	Otmane O/ Magha	"	"	"	"
124	Rahya M/ Boilit	"	"	"	"
127	Brahim O/ Massaoud	"	"	"	"
128	Alioune O/ Massaoud	"	"	"	"
130	Zioud O/ Talem	"	"	"	"
132	Beyni O/ Awoynat	"	"	"	"
134	Hadramy O/ Abdy	"	"	"	"
135	Deuwa M/ Ramadan	"	"	"	"
141	Fatimettou M/ Oulel	"	"	"	"
143	Aichata M/ Hamet Daya	"	"	"	"
145	Hivra M/ Boubacar	"	"	"	"
146	Mohamed O/ Satma	"	"	"	"
147	Alioune O/ Mouzeydeuf	"	"	"	"
148	Moussa O/ Boyrick	"	"	"	"
149	Daya M/ Elhor	"	"	"	"
150	Tenib O/ Sambeyt	"	"	"	"
151	Amnetou M/ Sauga	"	"	"	"
153	Med Lemine O/ Madjigen	"	"	"	"
154	Sagar O/ Salmoune	"	"	"	"
155	Leyneyna O/ MBareck	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
156	Lehbouss O/ Dowlel	Hijaj	Haratine	Paysan	Hijaj
157	Fatimettou M/ Abdi	"	"	"	"
158	Aly O/ Aicha	"	"	"	"
159	Ahmane O/ Houweybou	"	"	"	"
160	Hrasoume O/ Houweybou	"	"	"	"
161	Jibril O/ Houweybou	"	"	"	"
162	Brahim O/ Abeydallah	"	"	"	"
163	Iyde M/ Douwa	"	"	"	"
164	Aline O/ Sidy Boubou	"	"	"	"
166	Zeynabou M/ Abdoulah	"	"	"	"
172	Khadjettou M/ Abdy	"	"	"	"
174	Jibril O/ Hawaly	"	"	"	"
176	Deyda M/ Yarg	"	"	"	"
177	Youmou M/ Haymar	"	"	"	"
178	Mohamed O/ Souweyloum	"	"	"	"
179	Dah O/ Abdoulah	"	"	"	"
180	Khadejja M/ Souweylou	"	"	"	"
182	Hamzata O/ Hamady	"	"	"	"
183	Brahim O/ Hamady	"	"	"	"
184	Tenib O/ Hamady	"	"	"	"
185	Awoycha	"	"	"	"

FN: WOLOUM.HAT

WOLOUM HATAR

Chefs de ménage présents

Activités	Nombres
Paysan	92
Paysan-Eleveur	3
Marabout	2
Eleveur.	1
Briqueur	1
Forgeron	1
Almudo-Ngai	1
Ouvrier Commerçant	1
Chauffeur	1
Total	103

211

WOLOUM HATAR

Chefs de ménage absents

Activités	Nombres
Commerce	44
Manoeuvre	1
Gardien	1
Policier	1
Tailleur	1
Carreleur	2
Entrepreneur	1
Militaire	1
Eleveur	1
Marabout	1
Professeur	1
Retraité	2
Total	57

3/2 X

WOLOUM HATAR

N°	Nom	Lenol	Caste	Activité	Lieu
1	Sow Abou NDoulou Oumar	Hatar	Peulh	Pays. El.	W. Hatar
2	Ousmane Samba Sow	"	"	"	"
3	Amadou Mody Sow	"	"	"	"
4	Coumba Samba	"	"	"	"
5	Demba Gouro	"	"	"	"
6	Saidou Ousmane	"	"	"	"
7	Amadou Saidou Demba	"	"	"	"
8	Kalidou Amadou	"	"	"	"
9	Mamadou Demba Saidou	"	"	"	"
10	Idrissa Aamadou	"	Torodo	"	"
11	Samba Amadou	"	"	"	"
12	Moussa Amadou	"	"	"	"
13	Abou Amadou	"	"	"	"
14	Hamath Amadou	"	"	"	"
15	Harouna Amadou	"	"	"	"
16	Mamadou Diouldé	"	"	"	"
17	Mamadou Hamath	"	"	"	"
19	Djiborou Samba	"	"	"	"
20	Amnata Samba	"	"	"	"
21	Bocar Amadou	"	"	"	"
23	Boubou Yéro	"	"	"	"
24	Mody Aliou	"	Peulh	"	"
25	Samba Amadou	"	Torodo	"	"
27	Moussa Ifra	"	"	"	"
28	Mamadou Abou	"	"	"	"
29	Moussa Abou	"	"	"	"
30	Samba Belal	"	"	"	"
31	Harouna Belal	"	"	"	"
32	Aliou Belal	"	"	"	"
37	Hamidou Hamady	"	Peulh	"	"
38	Hamatt Hamady	"	"	"	"
39	Amadou Hamady	"	"	"	"
43	Ibrahima Idy	"	"	"	"
44	Abou Idy	"	"	"	"
48	Youssouf Demba	"	"	"	"
49	Sow Samba Adoulaye	"	"	"	"
50	Farmata Samba Adoulaye	"	"	"	"
52	Saidou Ifra	"	Torodo	"	"
53	Mika Djiby	"	"	"	"
58	Amadou Ousmane	"	"	Thierno	"
59	Faty Dioulde	"	"	"	"
60	Saidou Hamady	"	"	"	"
61	Abdoul Samba Djety	Nereyel	"	"	"
64	Amadou Abdoul	"	"	"	"
68	Coumba Laha	"	"	Paysan	"
69	Saidou Samba	"	"	"	"
70	Saidou Maraba	Hatar	"	"	"
71	Mamadou Saidou	"	"	"	"
72	Oumar Hamady	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
73	Sidy Hamet	Maure	Beidane	Commerce	W. Atar
74	Sidy Samba	Hatar	Torodo	Paysan	"
75	Abdou Amadou	"	"	"	"
78	Amadou Hamady	"	Peulh	"	"
81	Abdoul Hamady	Maure	Haratine	"	"
82	Mohamed Djonilo	"	"	"	"
84	Amadou Mijine	"	"	"	"
85	Mamadou Aly	Hatar	Torodo	"	"
86	Samba Oumar	"	"	"	"
87	Ibrahima Oumar	"	"	"	"
88	Alhassane Oumar	"	"	"	"
89	Ousmane	"	"	"	"
90	Oumar Mamadou	"	"	"	"
95	Ndounaba Hamdou	"	"	"	"
96	Alem Sy	Maure	Haratine	"	"
97	Mohamed Sehly	Tmoudeck	"	"	"
98	Cheibany	"	"	"	"
99	Youmao M/ Khoidem	"	"	"	"
100	Demba Alassane	Hatar	Peulh	"	"
102	Mamadou Samba	"	"	"	"
105	Hatou O/ Laichi	Tmoudeck	Haratine	"	"
107	Moktar O/ Laichi	"	"	"	"
109	Harouna O/ Boua	"	"	"	"
112	Abdalla O/ Talmody	"	"	"	"
115	Sileymane O/ Salem	"	"	"	"
116	Hamet O/ Salem	"	"	"	"
118	Thiaba M/ Mbareck	"	"	"	"
119	Amadou O/ Moctar	"	"	"	"
120	Amadou O/ MBareck	"	"	"	"
121	Messouda M/ Tabar	"	"	"	"
122	Samba Abdoul	Golyajo	Peulh	Marabout	"
124	Mudo Abdoul (F)	"	"	Paysan	"
125	Samba Tougui	Tmoudeck	Haratine	"	"
126	Abou O/ Samba Youba	"	"	"	"
128	Abou Raky	Hatar	Maccudo	"	"
129	Mody Raky	"	"	"	"
130	Djibourou Hamady	"	Peulh	"	"
132	Aly Djbourou	"	"	"	"
138	Djiby Amadou	"	"	Ouvr. com	"
143	Raky Egoudou	"	Maccudo	Paysan	"
144	Amadou Egoudou	"	"	"	"
145	Hawli Egoudou	"	"	"	"
146	Boudi Egoudou	"	"	Aveugle	"
149	Mariata Tackoy	"	Torodo	Paysan	"
150	Demba Hamady	"	Peulh	"	"
151	Samba Demba NDiaye	"	Bailo	Forgeron	"
152	Coumba Korka	"	"	Paysan	"
153	Abdoulaye Aly Dia	"	Peulh	Eleveur	"
154	Boudel Coumba Cira	"	Mabo	Paysan	"
155	Mamadou Abou	"	Peulh	"	"
157	Demir	Tmoudeck	Haratine	"	"
158	Fat Demba Samba	Hatar	Torodo	"	"

3/4X

FN: MBAHE

MBAHE

Activités	Chefs de ménage présents Nombres
Paysan	143
Eleveur	1
Tisserand	1
Potière	2
Commerçant	2
Marabout	3
Manoeuvre compressé	1
Veuve	7
Jagaraaf	1
Sans activités	1
Total	162

MBAHE

Chefs de ménage absents

Activités	Nombres
Commerçant	116
Assistant d'élevage	1
Manoeuvre	20
Conducteur d'engin	1
Fonctionnaure	7
Comptable	1
Militaire	2
Mendiant	1
Etudiant	1
Ménagère	1
Tailleur	1
Marabout	1
Ouvrier	1
Tisserand	1
Retraité	6
Boy	1
Férailleur	2
Menuisier	1
Chauffeur	1
Employé SNIM	4
Enseignant	1
Facteur	1
Sans activité	12
Total	184

316x

MBAHE

N°	Nom	Lenol	Caste	Activité	Lieu
1	Salif Samba	Focol	Torodo	Paysan	MBahe
7	Ba Mamoudou	Dakle	Ceddo	"	"
10	Abou Samba	Focol	Torodo	Maç. Pays	"
11	Therno Aly	"	"	"	"
18	Cire Amadou	"	Ceddoo	Paysan	"
24	Abdoul Baidy	"	"	Jagaraf	"
25	Dioum Maimouna	"	"	Paysan	"
26	Abdourahmane Cire	"	"	"	"
28	Koumba Ousmane	"	Torodo	"	Veuve
30	Aissata Yero	"	"	"	"
31	Amadou Boudi	"	"	"	MBahe
32	Mamadou Aly	"	"	"	"
38	Daouda Abdoul	"	"	"	"
45	Aissata Pennda	"	"	"	Veuve
49	Tabara Mamadou	"	"	"	"
56	Hondou Tiapato	Maure	Haratine	"	MBahe
57	Peimpi Yerel	Focol	Ceddo	"	"
60	Amadou Samba Cire	"	Torodo	"	"
63	Bah Thiapato	Maure	Haratine	"	"
64	Fatimata Abdoul	Focol	Torodo	"	"
66	Mamadou Hamet	"	"	"	"
68	Kadiata Baidy	"	"	"	"
71	Bocar Demba	"	"	Eleveur	"
74	Aissata Aly	"	"	Paysan	"
76	Demmo Bailaa	"	"	"	"
82	Coumba Dieyna	Boguel	"	"	"
83	Amadou Samba Ba	"	"	"	"
85	Fatmata Besse	Focol	"	"	"
92	Aissata Mamadou	Boguel	Mabo	"	"
95	Fatimata Djiby	"	"	"	"
97	Kadji Baidy	"	"	"	"
104	Malick Baidy	Focol	Torodo	"	"
108	Alassane Saidi	"	"	"	"
111	Salamata Boubou	"	"	"	"
113	Saidy Boudi	"	"	"	"
115	Samdi Deudia	"	Maccudo	"	"
117	Maimouna Thierno	"	Torodo	"	"
118	Amadou Aboh	"	Ceddo	"	"
119	Kadiata Yero	"	Torodo	Paysan	"
120	Hamidou Abdoul	"	"	"	"
121	Abdoulaye Amadou	"	"	"	"
122	Thierno Sileye Sy	"	"	Thierno	"
123	Alhousseyni Thierno	"	"	"	"
125	Djinguoudy Mody	Boguel	"	Paysan	"
126	Saidou Amadou	"	"	"	"
127	Deynabou Samba	"	"	"	"
129	Aisse Aly	"	"	"	"
131	Fatmata Kouma	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
133	Pennda Samba	Boguel	Torodo	Paysan	MBahe
134	Andoulaye Cire	"	"	"	"
135	Haby Abdoulaye	"	"	"	"
136	Amadou Samba	"	"	"	"
140	Penda Coumba	"	Maccudo	"	"
142	Mairam Dia	"	"	"	"
147	Hawa Amnata	"	"	"	"
148	Yero Elimane	"	Torodo	"	"
149	Samba Elimane	"	"	"	"
151	Mamadou Mody	Focol	"	"	"
152	Samba MBomel	"	"	"	"
153	Moussa Demba	"	"	"	"
156	Komba Fondi	Boguel	Mabo	"	"
160	Salik Coola	"	"	Tisserand	"
162	Aissata Baidyu	"	"	Potière	"
164	Mamadou Kalidou	"	"	Pays. com	"
170	Salif Demba	Dekle	Ceddo	Paysan	"
172	Aly Hawoli	Boguel	Torodo	Paysan	"
176	Hawoly Ba	"	"	"	"
177	Ba Samba Leguel	Dekle	Ceddo	Musicien	"
178	Bilel Diop	"	Cubballo	Paysan	"
179	Koumba Cire	"	Ceddo	"	"
180	Amadou Hamady	"	"	"	"
181	Samba Demba	"	"	"	"
183	Aisse Mali	Boguel	Torodo	P. Veuve	"
186	Tacko Mariam	Dekle	Ceddo	Paysan	"
188	Yero Mamadou	"	"	"	"
191	Abssa Demba	Boguel	Torodo	"	"
192	Amadou Alassane	"	"	"	"
194	Fatimata Moussa	"	"	"	"
196	Aly Moussa	"	"	"	"
201	Abdourahmane Thilo			"	"
202	Faty Banna			"	"
205	Demba Raky MBaye	Focol	Maccudo	"	"
208	Mamoudou Demba	"	Torodo	"	"
210	Amadou Cire Dia	Boguel	Maccudo	"	"
213	Mamadou Lamine Smadou	"	"	"	"
214	Amadou Demba	Focol	Torodo	"	"
215	Mariam Amadou	"	"	"	"
216	Samba Demba	"	"	"	"
217	Binta Malado	Boguel	Kordo	"	"
223	Yero Diaw	Focol	Maccudo	"	"
224	Mali Diaw	"	"	"	"
227	Amadou Sly Ba	Boguel	Torodo	"	"
228	Hanel Tidiane	"	Mabo	"	"
229	Amadou Yaya	"	"	"	"
233	Ibrahima Aly	"	Torodo	"	"
234	Aly Boubou	"	"	"	"
235	Boubou Hamady			"	"
236	Abdarahmane Hamady			"	"
237	Samba Dembouna	Focol	Maccudo	Paysan	"
238	Yero Demba	"	Ceddo	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
240	Koumba Samba	Boguel	Torodo	Paysan	MBahe
242	Yero Abdoul	"	Mabo	"	"
244	Mamadou Lamine				"
245	Mamoudou Elimane		Torodo	"	"
247	Mamadou Elimane			"	"
248	Penda Maliahe			"	"
249	Hamat Saidou	"	"	"	"
251	Djibril Malal		Maccudo	"	"
255	Koumba Sambal	"	Mabo	"	"
256	Alassane Djibi	"	"	"	"
258	Aissata Yero	"	Maccudo	"	"
259	Kalidou Malick	"	Mabo	"	"
264	Daouda Samba	"	Torodo	"	"
271	Abou Elimane Dia	"	"	"	"
272	Hamidou Aly	"	"	"	"
274	Thierno Hamet	"	"	"	"
275	Rassoul Aly	Boguel	"	"	"
276	Sleye Bouboua Ba	"	"	"	"
277	Oumou Boubou	"	"	Paysan	"
278	Samba Pathe	"	"	"	"
280	Barou Abdoulaye	"	"	"	"
281	Moussa Mamoudou	"	"	"	"
282	Moussa Kalidou	"	"	"	"
283	Amadou Saidou	"	"	"	"
284	Abou Saidou	"	"	"	"
285	Djibril Saidou	"	"	"	"
286	Alassane Saidou	"	"	Aveugle	"
289	Aissata Dioumo	"	"	Paysan	"
290	Amadou Babaly	"	"	"	"
291	Altine Tacko	"	"	"	"
297	Houraye Boubou	"	"	"	"
298	Deynaba Houraye	"	"	"	"
300	Haby Sidy	"	"	"	"
301	Mamadou Diouma	"	"	"	"
302	Koumba Abome	"	Mabo	Potière	"
304	Samba Bocar	"	Torodo	Commerç.	"
308	Mali Amadou	"	"	"	"
309	Youma M?Fejjou	Maure	Haratine	Paysan	"
314	Aissata Hamady	Boguel	Mabo	"	"
317	Mamoudou Baidy	"	"	"	"
322	Yero Ousmane	"	"	"	"
324	Abdoulaye Yero Guisse	"	"	"	"
325	Mamoudou Hafasa	"	"	"	"
328	Mamadou Hamady	"	"	"	"
331	Mariam Baidy	Focol	"	"	"
322	Abdoul Baidy	"	"	"	"
333	Demba Cire	Boguel	"	Thierno	"
336	Oumar Cire	"	"	Paysan	"
338	Amadou Abou	"	Torodo	"	"
342	Sileymane Djiby	Focol	"	"	"
346	Kadji Penda	Dekle	Ceddo	"	"

FN: FERALLA

VILLAGE CENSUS SHEET

FERALLA

Chefs de ménage présents

Activités	Nombres
Paysan	209
Fonctionnaire	1
Tresseuse	1
Forgeron	5
Retraité	4
Berger	3
Marabout	1
Imam	1
Commerçant	3
Sans activités	5
Manoeuvre	1
Total	234

320x

FERALLA

Chefs de ménage absents

Activités	Nombres
Commerçant	28
Forgeron	1
Manoeuvre	12
Chômeur	1
Garde	1
Militaire	4
Menuisier	1
Marabout	3
Boy	1
Mécanicien	1
Employé à la SNIM	3
Vendeur de poisson	2
Total	58

FERALLA - PRESENT

N°	Nom	Lenol	Caste	Activité	Lieu
1	Penda Yero	Aoloum	Torodo	Paysane	Ferella
2	Demba Dede	Maure	Hormanke	"	"
3	Demba Alamina	Niskoul	Maccudo	"	"
4	Dahirou Demba	"	"	"	"
5	Oumou Mamoudou	"	Torodo	"	"
6	Mamadou Mamoudou	"	"	"	"
10	Youssouf Adama	"	"	Commerc.	"
11	Saiko Amadou	"	"	Retraité	"
15	Hamady Demba	"	Baylo	"	"
16	Boubou Amadou	Noki-Winde	"	"	"
19	Coumba Hadja	"	"	Tresseuse	"
20	Samba Djiby	Focol	Ceddo	Berger	"
21	Baidy	"	"	"	"
23	Penndo Koumba	Niskoul	Maccudo	Paysan	"
24	Mamadou Malal	Boguel	"	"	"
27	Aldiouna Demba	Focol	"	"	"
30	Samba Demba Diallo	"	"	"	"
32	Boubou Sy	Niokoul	"	"	"
33	Samba Malal	Boguel	"	"	"
37	Demba Malal	"	"	"	"
38	Farmata Corguel	"	"	"	"
39	Mamadou Samba	Niokoul	Ceddo	"	"
40	Korka Samba	Maure	Hormanke	"	"
41	Amadou Yero	"	"	"	"
42	Boubou Samba	"	"	"	"
45	Demba Amadou	Noki-Wendy	Bailo	Forgeron	"
48	Amadou Cire	Dekle	Ceddo	Paysan	"
51	Abda Cire	"	"	"	"
53	Baidy Demba	Hrask-Diom	"	"	"
55	Aly Samba	Focol	Torodo	Paysan	"
56	Farmata Samba	Niokoul	"	"	"
57	Cire Demba	Focol	"	Manoeuvre	"
59	Demba Sada	"	"	Paysan	"
60	Aly Sada	"	"	"	"
61	Cheikh Bilali	Maure	Haratine	"	"
62	Hamady Samba	"	"	"	"
63	Idy N'Diaye	Dekle	Ceddo	Retraité	"
64	Souleymane Harouna Ba	"	"	"	"
70	Alio Kamara	Niokoul	Maccudo	Paysan	"
72	Demba Ndiabel	"	Torodo	"	"
74	Mamadou Sileye	"	"	"	"
76	Diallo Pathe	Focol	Ceddo	Retraité	"
77	Moussa Cire Diallo	"	"	Paysan	"
78	Boubou Amadou	"	"	"	"
79	Djibirou Bocar	"	Torodo	"	"
80	Amadou Bocar	"	"	"	"
88	Mamoudou Hamady	Dekle	Jawando	Paysan	"
89	Sily Samba	Maure	Hormo	"	"

322X

N°	Nom	Lenol	Caste	Activité	Lieu
90	Sily Dioulde	Maure	Hormo	Paysan	Ferella
91	Amadou Djiby	"	"	"	"
95	Aissata Kalidou	"	"	"	"
96	Boubou Thiam	"	"	"	"
98	Mairam Yero	Focol	Torodo	"	"
97	Aissata Mali	"	"	"	"
99	Moussa Boubou	Niokoul	Ceddo	"	"
100	Mamoudou Boubou	"	"	"	"
101	Hawo Boubou	"	"	"	"
103	Seleymane Bocoum	Dekle	Jawanndo	"	"
106	Mamadou Samba War	Niokoul	Torodo	"	"
107	Mamoudou Mamadou	"	"	"	"
109	Hawa Yesta	Focol	"	"	"
110	Alassane Samba Diallo	Maloum	"	"	"
111	Kadiata Saydou	Niokoul	"	"	"
112	Aliou Thilo	Maloum	"	"	"
113	Mamadou Samba	Niokoul	Maccudo	"	"
114	Cheikna Mamadou	"	Torodo	Thierno	"
116	Abdoulaye Mamadou	"	"	Paysan	"
117	Saidou Samba War	"	"	Commerc.	"
119	Mamoudou Samba Ba	"	"	Paysan	"
120	Houleye Coumba	"	"	"	"
122	Hamady Faty	Focol	Maccudo	"	"
123	Moussa Hamady	"	"	"	"
124	Oumou Hamady	"	"	"	"
125	Daouda	"	"	"	"
127	Sileye Amadou War	Niokoul	Torodo	"	"
128	Mamoudou Samba	"	"	"	"
129	Gouro Aisse	"	"	"	"
130	N'Diaye Saidou	"	"	"	"
133	Oumou Abdoulaye	Nioukoul	Torodo	Paysan	"
134	Amadou Djiby	Maloum	Maccudo	"	"
136	Sada Malal	"	"	"	"
137	Djiby Malal	"	"	"	"
139	Dioulde Amel	Niokoul	Torodo	"	"
140	Mamadou Dioulde	"	"	"	"
141	Aly Mody	"	"	"	"
142	Bocar Aly	"	"	"	"
143	Racky Mamadou	Maure	Horma	"	"
114	Demba Dobale	"	"	"	"
146	Abou Demba	"	"	"	"
147	Amadou Demba Thiam	"	"	"	"
148	Mamadou Landatt	Niokoul	Torodo	"	"
149	Mamoudou Landatt	"	"	"	"
150	Yero Oumba	Focol	"	"	"
151	Amadou Yero	"	"	"	"
152	Baba Dede	"	"	"	"
153	Sileymane Mody	"	"	"	"
154	Moussa Wele	"	"	"	"
155	Mamoudou Diao Sow	Niokoul	Peul	Berger	"
158	Samba Aly Ba	Focol	Torodo	Paysan	"

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N°	Nom	Lenol	Caste	Activité	Lieu
159	Hapsetou Sada	Focol	Torodo	Paysan	Ferella
160	Adama Sidy	"	"	"	"
161	Abou Sidy	"	"	"	"
162	Ramatoulaye Ba	"	"	"	"
163	Ibra Mamoudou	"	"	"	"
164	Mamadou MBahe	"	"	"	"
165	Mamoudou MBahe	"	"	"	"
166	Samba Houraye	"	"	"	"
167	Malik Sileye	"	"	"	"
168	Moussa Yero	"	"	"	"
169	Yaya Yero	"	"	"	"
170	Ifra Alassane	"	"	"	"
171	Mamoudou Yero	"	"	"	"
172	Amadou Abdoul Wone	"	"	"	"
173	Abdoulaye Sileye	"	"	"	"
174	Bolo Samba	"	"	"	"
175	Yaya Sileye	"	"	"	"
176	Ousmane Samba Ba	"	"	"	"
177	Hamady Samba Ba	Focol	Torodo	Paysan	Feralla
178	Amadou Samba Ba	"	"	"	"
179	Moussa Samba Ba	"	"	"	"
180	Alassane Ousmane	"	"	"	"
181	Mamoudou Sidy	"	"	"	"
182	Hamady Gomel	"	"	"	"
183	Amadou Hamady	"	"	"	"
184	Oumar Salif	"	"	"	"
185	Mohamadou Salif	"	"	"	"
186	Adama Baila	"	"	"	"
187	Hamouda Baba Sy	"	"	"	"
188	Oumar Baba Sy	"	"	"	"
189	Bocar Harouna	"	"	"	"
190	Daouda Harouna	"	"	"	"
191	Abdoulaye Harouna	"	"	"	"
192	Samba Harouna	"	"	"	"
193	Amadou Samba Sy	Niokoul	Ceddo	"	"
194	Bocar Gogne Diallo	Focole	"	"	"
195	Abdoulaye Bocar	"	Torodo	"	"
196	Amadou Abdoulaye	"	"	"	"
197	Oumar Sileymane Diallo	Halaybe	"	Enseign.	"
198	Samba Mody	Niokoul	"	Paysan	"
199	Demba Malal Ba	Maloum	Maccudo	"	"
200	Hamady Demba Bouri	"	"	"	"
201	Aisse Mali	Focol	Torodo	"	"
202	Demba Malado	"	Maccudo	"	"
203	Sileye Demba	"	"	"	"
204	Harouna Demba	"	"	"	"
206	Younouss Demba	"	"	"	"
207	Cire Gogné	"	Ceddo	"	"
209	Abdourahmane Cire	"	"	Paysan	"
210	Baidy Hamady	Niokoul	"	"	"
211	Mamadou Boubou	"	"	"	"

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N°	Nom	Lenol	Caste	Activité	Lieu
212	Samba Boubou	Niokoul	Ceddo	Paysan	Ferella
213	Hawa Dede	"	"	"	"
214	Samba Banno	Focol	Torodo	"	"
215	Amadou Banno	"	"	"	"
216	Mamadou Pennda	"	"	"	"
217	Daouda Malal	Niokoul	"	"	"
218	Mody Samba Diaw	Maloum	Maccudo	"	"
219	Amadou Mody	"	"	"	"
220	Marième Mody	"	"	"	"
221	Bocar Mamoudou	Focol	Torodo	"	"
222	Yaya Samba	"	Maccudo	"	"
223	Samba Aly Diallo	Niokoul	Torodo	Commerç.	"
224	Mamoudou Aly Diallo	"	"	Paysan	"
225	Moussa Samba Diallo	"	"	"	"
226	Aly Mamoudou Ba	Focol	"	"	"
227	Samba Mamoudou Ba	"	"	"	"
228	Moutar Mamoudou Sy	Maure	Horma	"	"
229	Abou Samba	"	"	"	"
230	Ousmane Samba	"	"	"	"
231	Yero Boudi Ba	Focol	Torodo	"	"
232	Oumar Mody Diaw	Maloum	Maccudo	"	"
233	Amadou Mody Diaw	"	"	"	"
234	Bocar Mody	"	"	"	"
235	Amadou Mody Diawlel	"	"	"	"
236	Farmata Samba Ba	Niokoul	Torodo	"	"
237	Haby Mali	"	"	"	"
238	Demba Yero	"	"	"	"
239	Amadou Demba	"	"	"	"
240	Mama Gouro	Focol	"	"	"
241	Mairam Samba (Mueta)	"	"	"	"
242	Haby Cire	"	"	"	"
243	Aly Cire	"	"	"	"
244	Cire Samba	"	"	"	"
245	Aly Bna	"	"	"	"
246	ElHadji Aly	"	"	"	"
247	Mamadou Rabou	"	"	"	"
248	Mamadou Saidou	"	"	"	"
249	Samba Saidou	"	"	"	"
250	Alassa Mamoudou	"	"	"	"
251	Youssouf Alassane	"	"	"	"
252	Abdoulaye	"	"	"	"
253	Mamadou Demba	"	"	"	"
254	Namoudou Demba	"	"	"	"
255	Babacar Aly	"	"	"	"
256	Samba Mamadou	"	"	"	"
257	Mamadou Samba	Focol	Torodo	Paysan	Feralla
258	Diallo Ousmane Gogne	"	Ceddo	"	"
259	Abou Paldi	Niokoul	"	"	"
260	Samba Saidou	"	"	"	"
261	Gogno Saidou	"	"	"	"
263	Amadou Cire M'Bengue	"	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
264	Samba Cire M'Bengue	Niokoul	Ceddo	Paysan	Ferella
265	Alassane Cire M'Bengue	"	"	"	"
266	Abdoul Mamadou	"	Torodo	"	"
267	Mamadou Abdoul	"	"	"	"
268	Moussa Alassane	Boguel	"	"	"
269	Bocar Mamoudou Diallo	Focol	"	"	"
270	Adama Saidou	Niokoul	"	"	"
271	Samba Abdoul	"	Ceddo	"	"
272	Raky Gogne	"	"	"	"
273	Abou M'Bengue	"	"	"	"
274	Abdoulaye Samba	"	"	"	"
275	Samba Demba Cire	Focol	Torodo	"	"
276	Adouna Malal	Niokoul	"	"	"
277	Saidou Samba	Focol	"	"	"
278	Yaya Mamoudou	"	"	"	"
279	Amadou Mamoudou	"	"	"	"
280	Alassane Mamoudou	"	"	"	"
281	Malick Djiby	Niokoul	Ceddo	"	"
282	Sadio Saidou	"	Torodo	"	"
283	Amadou Cire Gouda	Maure	Horma	"	"
284	Yaya Mamoudou	Niokoul	Torodo	"	"
283	Abdoulaye Mamoudou	"	"	"	"
286	MBahe Rero	Focol	"	"	"
288	Aissata Samba Saidou	Niokoul	"	"	"
290	Amadou Demba	"	"	"	"

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FN: NERE WALO

NERE WALO

Activités	Chefs de ménage présents Nombres
Paysan	64
Retraité	10
Marabout	4
Almudo	1
Eléve	1
Maçon	1
Menuisier	1
Eleveur	7
Berger	1
Cherif	1
Total	91

NERE WALO

Chefs de ménage absents

Activités	Nombres
Gardien	4
Matelot	2
Enseignant	2
Manoeuvre	18
Electricien	4
Chauffeur	2
Militaire	21
Garde	4
Commerçant	33
Retraité	12
Jardinier	1
Boy	2
Mecanicien	2
Cuisinier	1
Employé SNIM	2
Menuisier	3
Maçon	1
Technicien Air Mauritanie	2
Marin	2
Agent PTT	2
Chef du Personnel PTT	1
Marabout	2
Employé District	2
Photographe	1
Professeur	1
Planton	5
Briquier	1
Employé à SONELEC	1
Elève	1
Chômeur	3
Total	138

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NERE WALO

N°	Nom	Lenol	Caste	Activité	Lieu
1	Demba Aly Jagaraf	Wantiando	Ceddo	Paysan	N. Walo
6	Samba Baidy Gouro	"	Torodo	"	"
9	Amadou Seidi Hamidou	Basso	"	"	"
15	Diago Samba Djiby	Wantiando	"	Retraité	"
17	Diago Moussa Djiby	"	Torodo	"	"
18	Diago Guida Djiby	"	"	Paysan	"
20	Thierno Demba Pat.Yero	"	"	Thierno	"
21	Faty Bannel	Basso	"	Paysan	"
27	Kane Hamady Falilou	"	"	"	"
28	Kane Samba Falilou	"	"	Thierno	"
32	Diop Demba Mody	H. Néré	"	Paysan	"
				(Pompiste au champ)	
34	Ba Amadou Yero	Basso	"	Paysan	"
37	Ba Amadou Mamadou	"	"	"	"
39	Hadrame Mairam	Maure	Beidane	Cherif	"
42	Niass Harouna Moussa	Wantiando	Ceddo	Menuisier	"
46	Houleye Ndoundou	Basso	Torodo	Paysan	"
50	Ndongo Moussa Samba	Wantiando	"	"	"
48	Yero Barka Samba	H. Néré	Maccudo	"	"
53	Mbaye Samba Sada	"	Torodo	Retraité	"
55	Mbaye Mamoudou Aly	"	"	Paysan	"
57	Binta Mairam	"	Beidane	"	"
59	Ba Moussa Idy	Basso 1	Torodo	"	(Aveugle)
64	Sy Harouna Samba	H. Néré	Maccudo	"	N. Walo
66	Ba Yero Mamadou	Basso	Torodo	"	"
68	Ba Abdoulaye Demba	"	"	Maçon	"
70	Ba Penda Hamady	"	"	Paysan	"
71	Diago Mali Bocar	Wantiando	"	Paysan	"
73	Dia Djiby Yero	H. Néré	Maccudo	"	"
76	Sy Samba Baidy	Basso	Torodo	"	"
78	Ba Samba Bouky	"	"	"	"
81	Sall Mamadou Demba	Wantiando	"	Retraité	"
90	Datt Aliou Hamatt	"	"	"	"
92	Datt Saidou Samba	"	"	Paysan	"
94	Sow Amadou Hamatt	"	"	"	"
95	Ba Amadou Thierno	"	"	"	"
97	Ba Abdoulaye Yero	"	"	Almudo	"
					(Sup.mère)
99	Gadio Abass	"	Cubballo	Pech.Pays	N. Walo
100	Diaw Samba Dado	"	Maccudo	Paysan	"
101	Bolo Faty	Basso	Torodo	"	"
102	Mawdo Pennda	"	Torodo	"	"
106	Ba Demba Diama	Wantiando	"	"	"
107	Dieo Mamadou Djibril	Basso	"	"	"
108	Diaw Daoud Djibril	"	"	"	"
113	Ndoujel Thimbo	Wantiando	"	"	"
114	Diop Amadou Harouna	H. Néré	"	"	"
115	Diop madou Taalo	"		"	"
118	Diop Dioulde Samba	"		"	"
119	Sow Yero Hamady	Basso	Peulh	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
121	Sow Gallo Hamady			Paysan	N. Walo
122	Sow Amadou Gallo			"	"
123	Sow Samba Hamady			"	"
124	Diop Samba Doro	H. Néré		"	"
134	Barro Hawo Racky	Wantiando	Torodo	"	"
135	Sy Hamadi Demoura			"	"
137	Ndiaye Abdoul Doro	Basso	"	Retraité	"
143	Harouna Yero Korka	"	"	Paysan	"
144	Mamadou Yero Korka	"	"	"	"
151	Thierno Amadou Idy			"	"
152	Mamadou Harounaar			"	"
155	Irfa Harouna			"	"
156	Ba Mamadou Samba	Basso	Torodo	"	"
158	Ba Elimane Samba	"	"	"	"
162	Ba Djiby Ousmane	"	"	"	"
163	Ba Saidou Bocar	"	"	"	"
164	ElHadji Samba Hamatt	"	"	"	"
169	Amadou Diawando	"	"	"	"
171	Sy Saidou Amadou	Wantiando	"	Retraité	"
172	Sy Samba Amadou	"	"	"	"
173	Sy Samba Idy	"	"	Paysan	"
177	Ndongo Jagaraf Ifra	"	Ceddo	"	"
180	Ndongo Demba Jagaraf1	"	"	"	"
181	Sow Moussa Aissata	"	"	Elève	support mère
183	Diop Samba Amadou	H. Néré	Torodo	Retraité	N. Walo
197	Ba Aly Samba	Basso	Torodo	"	pas de pension
198	Ba Harouna Aly	"	"	Paysan	N. Walo
199	Ba Abou Samba	"	"	"	"
200	Ba Pathe Mamadou	"	"	"	"
201	Kane Amadou Samba	"	"	"	"
204	Dougou Hamady	Wantiando	Maccudo	Paysan	"
209	Sam Demba	"	Maccudo	"	"
210	Ba Boily Moussa	"	Peulh	Berger	"
212	Abou Boubou	"	"	Eleveur	"
222	Samba Bineta	Basso	"	"	"
223	Amadou Yero	"	"	"	"
224	Gallo Ba	"	"	"	"
225	Sileye Samba	"	"	"	"
226	Demba Coumbayel	"	"	"	"
227	Amadou Aliou	"	"	"	"
228	Coumba Thioye	"	Torodo	Paysan	"

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FN: DIOKE

DIOKE

Activités	Chefs de ménage présents Nombres
Paysan	105
Retraité	5
Berger	2
Almoudo	1
Boulanger	1
Sans activités	2
Total	116

DIOKE

Chefs de ménage absents

Activités	Nombres
Commerce	82
Peintre	1
Tailleur	2
Fonctionnaire	5
Ouvrier	5
Enseignant	1
Retraité	6
Gardien	1
Manoeuvre	11
Chauffeur	1
Militaire	3
Ferailleur	2
Employé District	1
SENELEC	1
Boy	1
Marabout	2
Paysan	1
Photographe	1
Total	127

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DIOKE

N°	Nom	Lenol	Caste	Activité	Lieu
1	Moussa Samba Kane	Basbe	Torodo	Retraité	Dioké
2	Racine Djiby Kane	"	"	Paysan	"
3	Samba Boubou Kane	"	"	"	"
8	Coumba Amadou	"	"	"	"
10	Demba Hamatt	"	"	Retraité	"
12	Cira Hamatt	"	"	Paysan	"
13	Mamadou Demba	"	"	"	"
14	Ousmane Hamatt	"	"	"	"
16	Jafara Abdoul	"	"	"	"
18	Mamadou Samba	"	"	"	"
20	Mamadou Hamatt	"	"	"	"
23	Yero Bocar	"	"	"	"
30	Racine Hamady	"	"	"	"
32	Fatimata Hamatt	"	"	"	"
33	Daouda NDiallo	Dabianabé	"	"	"
37	Hamady Samba	KaneHano	"	"	"
40	Saidou Aly Dem	Dem-Dembe	"	"	"
42	Saidou Dabe	"	"	"	"
43	Idy Debe	"	"	"	"
44	Abdoul Debe	"	"	Boulanger	"
45	Abdoul Dioumo	Sal-Salbe	"	Paysan	"
48	Aissata Djibril	"	"	"	"
49	Thierno Djibril	"	"	"	"
55	Adama Harouna	"	"	"	"
56	Saidou Harouna	"	"	Berger	"
58	Abdoulaye Ali Tall	Tal-Talbe	"	Paysan	"
60	Saidou Harouna Sall	Sal-Salbe	"	"	"
65	Demba Dounde Sall	"	"	"	"
69	Mamadou Moudo	"	"	"	"
71	Mohamadou Habibou	"	"	"	"
72	Youma Aissata	"	"	"	"
73	Alassane Demba Sao	Sao-Sao	"	"	"
74	Hamady Alassane	"	"	"	"
77	Hamady Malick Kane	Kane-Kano	Maccudo	"	"
79	Aminata Soumare	"	"	"	"
84	Haby NDiaye	Sal-Salbe	"	"	"
86	Koumba Malick Kanelaye	Kane-Kano	"	"	"
89	Ousmane Thierno	Sisiho	Torodo	"	"
90	Abdoulaye Samba	Basbe	"	"	"
91	Djibril Diago	"	"	"	"
92	Abou Samba Diago	"	"	"	"
98	Alassane Samba Welle	Diongtonabe	"	"	"
103	Salif Amadou	"	"	"	"
106	Adama Ely Camara	Goudoude	Maccudo	"	"
107	Mamadou Borgo	Jawara	"	"	"
108	Hamady Borgo	"	"	"	"
110	Hamat Alyraba	Basbe	Torobe	"	"
111	Moussa Aly	"	"	"	"
113	Abou Samba NDiaye	Bellicende	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
115	Moussa Samba Sao	Basbe	Torodo	Paysan	Dioke
116	Mamadou Moussa Sao	"	"	"	"
124	Amadou Malick Sy	Bechi.	"	"	"
125	Hamady Harouna Sao	Rindiawnabe	"	"	"
129	Abou Bocar Sao	"	"	"	"
131	Mamadou Samba Sao	"	"	"	"
135	Thialal Demba (F)	Sisih.	"	"	"
136	Amadou Amar Ly	"	"	"	"
138	Djiby Yero NDiaye	Bellicen.	Maccudo	"	"
140	Yero Cire NDiaye	"	"	"	"
142	Amadou Abou Dieng	Dien-Diengb	Torodo	"	"
145	Demba Abou	"	"	"	"
147	Aly Gouro Dem	Dem-Demo	"	"	"
152	Alassane Samba	"	"	"	"
153	Mody Samba	"	"	"	"
154	Saidou Idy Dem	"	"	"	"
155	Hamady Demba Sall	Belicinde	"	"	"
157	Tacko Aly Tall	Tal-Talbe	"	"	"
158	Saidou Mamoudou NDiaye	Sylla	Maccudo	"	"
160	Djiby Amadou Sao	Besso	Torodo	Pays.Elev	"
166	Ousmane Boubou Diop	Bellicende	"	"	"
173	Alassane Yero Sall	Sal-Salo	"	"	"
174	El Hadji Yero Sall	"	"	"	"
175	Samba Tacko	"	Peulh	Malade	"
178	Haby Demba	"	Torodo	"	"
179	Hamady Samba Diop	Belli-cend	"	Retraité	"
180	Samba Demba Diop	"	"	"	"
182	Harouna Mamadou	"	"	"	"
183	Codel Dia	"	"	"	"
184	Harouna Gorel MBaye	"	"	Paysan	"
186	Idy Boubou Diop	"	"	"	"
187	Hamady Abdoul Wone	MBoumbena	"	"	"
189	Samba Boujai Aw	Rindiack	Maccudo	"	"
190	Diakel Dia (F)	Silla Jonto	"	"	"
191	Samba Doulel	"	"	"	"
193	Mamadou Yero Dia	"	Torodo	"	"
195	Alassane Hamady Ly	"	"	"	"
196	Al Housseyny H. Ly	Basbe	Maccudo	"	"
197	Amadou Samba NDiaye	Wantianbe	Torodo	"	"
198	Thierno Yero Aw	Rindiao	"	Paysan	"
202	Aissa Daouda Aw	"	"	"	"
203	Coumbel Demba Dem	"	"	"	"
204	Hamady Sally Semege	Soninke	"	Almoudo	"
206	Alassane Hamady	Sissoko	"	Paysan	"
213	Samba Idy Dieng	Dieng-dien	"	Retraité	"
214	Thierno Sileymane Dien	"	"	Paysan	"
216	Ibrahima Ly	Sisiho	"	"	"
218	Koumba Hode	Hou Fode	"	"	"
220	Aly Sadio NDiayera	Rindao	Maccudo	"	"
223	Harouna Amadou Aw	Nere	"	"	"
224	Abdoulaye A. Aw	"	"	"	"

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N°	Nom	Lenol	Caste	Activité	Lieu
227	Coumba Elymba Dem	Nere	Maccudo	Paysan	Dioke
229	Binta Amar	Bellicende	Torodo	"	"
230	Yero Demba Ba	"	Peulh	Berger	"
233	Djinda Kamara	"	"	Paysan	"
234	Hapsatou Mody	"	Maccudo	"	"
244	Samba Demba Sall	Sal-Salbe	Torodo	Retraité	"

FN: DAWALEL

DAWALEL

Activités	Chefs de ménage présents Nombres
Paysan	39
Pêcheur	169
Bergers	3
Boulanger	1
Bucheron	3
	Total 215

DAWALEL

Chefs de ménage absents

Activités	Nombres
Fonctionnaire	1
Vendeur de tomate	1
Boulanger	1
Commerçant	2
Manoeuvre	1
Tisserand	1
Courtier	1
Total	8

DAWALEL

N°	Nom	Lenol	Caste	Activité	Lieu
1	Aissata Binta	MBadjbe	Cuballo	Paysan	Dawalel
2	Hamady Sinna	Niokol	"	Pecheur	"
3	Bunta Abou Dia	"	"	"	"
4	Farmata Hamady	"	"	"	"
5	Oumar Hamady	"	"	"	"
6	Farmata Diewo	NDiaybe	"	"	"
7	Dialtabé Amadou	Sysibe	"	"	"
8	Hawa Oumar	Gueygueybé	"	"	"
9	Aissata Demba	NDiaybé	"	"	"
10	Abdoul Hamady	"	"	"	"
13	Baya Abdoul	"	"	"	"
14	Aissata Abou	"	"	"	"
16	Dicko Koudy	Diagnebé	"	"	"
17	Oumar Thiam	Ouolof	"	Boulanger	"
18	Penda Mayo	Sysibé Hou	"	Pecheur	"
19	Yero Samba NDiaye	Ndiaye	"	"	"
20	Abou Abdoul NDiaye	"	"	"	"
21	Mariam Fodiya	Sarro	"	"	"
22	Binta Malal	Diddiao	"	"	"
24	Houleye Kadiatel	MBaye	"	"	"
25	Boubou Thiapato	Maure	Haratine	Bucheron	"
26	Oumou Daouda	Diobot Dian	Cuballo	Paysan	"
27	Thiedou Bayer	NDiaye	"	"	"
28	Boubou Hamady	Sysibe Hou	"	"	"
29	Maimouna Kadiata	Diagno	"	"	"
30	Ayssata Boubouyel	Sisibe H	"	"	"
31	Meddo boubou	"	"	"	"
32	Amnata Coumba	Diadiawo	"	"	"
33	Habi Demba	"	"	"	"
34	Waounde Faty (F)	Diagno	"	"	"
35	Diaba Boubou	Sysibe Houn	"	"	"
36	Bombara Medda	"	"	"	"
37	Mairam Moussa	MBayo	"	"	"
38	MBoirika Moussa	S. H.	"	"	"
39	Coumba Mairam	"	"	"	"
40	Aissata Hamady	Ndiayo	"	"	"
41	Oumou Thiedel	Niokoul	"	"	"
42	Moussa Samba	Ndiayo	"	"	"
43	Alassane Yero	Niokoul	"	"	"
44	Mamadou Alassane	Niokoul	Cuballo	"	"
45	Kadiata Baya	Mdiayo	"	"	"
46	Oumou Saidou	Sarro	"	"	"
47	Diye Koudy	Diobo	"	"	"
48	Malado Medda	S. H.	"	"	"
49	Mairam MBolo	Babaho	Maccudo	"	"
51	Abou Faty Sy		Cuballo	"	"
52	Aissata Coumba Diop	Diobo	"	"	"
53	Houleye Hamady	Ndiayo	"	"	"

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N°	Nom	Lenol	Caste	Activité	Lieu
54	Barrayel Moussa	S. N.	Cuballo	Paysan	Dawalel
55	Tako Moussa	"	"	"	"
56	Bahali Oumar Sy	"	"	"	"
57	Matel Amadou	Diagno	"	"	"
58	Boubou Oumar Sarr	Sarro	"	"	"
59	Mamadou Diouldeyel	S. N.	"	"	"
60	Coumba Thiarido	Sarro	"	"	"
61	Samba Maimouna Sy	S. N.	"	"	"
62	Hawa Aly	Diobo	"	"	"
63	Sarr Saidou Oumar	Sarro	"	Pecheur	"
64	Sarr Mamadou Saidou	"	"	"	"
65	Sarr Baya Saidou	"	"	"	"
66	Oumou Faty Diagne	Diagno	"	"	"
67	Signetou Faty	"	"	"	"
68	Faty Baidy	"	"	"	"
69	Djiby Demba	"	"	"	"
71	Dioulde Dieynaba	Thiamo	"	"	"
72	Houleye Penda	Sarro	"	"	"
73	Kadiata Faty Baydi	Diagno	"	"	"
74	Coumba MBaye	MBayo	"	"	"
75	Maimouna Amadou	S. N.	"	"	"
76	Bayel Sarr (F)	Sarro	"	"	"
77	Samba Boyel	"	"	"	"
78	Baba Boudel	Babaho	Maccudo	"	"
79	Boudel NDoumbe	S. N.	"	"	"
80	Mali Moumo	Diayo	"	"	"
81	Abou Thiourel	Sarro	Cuballo	"	"
82	Harouna Abou Sarr	"	"	"	"
83	Bonny Gaye	Babaho	Peulh	"	"
84	Demmba Dicko	NDiayo	Cuballo	"	"
85	Samba Dicko	"	"	"	"
86	Bintayel Moussa	S. N.	"	"	"
87	Samba Saidou	NDiayo	"	"	"
88	Faty Amadou	S. N.	"	"	"
89	Hamady Harouna	"	"	"	"
90	Ramata Coumba Diallo	Niokoul	"	"	"
91	Abou Samba Sy	S. N.	"	"	"
92	Demba Ly	Lido	"	"	"
93	Fado Mamadou Diagne	Diagno	"	"	"
94	Doumoyely Kanara	Diobo	"	"	"
95	AmadouYero NDiaye	Ndiayo	"	"	"
96	Coumba Moussa	S. N.	"	"	"
97	Coumba Faty	Diadiaho	"	"	"
98	Kalidou Aly Diagne	"	"	"	"
99	Abou Hamady NDiaye	NDiayo	"	"	"
100	Sewdeyel Sy	S. N.	"	"	"
103	Waoundi Faty NDiaye	Diagno	"	"	"
104	Malado Meddaadel	S. N.	"	"	"
107	Oumar Aliou	Diagno	"	"	"
108	Coumba Assetgal Dia	S. N.	"	"	"
110	Mamadou Cire	Diagno	"	"	"
111	Houleye Hamady	NDiayo	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
112	Boiry Mamoudoullo	NDiayo	Cuballo	Pecheur	Dawalel
113	NDognou Batouli	Niokoul	"	"	"
114	Sileye Marma	MBayo	"	"	"
115	Amadou Marma	"	"	"	"
116	Coumba Aly	Diopo	"	"	"
117	Saidou Woudou	Sall	Labo	Bucheron	"
118	Coumba Faty Yero	Diadiaho	Cuballo	Pecheur	"
119	Oumar Abdoul	S. N.	"	"	"
120	Faty Amadal	Diagno	"	"	"
121	Oury Coumba	MBayo	Labo	Bucheron	"
122	Abou Abdoul	S. N.	Cuballoe	Pecheur	"
123	Aissata Faty	Diagno	"	"	"
124	Faty Bintayel	NDiayo	"	"	"
125	Kardiata Dioulde	Thiamo	"	"	"
127	Samba Pathe	MBodj	"	"	"
128	Aliou Pathe	"	"	"	"
129	Baidy Hamady	S. N.	Cuballo	"	"
130	Boubou HamadyBa	"	"	"	"
131	Marieme Ousmane	NDiayo	"	"	"
132	Fat. Samba	"	"	"	"
133	Diarra Baya	"	"	"	"
134	Coumba Samba	"	"	"	"
135	Mariam Samba	"	"	"	"
137	Dieynaba Gaysnel	"	"	"	"
138	Ousmane Hamady	S. N.	"	"	"
139	Baya Hamady	"	"	"	"
140	Kalidou Hamady	"	"	"	"
141	Diarri Boubou	"	"	"	"
142	Houleye Sileye	Diagno	"	"	"
143	Thiam Dioulder	Thiamo	"	"	"
144	Oumou Demba	Diagno	"	"	"
145	Alassane SambaSow	Diadiaho	"	"	"
146	Farmata Hamady	Nokoul	"	"	"
147	Boubou Sarr	Sarro	"	"	"
149	Coumba Gaye	Gaygayo	"	"	"
150	Oumar Idy	S. N.	"	"	"
151	Aissata Bathily	Sarro	"	"	"
152	Hamady Faty	Diagno	"	"	"
153	Faty Mawdo	NDiayo	"	"	"
154	Pennda Asset	S. N.	"	"	"
155	Doro Mamoudou	NDiayo	"	"	"
157	Coumba Bombora	Diopo	"	"	"
158	Ousmane Doleng	NDiayo	"	"	"
159	Hamady Baidy	Sarro	"	"	"
160	Amadou Kadija	Thiamo	"	"	"
161	Yero Samba Houleye	S. N.	"	"	"
162	Hamidou Aliou	Diagno	"	"	"
163	Meddo Mama	"	"	"	"
164	Sileye Medda	"	"	"	"
165	Alassane Samba Sy	S. N.	"	"	"
166	Faty Mama	"	"	"	"
167	Amnata Maladel	Sarro	"	"	"

N°	Nom	Lenol	Caste	Activité	Lieu
168	Faty Gueyel	Guey	Cuballo	Pecheur	Dawelel
169	Doudou Djiby	Sarro	"	"	"
170	Saidou Mouctar	NDiayo	"	"	"
171	Amadou Tacko	"	"	"	"
172	Demba Hamady	Diadiaho	"	"	"
173	Samba Djiby	S. N.	"	"	"
174	Binta Morki	MBayo	"	"	"
175	Tacko Pathe	MBodj	"	"	"
176	Samba Hamady	MBoy	"	"	"
177	Samba Diaw	Barry	Maccudo	"	"
178	Houleye Diaw	Diaw	"	"	"
179	Amadou Sileye	Sy N.	"	"	"
180	Samba Boudal	"	"	"	"
181	Coumbayel Mali	Diobo	"	"	"
183	Abrahima Sarr	Sall	"	"	"
184	Pennda Mabo	Coumme	Mabo	"	"
185	Dieynaba Boubou	S. N.	Maccudo	"	"
186	Amadou Papa	Sarro	Cuballo	"	"
187	Hamady Altine	Diagno	Maccudo	"	"
188	NDiaye Sarr	Sarro	"	"	"
189	Kalidou Papa	Sarro	Cuballo	"	"
190	Coumba Oumouharri	Diobo	"	"	"
191	Koya Soumare	Soumare	Maccudo	"	"
192	Houleye Gabel	Diobo	Cuballo	"	"
193	Sileye Djimo	Sarro	"	"	"
194	Douguel Coumba	Sally	Kordo	"	"
195	Djengoudi Diallo	Niokoul	Ceddo	"	"
196	Coumba Kadiata	Diagne	Cuballo	"	"
197	Cire Samba	S. N.	"	"	"
198	Yero Hamedinei	MBodjo	"	"	"
199	Samba Hamedine	"	"	"	"
200	Sira Hamady	Sy N.	Kordo	"	"
201	Malado Hawo	"	"	"	"
202	Hamady Moussa	"	Maccudo	"	"
203	Samba Abouctar	Niokoul	Peulh	Bergduvil	"
204	Coubayel Sy	S. N.	"	P. P.	"
205	Mamadel Diallo	Niokoul	"	Berger	"
206	Sira Hako	S. N.	Cuballo	"	"
207	Haby Coumba	"	"	"	"
208	Mamadou Alassane	S. N.	"	"	"
209	Pennda Hawa		Kordo	"	"
210	Mali Tokossel	Wadou	"	"	"
212	Saidou Alassane	S. N.	Cuballo	Pecheur	"
213	Oumar Sarr	Sarro	"	"	"
214	Kardiata Samba	Diobo	"	"	"
215	Mamadou Amadou Sy	S. N.	"	"	"
216	Amadou Hamady Diallo	Niokoul	"	"	"
217	Abderahmane Demba	"	Mabo	"	"
218	Diarra Maimouna Sarr	Sarro	"	"	"
223	Coumba Cire	Niokould	Peulh	Berger	"

ANNEX F

DIROL PLAIN PROJECT

INSTITUTIONAL ANALYSIS

PROJECT IDENTIFICATION DOCUMENT

Prepared by

Development Alternatives, Inc.
624 9th Street
Washington, D.C. 20001

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INSTITUTIONAL ANALYSIS SUMMARY

The MRVDP will work in close collaboration with existing traditional, GIRM and parastatal institutions and avoid institutionalizing project activities outside those collaborating structures. The principal institutional participants in the project are the villages and supra-village traditional organizations (Hebiabe, Irlabe, Nerenabe, Bosseabe, Tamoudek, Hijaz, etc.) on and around the Dirol Plain. These groups have farmed the plain for centuries and have evolved economic and social patterns particularly well-suited to the requirements of recessional agriculture. This is particularly true of their systems of land tenure and local taxation. The institutionalization of water management, agricultural production, and water control structure maintenance will take place entirely within the village context.

GIRM and parastatal organizations will provide support to these traditional social and economic structures, as needed, particularly during the first phase of the MRVDP. The most important of these organizations are:

ONRADA: on farm trials and demonstrations, training, extension, monitoring and evaluation;
ENFVA: training, cooperative development, monitoring and evaluation, extension;
SONADER: extension, construction monitoring, water management;
Kaedi Agricultural Inspectorate: extension, monitoring and evaluation.

The MRVDP will have no full-time Mauritanian staff, but will draw on the services of counterparts named by the above institutions for specific sets of activities. Collaborating institutions will also hire subordinate personnel for the MRVDP. The project will benefit from the services of 4 Peace Corps volunteers, who will be assigned through the on-going SONADER/Peace Corps agricultural development program.

The MRVDP will also collaborate with private sector entities in Kaedi such as the Chaitous and the Palikaba, as well as other merchants, by encouraging them to purchase grain from the Dirol Plain and to supply intersted farmers with tools, seeds, fertilizer and other inputs as required.

In addition, numerous other GIRM agencies and donors have established projects of varying scale in Kaedi. All of these entities have expressed eagerness to work with the MRVDP in their fields (vegetable gardening, fisheries, forestry, etc.).

The MRVDP can be seen as a de-institutionalized institution-building project. It will reinforce traditional organizations on the Dirol Plain by helping them to use their resurces to increase agricultural production and thus income and welfare for their

members. It will encourage the creation of a dynamic agricultural sector organization in and around Kaedi and catalyze the contributions of each of its participating organizations to mutually supportive, well-coordinated, successful interventions.

INSTITUTIONAL INVENTORY

The MRVDP will work with a wide range of existing institutions in Kaedi and in Nouakchott. The project will profit from the skills and experience of these institutions and thus avoid the need to establish its own internal capacity in thefields in which these groups work. In addition, the MRVDP will work intensely and primarily with the traditional institutions of the Dirol Plain villages. These latter are inventoried and described in the Social Soundness sections of this PID.

The PID team has conducted preliminary discussions with all of the institutions listed below. They have understood that there is as yet no assurance that the MRVDP will be financed by USAID, but nonetheless have expressed interest in working with the project. In this inventory we present the following information about each institution:

- o name
- o location
- o primary goal/tasks
- o field of collaboration with the MRVDP

Further details about the institutions mentioned here are given in the Institutional Analysis Annex to this PID.

GIRM AGENCIES IN KAEDI:

1. The Govenor of the Gorgol is responsible for the administration and the economic and social development of his region, including the one third of the Dirol Plain that lies within the Gorgol. He agrees that the Project should have its base in Kaedi and has instructed his technical agents to offer every collaboration to the MRVDP study and implementation teams.

2. The National Agricultural Training and Extension School (ENFVA) prepares agricultural extension and training agents for the GIRM and for private and parastatal enterprise. They run a 3 year course for primary school graduates and another for graduates of three year secondary schools (colleges). Their graduates are prepared to work in either agronomy, forestry or animal husbandry. They also have an agricultural engineering section. The ENFVA has agreed to provide training facilities and personnel for Dirol Plain villagers and project personnel. They will participate in monitoring and evaluation missions and will provide student trainees to assist with on-farm research, extension and monitoring.

3. The National Agricultural Research Center (CNRADA) is charged with planning and coordinating agronomic research throughout Mauritania. From its principle base in Kaedi (new buildings, including offices, laboratories and housing, are under construction in Kaedi now), it conducts adaptive research trials

on crop varieties, input use, and improved agronomic practices for cereals, fruit, vegetables and forage. Historically, its primary emphasis has lain on irrigated agriculture, but over the past few years, it has begun on-station and on-farm trials in both rain-fed and recessional agriculture. The CNRADA will help the MRVDP organize and conduct on-farm trials on the Dirol Plain, participate in the analysis of results and in the elaboration of extension programs based on these results. They will provide training for farmers and project agents in conducting on-farm trials and demonstrations and will participate in monitoring and evaluation activities.

4. The Agricultural Inspectorate of the Gorgol (IAG) is based in Kaedi and has Sectors in Maghama and Mbout. Their mandate covers about one third of the Dirol Plain, from Sylla to a line from Roufi Aoudi to a point in between Oullom Nare and Oullom Hattar. They work closely with the FAO Extension Project and provide agricultural Extension services for rain-fed and recessional farmers throughout the region. The Crop Protection Service is represented within the IAG. The IAG has agreed to provide extension services on the Dirol Plain and to coordinate crop protection services there in support of the MRVDP.

5. The Agricultural Statistics Service (ASS) of Kaedi executes the surveys and studies required by the ASS of Nouakchott, which is under the office of the Secretary General of the MDR. These studies include annual agricultural production surveys, periodic agricultural censuses, and studies ordered by anyone who chooses to fund such activities. The ASS/Kaedi is perfectly willing to share their results with us, although they do not analyze their own data. They will carry out monitoring and evaluation work, as well as specific studies requested by the MRVDP, to the extent that the ASS/Nouakchott authorizes them to do so.

6. The National Rural Development Society (SONADER) Regional Office in Kaedi is responsible for irrigated agriculture in the Gorgol and part of the Brakna. They cover the entire Dirol Plain. They provide construction, extension, operations and maintenance, credit, and input supply services to small,medium and large irrigated perimeters run by cooperatives approved by the GIRM, including the large Gorgol Pilot Perimeter (PPG). The SONADER has acted as the Mauritanian counterpart agency for the preparation of the PID. They have agreed to provide extension services to the MRVDP, to provide Peace Corps volunteers through an expansion of their on-going program, to help supervise the construction of the floodgate and participate in monitoring, evaluation and training activities.

7. The Environmental Inspectorate (IPN) of the Grogol is based Kaedi. They maintain a tree nursery which provides forestry seedlings (not fruit trees) for GIRM activities and projects in the region. They cover the same zone as the IAG (see No. 4 above).They also act as the environmental police force, controlling tree-cuting, charcoal burning and bush fires as best

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they can. The IPN is prepared to furnish seedlings to any MRVDP reforeststaion or woodlot activities and to participate in training, monitoring and evaluation tasks.

8. The Food Security Commissariat (CSA) in Kaedi purchases paddy and traditional crops (sorghum and maize) from farmers at government-set floor prices, which are higher than free-market prices throughout most of the year. The CSA will collaborate with the MRVDP by purchasing the cerals grown on the plain, including those that will be sold to finance floodgate maintenance.

9. The Economic Control Office (BCE) of Kaedi sets local prices for staple commodities in the Gorgol. If sorghum prices fall behind inflation, they will play a key role in getting these prices increased.

DONOR FUNDED ACTIVITIES IN KAEDI:

1. The FAO Seed Multiplication Project in Kaedi provides improved and selected paddy seed to SONADER and private irrigated perimeters throughout Mauritania. It has begun attempts to identify (in collaboration with the CNRADA/AGRES II) improved and selected recessional sorghum varieties The FAO has agreed to continue this program and to undertake trials and multiplication of promising varieties identified by the MRVDP.

2. The Gorgol Herder Training Project (PEEG), funded by the FAO/CCCE, is based in Kaedi. It has undertaken animal health and production improvement activities, including setting up village veterinary pharmacies, as well as veterinary research projects in collaboration with the CNERV (see below). The PEEG has expressed willingness to collaborate with Dirol Plain villages(even with those in the Brakna) if they decide that they wish to carry out animal husbandry improvement actvities. In this case they will participate in training and extension. In any case, they are prepared to assist with monitoring MRVDP impacts on animal husbandry on the Plain.

3. The Italian-funded Africa 70 Project is based in Kaedi and concerned with urban development, including market gardening, improved housing, and urban planning. They have funded an agricultural input supply cooperative in collaboration with the Palikaba merchants group. Although primarily oriented toward supply Kaedi vegetable growers with tools, seeds, fertilizer and other inputs, AFRICA 70 and the Palikaba are eager to see this cooperative expand its supply functions to other areas and activities. The Dirol Plain farmers will be able to buy inputs from the Palikaba Center and if the MRVDP can finance inventory, they will manage sales of other commodities as well.

4. The Partnership for Productivity (PfP) Operaional Research Program in Kaedi worked for over a year on the Dirol Plain, testing innovations in agricultural production and processing. We swait their report tojudge the usefulness of their

intervention.

5. The USAID-funded Agricultural Research II Project (AGRES II) provides Technical Assitance to the CNRADA (see above) in farming systems, on-farm trials and demonstrations, agronomy and management. In addition they provide long and short term training for Mauritanian agriculturalists. The University of Arizona staff of AGRES II has agreed to help with all aspects of the MRVDP through the CNRADA.

GIRM AGENCIES IN THE BRAKNA:

1. The Governor of the Brakna is responsible for administration and economic and social development of approximately two thirds of the Dirol Plain. However, the two major centers of the Region, Aleg and Boghe are more than 100 kms from the Plain and lack the agricultural sector and housing/utilities infrastructure of Kaedi. For this reason, the Governor has agreed that the project should be based in Kaedi. However, he would like his technical representatives to be kept informed of Project activities and to sit on the Coordinating Committee (CC) in Nouakchott.

2. The Center for Cooperative Training (CFC) in Boghe receives groups of villagers (men and women) and trains them in cooperative management and administration. They have agreed to hold courses for Dirol Plain villagers financed by the MRVDP either in Boghe or on the Plain, as appropriate.

OTHER DONORS IN MAURITANIA:

1. The United Nations Development Program (PNUD) is very interested in the Kaedi area and finances a number of activities there,including the FAO seed multiplication program, the FAO extension Program (see below), SONADER activities, and the ASS. The PNUD is eager to coordinate the activities of the donors working in the Kaedi area and is open to all concrete proposals to any of its projects.

2. The World Bank (IBRD) works in the Kaedi area primarily through the SONADER. They are very interested in the potential of recessional agriculture and eagerly await the results of the MRVDP, which they hope will help guide their program in the future. With the FED, the IBRD will finance an important study of SRB development in the post-Manantali/Diama era. This study should begin in 1986 and be available at the end of that year.

3. The European Development Fund (FED) has concentrated more than two thirds of its funds for Mauritania (excluding those in a risk capital fund) for integrated rural development in the Kaedi area. They will undertake feeder roads, agriculture, water supply, health, education, cooperatives, and rural credit. This area includes the Dirol Plain, as well as Foum Gleita. The FED has been slow to operationalize its program because of uncertainties

surrounding both the viability of irrigated agriculture in Mauritania and the availibility of water for agricultural purposes after the Manantali Dam begins operations. However, they are very interested in recessional agriculture and ready to work closely with the MRVDP. The FED funds a team of three experts at the SONADER in Kaedi.

4. The French Assistance and Cooperation Fund (FAC = French bilateral aid) does not work in the Kadi area now, except through the PEEG. However, they have funded the the R'Kiz Lake Recessional Agriculture Development Project, which is the only such effort in Mauritania at this time. They have achieved excellent results and have offered full cooperation with the MRVDP.

5. The FAO finances an Agricultural Extension Project (PVA) that covers the Gorgol, Trarza, Eastern Hodh and Assaba regions. It provides technical assistance, training and some transport and materials to reinforce the extension activities of the Agricultural Inspectorates in these regions. The FAO has stated that it would be very interested in having the Dirol Plain named a special intervention zone for the PVA. This would enable the IAG to work on the entire plain, rather than just in the Gorgol third of the area. In this case, they would undertake extension and farmer training activities for the MRVDP and participate in monitoring and evaluation as well.

GIRM AGENCIESIN NOUAKCHOTT:

1. The SONADER General Headquarters are in Nouakchott. All planning and programming are done in the capital, while the regional offices carry out the programs, using funds allocated to them by the General Headquarters. The SONADER Studies Bureau has acted as USAID's interlocutor for the PID for the MRVDP. The Studies Bureau is under the Technical Directorate. The Technical Director has chaired all joint meetings so far. After implementation, the SONADER hopes to monitor the project closely and participate in planning and programming its activities.

2. The Ministry of Rural Development will be the official tutor of the MRVDP and sign a Project Agreement if the project is funded. The MDR will name a Host Government Implementing Agency, presumably the Directorate of Agriculture.

3. The Directorate of Agriculture, one of four directorates of the MDR (Livestock, Environment, and Engineering are the others), contains two services of crucial importance to the MRVDP. The Extension Service, working with the FAO PVA will probably carry out much of the agricultural extension activity on the Dirol Plain. The Crop Protection Service, which works closely with the CNRADA and the ENFVA in Kaedi, will work closely with the MRVDP to ensure adequate protection against all predators.

4. The Ministry of Rural Development Planning Cell (CP) must

review all agricultural and rural development projects in Mauritania to see that they conform to national priorities as laid out in the Economic and Financial Reform Program (PREF). They participate in preparing studies for, monitoring and evaluating all MDR Projects. They have coordinated MRVDP meetings in Nouakchott with the SONADER and have participated in discussions on project planning.

5. The Agricultural Statistics Service (ASS) in Nouakchott is charegd with collecting and analyzing data on crop agriculture and herding throughout the country. They have regional offices in certain areas, including Kaedi. They are eager to collabroate with the MRVDP in ensuring compatible data collection and in coordinating analyses of that data. They will also be able to carry out specific studies funded by the project.

THE PEACE CORPS:

The Peace Corps has agreed to furnish four volunteers to help with extension and monitoring for the MRVDP. The Peace Corps currently has 60 volunteers in country, split between agriculture and health programs. As volunteers are already assigned to the SONADER, this program will simply be expanded to include the four MRVDP volunteers.

THE PRIVATE SECTOR:

1. The General Confederation of Employers (CGEM) in Nouakchott groups eight business associations whose purpose is to protect the rights of the private sector and to promote investment opportunities. The CGEM is not particularly active in Kaedi at this point but is ready to promote private investment in any viable projects which the MRVDP can identify. They will publicize these opportunities and attempt to help marshall investors' groups.

2. In Kaedi, there are three main groups of merchants interested in the rural sector: Chaitou Freres, Chaitou Fils and the Palikaba. All three stock small quantities of tools, vegetable seeds and other inputs chosen it seems, almost at random. All can procure, within Mauritania, any other input that may be needed, from fencing to herbicides to veterinary medicines. The Palikaba have agreed with the Africa 70 Project to run their Agricultural Input Supply Center. Chaitou Fils carries out construction and pre-fabricated cement work contracts for the SONADER. All are eager to supply the MRVDP with anything we want. The Palikaba is the only one to actively participate in sorghum and niebe marketing. Until now, they have oriented themselves toward the Guidimaka, but are willing to look to entering the Dirol Plain market if production justifies it.

3. There is one bank in Kaedi, the BMDC. They have no powers of decision and give no agricultural credit at all. The project can establish accounts there if necessary.

Further details on these institutions are presented in the Institutional Analysis Annex.

FN: REUNION

COMPTE RENDU DE LA REUNION DES PAYSANES DE LA PLAINE DE DIROL

A BAGODINE LE MARDI 12/05/87

Dés l'ouverture du débat un intervenant demande à Elimane de Bagodine de reprendre les propos qu'ils ont tenus devant l'assemblée. Avant de répondre Elimane demande à Gaide de leur parler du but de la rencontre. Dans son intervention Gaide a fait savoir qu'ils ont là pour discuter avec eux des problèmes du barrage : vous nous avez toujours dit que les terres vous appartiennent et les investissements vous appartiennent. Nous avons procédé à des enquêtes qui nous permettent de voir comment sera réalisé le barrage. Après la réalisation du barrage il se peut que l'Etat la prenne en cahrge. Dans le cas où vous le prenez en charge, il sera difficile mais nous pouvons procéder par la méthode de "Asakal", selon les capacités des individus et leur étendu de terres cultivables, ainsi vous pouvez vous organiser pour entretenir le barrage. Mais ces points évoqués sont des propositions et il vous reviendra de décider. J'ai toujours tenu le même language à tous et de tout temps le même language et je suppose qu'il serait plus facile si chaque village arrive à s'organiser.

Un intervenant demande si l'idée du barrage vient d'eux, des Américains ou de l'Etat ?

Dans sa réponse Gaide a fait comprendre que le barrage constitue une aide au paysan controleur de la situation actuelle des paysans. Est ce que après la réalisation du barrage il nous

reviendra l'entretien ?

Gaide a fait comprendre qu'après la réalisation du barrage il leur reviendra de l'entretenir.

Un intervenant a dit que le barrage constitue une grande importance mais ce qui leur importe c'est le démarrage, et sa question est : si après le barrage toutes les terres seront innondées ?

Dans sa réponse Gaide a fait savoir que leur responsabilité se limite à létude et dans l'explication technique du barrage mais qu'ils ne peuvent garantir dès à présent que toutes les terres seront innondée.

Le représentant de Dawalel se demande après la réalisation du barrage comment leur pirogues peuvent naviguer ?

Gaide a fait comprendre que cette question est pertinante et qu'il n'est pas spécialisé dans ce domaine pour donner une réponse consistante. Mais en période d'ouverture du barrage pour la montée des eaux il est bien possible que les pirogues puissent naviguer mais pas à tout moment qu'on peut ouvrir pour leur céder le passage de sortie. Dans tous les cas ces points sont notés nous allons trouver des solutions et cela permettra de mieux .... sur cette question.

Un intervenant demande après la réalisation du barrage si les terres restent à eux et si l'innondation des terres est certaine ils demandent la réalisation du barrage.

Gaide dans sa réponse dit que la réalisation est certaine mais c'est le maintien et l'entretien du barrage qui risquent de poser des problèmes, c'est le but de notre entretien. Il est ..... dans le débat que les pays sont toujours organisés en coopérative, le système de "Asakal" est plus facile.

Un intervenant suppose que le systeème de "Assakal" est destiné aux pauvres du fait qu'ils sont des musulmans. L'idée de coopérative est bonne mais le "Asakal" ..... les gens, nous pouvons adopter un autre système de part sociale autre que le "Asakal".

Gaide a fait savoir que dans la société traditionnelle il a toujour existé un système de "Asakal".

Un intervenant demande l'élimination du mo "Asakal"

Gaide a fait comprendre que le "Asakal" est un geste, une action que chacun est libre de donner cela fait partie de notre organisation traditionnelle donc il peut repréasenter une part sociale.

Un intervenant a dit que le "Asakal" fait partie de l'organisation traditionnelle mais il n'est pas question d'en faire une part sociale.

Dans son intervention Gaide a fait comprendre que l'idée de "Asakal" n'est pas l'objet de la réunion, il a toujours demandé une consultation préalable entre eux avant de se prononcer au cours de la réunion.

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Un intervenant a dit que le "Asakal" n'est jamais utilisé pour la coopérative et ce qui constitue la contradiction principale du débat donc essayons de trouver une méthode autre que le "Asakal"

Un intervenant suppose que Gaide maintient toujours sa position mais il ne doit pas nous imposer l'idée de "Asakal" et il reviendra à nous de nous organiser.

Gaide a dit qu'il n'impose rien mais c'est une idée pour faciliter la contribution de tout le monde parce que tous les paysans n'ont pas les mêmes moyens ni la mêmes étendue de terre.

Un intervenant a dit que Gaide a .... la polimique, pour le "Asakal" il nous revient de décider. Nous optons un autre système de coopérative.

Gaide de sa réponse a fait comprendre que le système de "Asakal" constitue le procédé le plus simple et moins coûteux pour les paysans. L'idée de créer une coopérative ne se limite seulement à se .... mais aussi à d'autres domaines. Vous ne devez pas toujours compter sur l'état. Maintenant vous êtes libres de décider, consultez vous et optez le système de coopérative qui vous convient pour entretenir le barrage.

Un intervenant demande s'ils n'ont plus besoin du barrage qu'est ce qu'il en sera, parce que l'idée de "Asakal" commence à entrainer des doutes à leur niveau. Si vous n'êtes pas d'accord avec nous sur l'idée de ... une coopérative autre que le "Asakal" nous renonçons au barrage.

Gaide répond en leur disant que leurs idées sont bonnes mais il faut des arguments pour convaincre l'assistance.

Un intervenant a parlé de signature d'accord mais qu'ils ne le feront pas avec les Américains parce qu'ils les connaissant pas ils feront cette signature avec ceux qui sont chargés de l'étude du projet à savoir les nationaux. Et si réellement le barrage coupe nos relations avec nos frères sénégalais nous n'avons pas besoin du barrage.

Gaide dit que si le barrage les intéresse on trouvera un moyen de communique avec leurs frères Sénégalais, Gaide poursuit son intervention et dit qu'il laisse tomber l'idée de "Asakal" mais qu'il les fait comprendre qu'ils n'ont mûri leurs idées. Maintenant nous vous décidez ce qui vous convient.

Un intervenant dit que le "Asakal" est exclu et au'il leur revient la tâche de décider leur système de coopérative.

Un autre intervenant dit que quelaue que soit le système de coopérative adopté les changes d'entretenir le barrage leur reviennent. Nous nous connaissons assez pour comprendre ce dont quelau'un d'entre nous est capable de contribuer. Pour la coopérative ce qui peuvent donner leur part sociale en mil le font, ou d'autre en espèce tant mieux.

Un intervenant suppose que pour Gaide le "Asakal" est un moyen plus facile et moins coûteux mais le "Asakal" est un aspect religieux qui ne doit pas être lié à la coopérative et quelques soient les arguments avancés au cours de la réunion il revient à

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Gaide de voir ou d'étudier l'apport économique au niveau des paysans.

Gaide dans sa réponse a fait savoir que l'idée de "Asaka" n'est pas une mauvaise intention, il est ressorti dans le débat que vous pouvez vous organiser en coopérative pour entretenir le barrage, mais il faut réfléchir sur le coût de l'entretien. En conclusion vous acceptez le barrage et chaque village s'organisera en coopérative.

Max a pris la parole pour remercier tous les paysans de la plaine qui ont effectué le déplacement à Bagodine pour assister à la réunion. Max a exprimé sa fierté de voir les paysans s'exprimer librement au cours de la réunion ce qui a permis de comprendre leurs idées sur la réalisation du barrage. Max a dit que les idées sont claires, ils ont compris et tiendront compte de ce qui a été débattu. Ainsi la séance a été levée.

INSTITUTIONAL ANALYSIS ANNEX

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Gorgol Herder Extension Project
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Governorate of the Brakna
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ANNEX: INSTITUTIONAL ANALYSIS

The MRVDP will seek to establish an institutional base that will ensure that project benefits continue to accrue to the villagers of the Dirol Plain after the PACD. The implementing agencies will construct this base on two foundations: the traditional institutions of the people who farm the Dirol Plain and GIRM institutions in Kaedi.

Traditional Institutions:

The PID Social Soundness Analysis presents the political and socio-economic characteristics of the Dirol Plain in some detail. The families, villages, clans, and fractions of the Poulaar and the Haratine farmers who practice recessional agriculture on the Plain are the basic blocks of which the project structure is built. The people of the Plain have expressed a good deal of eagerness to participate in the planning and execution of the MRVDP. Their system of land tenure is particularly well adapted to the recessional farming system they have employed for centuries and which the MRVDP will improve and make more secure but not fundamentally change. Their system of collection of local taxes for local use also fits well with the need to generate funds for the maintenance of the floodgate the project will build at the mouth of the Dirol Creek.

The MRVDP will not have to interfere in traditional land tenure arrangements, in local taxation institutions, or in tribal or familial political and economic structures to ensure implementation success. If the project can provide technical training and organizational support to existing village and Plain-wide institutions, their ability to support increasing agricultural production and thus income and welfare among their adherents will become effective and self-sustaining.

The only institutional inovation the MRVDP will introduce are the creation of a Dirol Plain Water Users Association and of Village Resource Center Associations. These two types of association are based closely on traditional forms of social organization. They represent adaptations to modified traditional conditions rather than inventions to cope with radical departures fromtraditional ways.

GIRM INSTITUTIONS IN KAEDI:

The villagers participating in the MRVDP will need intensive training and support during the first few years of project activity. However, this need should diminish over time as the activities become self-sustaining. In the long run, light training and extension coverage and continued adaptive research on improving recessional crop yields should furnish the impetus needed to keep the Dirol Plain moving toward continued growth and prosperity.

This long term support can only come from GIRM agencies permanently established in Kaedi. For this reason, these agencies must join in the implementation of the MRVDP from the beginning as principal actors in the process of planning and implementing the activity. If the MRVDP is set up with a semi-autonomous institutional structure on the model of the DRIG or the FAO Seed Multiplication Project, the permanent agricultural sector institutions in Kaedi will be removed from the vital center of the activity and fail to assume their role, which is so necessary to long-term success.

However, these GIRM agricultural institutions lack personnel, transport, materials, and technical and managerial skills. The MRVDP will furnish funds, material, and personnel to these institutions to help them extend their activities to the Dirol Plain. This support will be coordinated with that provided by other institution-building projects in Kaedi, including AGRES-II (USAID), Seed Multiplication (FAO), Livestock Improvement (FAO/CCCE), SONADER support (FED), Agricultural Extension (FAO) and Crop Protection (USAID). The MRVDP will help collaborating GIRM institutions build their capacity to work with recessional agriculture, but will have to do so without imposing onerous burdens on the already over-strained technical and managerial resources of those institutions.

The MRVDP should work as an institution-less project, whose main focus is on building institutional capacity in the Kaedi agricultural sector which surrounds it. The project itself should contain only the TA team and their housing, equipment, and vehicles. Everything else, including counterparts, subordinate personnel, and office space should come from collaborating GIRM institutions in Kaedi. This is the only way to ensure that the organizations presented below accept theproject as their own and work on it with apprpriate dedication and efficiency.

The MRVDP has the good fortune to be situated in Kaedi, where a number of agricultural institutions already work. All of these have agreed to collabroate to the best of their abilities and capacities with the MRVDP. The principle among them will be the ENFVA, the CNRADA, the IAG, and the SONADER. Others will join the effort as required.

In addition a number of other donor-financed projects in Kaedi are ready to parcipate in the early phases of the MRVDP when intensive extensio training and monitoring will be needed on the Plain. Private sector groups will also have roles to play, as will national-level GIRM institutions in Nouakchott.

The information given below on these institutions is preliminary and the agreements proposed with them are tentative. This analysis will have to be fleshed out during the PP preparation and final propositions made to each collaboring group.

ECOLE NATIONALE DE FORMATION ET DE VULGARISATION AGRICOLE (ENFVA)

The Mauritanian National Agricultural Training and Extension School in Kaedi (ENFVA) trains all of the Ministry of Rural Development's lower and mid-level agents. The ENFVA has two cycles: the C Cycle is for primary school graduates who do three years at the school and come out with degrees in either agriculture, environmental protection (forestry), animal science, agricultural engineering, or extension and cooperative management. These graduates are known as Moniteurs de l'Economie Rurale, Infirmiers d'Elevage, or Agents Cooperatives. This level is the aproximate equivalent of the Brevet which students btain from Colleges adn Lycees.

The B cycle is for those students with a Brevet or more. They do a further three years at the school, in one of the same fields as the C Cycle students, and obtain a degree which is the aproximate equivalent of the Lycee Baccalaureate. They are known as Conducteurs de l'EConomie Rural, Assistants d'Elevage, etc. Students with this degree have been admitted to US universities and done well in BS courses.

The ENFVA presents all its courses in both a French and an Arabic version, although the French-language staff is far larger than that of the Arabic speakers. These latter are largely represented by three Sudanese professors, funded by the Organisation Arabe de Development Agricole (OADA).

The ENFVA has classrooms, laboratories, stables, a demonstration farm (which includes a parcel of irrigated land on the Perimetre Pilote du Gorgol (PPG)), offices,storerooms, dormitories, housing for its staff and in general, the infrastructure it requires. Through 1985, the GIRM guaranteed all of its graduates jobs in the Ministry of Rural Developmen or in a parastatal organization like the SONADER. In 1986, this guarantee ended, but all graduates were, in fact, hired by the administration. For 1987 graduates, this will be more difficult and the students are aware of the need to get out and hustle for work. However, many of the B Cycle students are government officials who have worked for three years or more before qualifying for admission to the upper-level course. Many of these already possess the C level diploma. Their places in the administration are saved for them when they return to school.

The Director of the ENFVA, Mr. Lam Hamady, has degrees in Soil Science from Ohio State and CalPoly/San Luis Obispo. He has served as the national Director of Agriculture and is amuch respected member of the agricultural establishment in Mauritania. His administration includes an agronomist whoserves as Director of Studies and Professor of Agronomy and an Orientation Advisor,

who is also an Assstant d'Elevage and gives courses when needed.

The staff includes:

Boubacar Conte, agronomist, head of the Irrigation/Rural Engineering Section;
Sidya o/ Abdallahi o/ Youssouf, agronomist, Director of Studies;
Bathily Abdul Karim, agronomist, Head of Crop Production Division;
Haidara Hamet Brahim, OADA agronomist, Crop Production;
Nongo Samba, Conducteur, Crop Production;
Dia Amadou Tidiane, Animal Scientist, AnimalProduction/health;
Biri Bocar Sidibe, animal scientist, Prof of Animal Science;
Dr. Souleyman, OADA DVM, animal health;
Mohammed el Habib Bal, Forester, Head of Nature Protection Division;
Ndongo Harouna, Animal Scientist, Head of AnimalProduction and Health Division;
Mubarek, OADA Forester, Nature Protection;
Bathily Alassane Diabi, ITA, head of the Extension and Farmer Training Division;
Kane Ibrahima, Conducteur, Assistant in Extension Division;
Diallo Oumar, Conducteur, animal traction specialist in Extension and farmer training division;
Ba Alassane, ITA, Prof of Mechanization, Rural Engineering;
Kane Mohammed Lamine, ITA, Prof of Nature Protection;
Galedou Sanunu, Conducteur, Nature Proection.

In addition, the school has hired professors of topography, FRench and Arabic on an hourly basis.

Note: The categories, agronomist, animal scientist, and forester correspond to the level of a French Ingenieur agronome. An ITA is an intermediate post-secondary degree, approximately equivalent to a technical AA or AS degree. Conducteurs are graduates of teh ENFVA's own B Cycle.

Seven members of the ENFVA staff are now in the US receiving long-term training. Their return will upgrade the level of teaching at the school significantly.

Currently there are 123 students in the ENFVA. They are distributed more less equally between Arabic and French courses and among the three major divisions of the MDR: Agriculture, Animal Husbandry, and Nature Protection. The Rural Engineering Section is just beginning now.

The ENFVA answers to a Board of Directors (Cnseil d'Administration)named by the MDR. This board includes:
Chairman: Head of the Planning Cell of the MDR
Members: Director of Rural Engineering
Director of Agriculture

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Directorof Animal Husbandry
Director of Nature Protection
Rep of MinFin.
Rep of UTM
Rep of Students
Rep of MinEdNat
Directorof Public Administration

Collaboration between the ENFVA and the Dirol PLain Project (MRVDP) should prove advantageous for both.

a. ENFVA faculty are trained and experienced in different fields of agricultural development. They know the Kaedi area quite well and speak the different languages practiced on theplain (Poular and Hassaniya, principally). The Director assures us that appropriate facultymembers, chosen after consultation with MRVDP staff, will be available for participation in evaluation missions, for the eventual analysis of project activities in order to add or subtract new ones, and for on-going monitoring and evaluation work. The MRVDP would provide local currencyfunds for per diem, fuel, materials, etc. The ENFVA would continue to pay the salaries of their personnel. This will save theproject from the expense of bringing GIRM evaluation andredesign participants from Nouakchott and avoid a certain amount of expatriate STTA.

b. ENFVA students make regular field visits of 2 to 3 days to surrounding villages. There they propose specific extension themes to the villagers or carry out focussed studies. The Director has said that if the project can supplylocal currency for the transport, per diem (frais de parrainage, in this case), andmaterials as needed for the students, they will give priority to MRVDP villages and include project themes, studies, monitoring, and research supervision in their program. MRVDP personnelwould mee with theheads of the ENFVA Divisions at thebeginning of each school term todetermine a schedule for these visits, which will save the project from having to hire observers to place in participating villages.

c. When apropriate, the MRVDP could rent ENFVA facilities to conduct training courses in technical subjects for participating villagersand cooperative groups. ENFVA faculty wouod be available to help excute these training programs as their schedules permitted. The MRVDP would pay the ENFVA for the use both of facilities and personnel at agreed upon rates in local currency. In this way, the project can avoid schedulingall but minimal amounts of STTA in fields such as training, cooperative organization, vegetable production and animal science.

In return the MRVDP will:

a. make its staff, both long and short term available to give

lectures and lead seminars at the ENFVA in their fields of expertise.

b. include the Director of the ENFVA as a member of the Coordinating Committee of the MRVDP.

c. invite ENFVA faculty to seminars arrangedby the MRVDP.

d. establish on-going contacts between the ENFVA and Universities, PVO's and/or companies carrying out the project to permit long-term exchanges profitable to both institutions.

The ENFVA is accustomed to organizing training courses at the request of cooperating institutions. Each August the Peace Corps brings its new agricultural volunteers for a one month course on vegetable gardening and general agriculture. In December, the school organizes an annual 7 to 10 day seminar forprimary school teachers to prepare them to implement school gardens in their villages.

In addition, the Ministry of Health and Social Welfare organizes periodic courses of a week or so for their rural 'monitrices'. The subject of the course is usually vegetable gardening and nutrition. In addition women's cooperative members often come for one week seminars on similar themes.

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THE NATIONAL AGRICULTURAL RESEARCH CENTER
CNRADA - KAEDI
AGRES II

Before Mauritania became independent and for a number of years thereafter, the country had no independent agricultural research institutions. In 1974, with French assistance, the country created the Centre National de Recherche Agronomique et du Developpement Agricole (CNRADA) in Kaedi. The CNRADA has received varying amounts of French technical and financial assistance since then and there is still one French expert working in the cereal crops section of the center. About a year and a half ago, USAID placed a team in the CNRADA for the first time. Two experts from the University of Arizona have undertaken an institution building program to help the CNRADA with internal management and with using farming systems research techniques (FSR) to help establish a program of on-farm trials and demonstrations which will enable CNRADA results to reach and be useful to the consumers of research in Mauritania: small-holding rainfed, irrigated and recessional farmers.

Since its birth, the CNRADA's primary goal has been the identification of cereal varieties adapted to Mauritanian conditions. The center has not undertaken fundamental agronomic research, but rather has limited itself to testing the adaptability of rice, sorghum, maize and other crops developed at other stations throughout the world. The CNRADA has established on-going relationshps with IITA, ICRISAT and SAFGRAD as well as with US research centers connected to the Universityof Arizona.

The CNRADA's primary success has been in identifying four varieties of rice which produce up to 6T/ha on irrigated perimeters in optimal conditions. In addition, they have identified three varieties of sorghum which, under irrigated conditions, yield up to 4t/ha and up to 2.5T/ha with good rainfed conditions (CE151, CE145; CE90). CE 151 is now under multiplication in Boghe and at the CNRADA, as well as by contractual farmers supervised by the FAO Seed multiplication project. It has apparently spread widely throughout the Guidimaka as a rainfed variety.

The CNRADA has only recently begun testing some recessional sorghum varieties. Traditional varieties (same, ndabiri) seem to give reasonable results with low levels of inputs. However, much work remains to be done in recessional crops. In the past, the center has concentrated on irrigated experiments to ensure results. Now they are ready tomove out into the field to apply FSR techniques to establish better links with recessional farmers. They have alarge collection of sorghum varieties they would like to try out in the walo.

The CNRADA has spent alot of effort on determining ne best farming practices to apply with the new varieties they test. These experiemnts have also had encouraging results.

The staff of the CNRADA is welltrained and energetic, but there are too few of them.

Director: Diarra Mamadou, agronomist (USSR)
Technical Director: Ngaide Hamath, MS (USA)
Cereal Crops Division Chief: Sidi Fall, Agronomist.
Cereal Crops advisor: Mr. Debos, FAC
Rice Division Chief: Sidi Fall (a.i.)
Fruit/Vegetable Division Chief: Ba Mamadou Lamine, Agronomist (France)
Pre-extension division chief: Sidio/ Rachid, Conducteur
Crop Protection Division Chief: vacant
FAO Seed Project: Ngam Abou Oumar, Agronomist
Vicenzo Avitabile, agronomist
Diallo Abou Beri, agronomist
OMVS Feedlot Unit: Ba Mamadou Abdoul, agronomist/pastoralist

Thus here are 7 Mauritanian researchers, including the (useless) head of the OMVS feedlot program. This latter and the seed program depend directly on the Director of the CNRADA. The Director technique supervises the other divisions. IN addition there are 5 expatriates: 1 from the FAC, 1 from the FAO, 2 from the Universityof Arizona and 1 UNV, who works in the seed program.

The CNRADA is ready and eager to collaborate with the Dirol Plain Project (MRVDP) as much as possible. The mostimportant aspects of this collaboration would include:

a. the use of CNRADA reseach results for on-farm trials of varieties and techniques in the Dirol Plain walo. Thiswould also include demonstrations and trials of new crops. CNRADA staff would help train MRVDP staff tocarry out these experiments or else the MRVDP could finance new staff members for the CNRADA. The MRVDP PCV's would also receive training from the CNRADA is establishing, following and evaluation on-farm research and demonstrations.

b. CNRADA staffwill participate in evaluation missions, studies, planning sessions and seminars implemented by the project.

c. The CNRADA will provide seeds, training, research protocols, supervision and evaluation of on-farm trial and demonstration results.

d. The CNRADA will name a member of the Coordinating Committee for the MRVDP. This willpresumably be the Technical Director or the Head of the Cereal Crops Division.

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e. CNRADA senior researchers will visit the Plain regularly to help plan and implement project activities.

f. fruit tree seedlings are available to the Rindiao experimental perimeter, on the edgeof the Dirol Plain. For 200UM/tree, participating villagers can obtain mandarin, orange, lime, pomelo, mango, guava, and banana seedlings. Most citrus and mango varieties are grafted.

In return, the MRVDP will:

a. provide local currency as needed to the CNRADA (no payments will be made to individuals, only to the institution) for personnel, transport, materials used for programs on the Dirol Plain in the context of the MRVDP.

b. provide the oppurtunity for closely supervised on-farm trials and demonstrations of CNRADA crops, varieties and techniques.

c. include CNRADA representatives in seminars, conferences, studies and missions organized by teh project.

There is a strong possibility that the CNRADA and the ENFVA, along with the Centre National d'Elevage et de Recherche Veterinaire (CNERV = National Veterinary Research Center), will join to form a single agricultural support agency for Mauritania. The Plan de Redressement Economique et Financier (PREF) calls for this union to take place in 1987. The PID team feels that action this year is unlikely, but that the union of the three institutions will ease coordination and collaboration,not make it more difficult. It should thus not effect the institutional analysis presented here.

THE AGRICULTURAL INSPECTORATE OF THE GORGOL
KAEDI

The Agricultural Inspectorate of the Gorgol in Kaedi (Inspection de l'Agriculture du Gorgol - IAG) is headed by Moussa Pere Ndiaye an agronomist trained at the Superior Rural Institute at Koulikoro in Mali. He has led the Gorgol Inspectorate since May 1985. He has eight technicians to help him including his Assistant, Gacko, a graduate of the B Cycle at the ENFVA, who also acts as the Sector Chief for the Department of Kaedi. It is thus he who is responsible for those parts of the Dirol Plain which are in the Gorgol. Three of his people work within the FAO Agricultural Extension Project (2 conducteurs and 1 moniteur, including the Sector Chief for Mbout who is Kane Abdoul Karim, another DRIG veteran). There a Conducteur in Maghma as Sector Chief, another in Kaedi as head of Crop Protection, and a third in charge of vegetable gardening. In addition, he has a conducteur in charge of pre-cooperative groups (this one is a woman) and another woman, a moniteur working with Africa 70 on vegetable gardens.

At this time of the year, the sector is working mainly on vegetable gardening. This year they gave tools and seeds away for free. They don't know what will happen next year.

In cereals agriculture, they work largely on crop protection. They have a stock of explosives to use against birds, blowing up their dormitories. They are inactive now, as they have run out of blasting caps (amorces) for their explosives. They expect more soon. All MRVDP cropprotection activity willbe coordinated through the Crop Protection Service, whichhas a labroatory near the ENFVA, as well as personnel in the Inspectorate.

They have noted a lot of both black and white smut in the walo this year. As usual, they made a distribution of free fungicides. The farmers can either bring their seeds to the Inspectorate for free treatment, or else can get the powder from agricultural agents in their home area. However, there is always a shortage of powder and few peasants can make the trip to Kaedi for the more effective treatment in the Inspectorate mixer. This mixer is portable and they do lend it out from time to time to other organizations.

For two years now the FED has financed the purchase of large quantities of sorghum seeds in the Gorgol. Two years ago, they bought anything they saw, but last year they were more selective and got good seed. However, this is not selected seed, chosen for any specific characteristic. Rather, it is sorted seed, chosen for good health and appearance. This seed has not yet been distributed, so the Inspector does not know whether it will be sold, given away, used for food or whatever.

The possibilities of collaboration with the sector include supervision of farmer traing, extension work, crop protection and

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input distribution. The IAG has very limited means and for them to work beyond the relatively small amount of the plain in the Gorgol region the FAP PVA would have to get the Dirol Plain declared a special priority zone. This does seem possible and in that case, the IAG becomes a prime candidate tocarryout extension activities for the MRVDP.

In anycase, the Inspector agrees that our villages can be given priority for whatever inputs the sector receives (if we want them!) and that his people will gladly cooperate with us on planning, supervising, monitoring, evaluating project activities. The project should keep the Inspectorate informed of its activities atall times and include them wherever possible in studies, missions, and seminars.

THE AGRICULTURAL STATISTICS SERVICE
KAEDI

The Agricultural Statistics Service in Kaedi was founded in January 1986 to decentralize the work of gathering information about agricultural production in Mauritania to the regional level. For the moment they are only an executing agency, receiving questionnaires from Nouakchott for local farmers to fill out and sending the completed instruments back to Nouakchott for sorting and analysis. The Gorgol Service is housed in a dormitory room at the ENFVA, since the explosion at the Agricultural Sector eradicated their offices late last year. Their staff includes two graduates of the ENFVA B cycle: Diallo Baidi, the Director and Moussa Kamara, his assistant. There are also three research assistants (enqueteurs), who have atleast three years ofpost-secondary training and undergo a two week seminar before beginning work. These latter are contractual personnel, not functionaries. Finally, the Service hires observers to actually fill out the questionnaires with the villagers. These are local people, chosen among the villagers of the area to be surveyed.

In 1986, the service covered both the Brakna and the Grogol, but in 1987, the Brakna got its own office. This year, they observed 27 zones. Each zones is approximately one village, but may be more if the population isinsufficient in the village chosen. The 1984-85 census constitutes their base document. In each observation zone, they choose a number from a random number table and begin with the family having thatnumberon the census list. They continue from there in roder of the census until they have 100 households. If the originalvillage is too small, they go to thenearest village to continue. They then choose ten families within the 100 by taking another random number to start with and choosing each tenth family from that number. They then follow these ten families throughout the agricultural season: three visits during the rains and three during recessional agriculture.

- o first visit when seeds sprout
- o second visit on month later
- o third visit at harvest time

A Copy of their survey instrument for each visit is attached to this report.

They measure the fields, measure out yield squares (carres de rendement) of 10x10 for sorghum/millet and 3x3 for maize, count the pockets in the field and observe any attacks by insects, birds, rodents or other enemies, including diseases. During the second visit the select 5 pockets as a sample and count the stalks and classify them by their egneral state of ehalth. During the third visit, the harvest the 5 pockets, weigh the heads in teh field; thresh the heads and weight the grain; and finally dry the grain and weigh it to determine moisture content at harvest. The observers are paid per passage and per farmer. Thus they have

370x

to fulfill 6 tasks per season per farmer to collect their full recompense. Their current rate of pay is 2500 per passage for all of their families. Thus they can earn a total of 15,000UM/year.

Several of the Dirol villages have found themselves in the sample:

Oulom Nere 1986-87
Oulom Hattar 1985-86
Bagoudine 1985-86
Mbagne 1985-86
Dawolel 1986-87 (done from Boghe)

The Kaedi service has not yet received any reports back based on data they colleted. They had one copy of the 1984-85 report, which I copied some numbers from (see below).

This service should be checked out more carefully during PP development to see to what extent the MRVDP can entrust it with certain monitoring functions. Possible uses of the service might include:

- using their trained observers to apply their instruments in participating villages to gather data comparable with national agricultural statistics;
- providing them with funds to hire and train other observers at their rates to apply MRVDP instruments for monitoring and evaluation activities.

Statistics from the 1984-85 Agricultural Census:

Table 1:

	pop77	pop84	menTot	menAG	menEl
Gorgol	131.577	227,525	35,244	27,348	8.918
Kaedi	50,469	59,143	8,817	5.031	1.206
Mbagne	21,009	31,315	5,148	4.232	681

types d'exploitation

	total	dieri	walo	other
Gorgol	38,621	21,966	4,846	1,809
Kaedi	8,245	2,515	4,936	794
Mbagne	5,477	3,954	1,525	---

Table 3 menages/activites

	total	ag	el	ag/el	other	oth/ag	oth/el
Gorgol	35,244	17,314	1,269	7,062	6,040	2,972	587
Kaedi	8,817	3,225	334	866	3,446	940	6
Mbagne	5,148	3,775	235	454	490	3	-

	tot/agri	tot/elevage
Gorgol	27,348	8,918
Kaedi	5,031	1,206
Mbagne	4,232	689

Table 4 size of farms

ha	Gorgol	Brakna
0-0.49	69 19%	79 30%
0.5-1	94 26	73 27.8
1-1.5	63-17	40 15
1.5-2	60 16	29 9.5
2-4	53 15	33 12.5
4-6	16 4	4 2
6-8	5 2	4 2
8-10	3 0.8	---
10-20	1 0.2	3 1
20-30		
30-40		
>40		1 0.2
ave:	1.6ha	1.5ha

mean of small farms 0.8ha
mean of medium farms 4.1ha
mean of large farms 19.4ha

Table 5 age/sex in %

	men				
	<14	15-25	26-40	41-64	>65
Kaedi	42	25	14	14	5
Gorgol	45	23	15	13	4
Mbagne	37	24	15	15	9
	women				
Kaedi	41	25	15	15	4
Gorgol	43	24	17	14	2
Mbagne	44	21	16	14	5

	H/F
Kaedi	49/51
Gorgol	52/48
Mbagne	50/50

Table 6: seeded area

	T/farmers	T/area	T/seeded	dieri	walo	other
Kaedi	5,031	7,437	6,798	1,596	4,435	767
Gorgol	27,348	34,233	26,890	13,526	11,586	1,782
Mbagne	4,232	5,334	2,813	1,914	899	-0-
RIM	97,379	207,700	155,269	114,954	36,740	3,575

Table 8: ha seeded/crop

	Gorgol	Brakna	RIM
sorghum	19,386	12,384	102,263
millet	1,146	4,037	22,170
maize	5,194	317	6,886
rice	717	159	1,909
cowpea	69	455	4,339

table 11: % of farmers selling part of harvest

	sell	don't sell
Kaedi	3.8%	96.2%
Gorgol	5.8	94.2
Mbagne	-0-	100.0

Republique Islamique de Mauritanie

MINISTERE DU DEVELOPPEMENT RURAL ---------- H.F.J.

SERVICE DES STATISTIQUES AGRICOLES

SUIVI, PREVISION ET EVALUATION des CULTURES

PREMIER PASSAGE

de la parcelle REF : /_ /_ /_ /_ /_ / C1

REG DP ST GR

Enquêteur: _____

Superviseur: _____

1.REGION _____/DEPARTEMENT _____/VILLAGE _____

2.GRAPPE N° /_/ /NOM DU PRODUCTEUR_____/NUMERO DU PRODUCTEUR_____/ C2

3.DATE DE RELEVE /_ /_ /_ /_ /_ /_ /
jour mois annee

4.NOMBRE CHAMPS SEMES EN: DIERI /1/_ /_ / C3 WALO /2/_ /_ / C4 B FOND /3/_ /_ / C5 AUTRES /4/_ /_ / C6

5.NUMERO DU CHAMP /_ /_ /_ / C7 NOMBRE DE PARCELLES /_ / C8 PARCELLE N° /_ / C9

6.PREMIER SEMIS: Mois /_ /_ / C10 Quinzaine /_ / (1 ou 2) C11

7.LEVE DE LA PARCELLE

	COTE	ANGLE		COTE	ANGLE
AB	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	FG	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
BC	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	GH	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
CD	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	HI	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
DE	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	IJ	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
EF	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	JK	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /

ERR % : /_ / , /_ /_ /_ / SUPERFICIE /_ /_ / , /_ /_ /_ / C22

8.DENSITE DES CULTURES : DIMENSION DU CARRE /_ /_ / X /_ /_ / m C12

NOMBRE DE POQUETS : TOTAL /_ /_ /_ / C13

CULTURE	CODE	PAR CULTURE		
_____	___	/_ /_ /_ /	C14	C15
_____	___	/_ /_ /_ /	C16	C17
_____	___	/_ /_ /_ /	C18	C19
_____	___	/_ /_ /_ /	C20	C21

codes des cultures

SORGHO 1
MIL 2
MAIS 3
RIZ 4
NIEBE 5
PASTEQUE 6
AUTRES 7
(a preciser)

9.APPLICATION THEME TECHNIQUE : -Semence traite /_ / C23 oui=1
-Emploi engrais /_ / C24 non=0

10.DEGATS SUR LES CULTURES

	TYPES	GRAVITE	NOMBRE POQUETS ATTAQUES	
1 Sauteriaux	/_ /_ /	/_ /	/_ /_ /_ /	C25 C26 C27
6 Secheresse	/_ /	/_ /	/_ /_ /_ /	C28 C29 C30
7 Autres (a preciser)	/_ /	/_ /	/_ /_ /_ /	C31 C32 C33

GRAVITE DE L'ATTAQUE

PAS D'ATTAQUES.....0
FAIBLE ATTAQUE SUR FEUILLES OU EPIS.....1
MOYENNE ATTAQUE SUR FEUILLES OU EPIS.....2
IMPORTANTES ATTAQUES SUR FEUILLES,TIGES ET EPIS.
DESTRUCTION DES JEUNES PLANTULES.....3

Types de Depredateurs

1 SAUTERIAUX : oedalaeus.....1
autres.....2
2 CANTBARIDES : psalydolitta vestita.....1
autres.....2
3 OISEAUX : moineau dore.....1
autres.....2
4 MALADIES : charbon.....1
autres.....2
5 M. HERBES : striga.....1
autres.....2
6 SECHERESSE : 1
7 AUTRES : a preciser.....1

2 741

وزارة التنميه الريفية
الكتابة العامة
مصلحة الإحصاء الزراعي

تحقيق لمتابعة المزروعات
وتقدير الحصاد الزراعي

الدور الأول

1- الولاية ____ المقاطعة ____ القرية ____

2- المركز ____ إسم المنتج ____ الرقم ____

3- تاريخ التحقيق ☐☐☐☐☐☐ (اليوم الشهر السنة)

4- كم عدد المزارع التي تم تحديدها: زراعة مطرية ☐☐ وفيضانية ☐☐ أودية ☐☐ أخرى ☐☐

5- نوع المزرعة ورقمها ☐☐ عدد القطع بالمزرعة ☐☐ القطعة رقم ☐

6- البند الأول: الشهر ☐☐ نصف الشهر ☐ (1 أو 2)

7- حساب مساحة القطعة الزراعية ☐☐,☐☐ الخطأ ☐☐,☐☐

الزاوية	الأضلاع	الزوايا	الأضلاع
☐☐	☐☐,☐☐	☐☐	☐☐,☐☐
☐☐	☐☐,☐☐	☐☐	☐☐,☐☐
☐☐	☐☐,☐☐	☐☐	☐☐,☐☐
☐☐	☐☐,☐☐	☐☐	☐☐,☐☐
☐☐	☐☐,☐☐	☐☐	☐☐,☐☐

8- الكثافة الزراعية: إعداد المربع لحساب الكثافة ☐☐ × ☐☐

الزراعات داخل المربع	الوليد	عدد الجور لكل زراعة على حدة	مجموع عدد الجور داخل المربع ☐☐
		☐☐	
		☐☐	
		☐☐	
		☐☐	

9- التطبيق الفني

- معالجة البذور ☐ نعم = 1
- إستعمال الأسمدة ☐ لا = 0

نوعية الحشرات الضارة

1- الخنافس { جراد أسود = 1 ، جراد آخر = 2
2- الحشرة الحارقة { الفارسية = 1 ، حشرة أخرى = 2
3- الطيور { السط = 1 ، طيور أخرى = 2
4- الأمراض { العجم = 1 ، مرض آخر = 2
5- الحشائش
6- الجفاف

10- الآفات الزراعية

	النوعية	درجة الإصابة	عدد الجور المصابة
1- الجراد	☐☐	☐	☐☐
6- الجفاف	☐☐	☐	☐☐

دليل الإصابة:
لم تصب = 0
إصابة ضعيفة على الأوراق أو السنابل = 1
إصابة متوسطة على الأوراق أو السنابل = 2
إصابة قوية على الأوراق، الخروع موت النبات = 3

Republique Islamique de Mauritanie

MINISTERE DU DEVELOPPEMENT RURAL ---------- H.F.J.

SERVICE DES STATISTIQUES AGRICOLES

SUIVI, PREVISION ET EVALUATION des CULTURES

DEUXIEME PASSAGE

de la parcelle REF : /_ /_ /_ /_ /_ / C1

REG DP ST GR

Enqueteur: _____

Superviseur: _____

1.REGION _____ /DEPARTEMENT _____ /VILLAGE _____

2.GRAPPE _____ /NOM DU PRODUCTEUR _____ /NUMERO DU PRODUCTEUR /_ / C2

3.DATE DE RELEVE /_ /_ /_ /_ /_ /
jour mois annee

4.NUMERO DU CHAMP /_ /_ /_ / C3 NOMBRE DE PARCELLES /_ / C4 PARCELLE N° /_ / C5

5.DERNIER RE SEMIS: Mois /_ /_ / C6 Quinzaine /_ / (1 ou 2) C7 NOMBRE RE SEMIS /_ /_ / C8

6.LEVE DE LA PARCELLE

	COTE	ANGLE		COTE	ANGLE
AB	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	FG	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
BC	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	GH	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
CD	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	HI	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
DE	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	IJ	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
EF	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	JK	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /

ERR % : /_ / , /_ /_ /_ / SUPERFICIE PORTANT LA CULTURE /_ /_ / , /_ /_ /_ / C9

7.SUPERFICIE TOTALE DE LA PARCELLE: /_ /_ / , /_ /_ /_ / C10 ERR % /_ / , /_ /_ /

8.DENSITE DES CULTURES : DIMENSION DU CARRE /_ /_ / X /_ /_ / m C11

NOMBRE DE POQUETS : TOTAL /_ /_ /_ /

	CULTURE	CODE	PAR CULTURE
a	_____	___	/_ /_ /_ /
b	_____	___	/_ /_ /_ /
c	_____	___	/_ /_ /_ /
d	_____	___	/_ /_ /_ /

Pour le tableau de la droite, il faut tenir compte des codes : 1.Tige pouvant donner
2.Tige perdue

NOMBRE DE PIEDS PAR POQUET

	I		II		III		IV		V		POQS. POUVANT DONNER	TOTAL	
	1	2	1	2	1	2	1	2	1	2		1	2
a													
b													
c													
d													

9.APPLICATION THEME TECHNIQUE : -Demariage /_ / C12 -T.Phytosanitaire /_ / C13
oui=1
non=0 -Repiquage /_ / C14 -Emploi d'engrais /_ / C15

10.DEGATS SUR LES CULTURES

Pour les codes de type de depredateur, gravite de l'infestation, et du type de culture, voir le questionaire du premier passage ou la liste de codification

	TYPES	GRAVITE	NOMBRE POQUETS ATTAQUES
1 Sauteriaux	/_ /_ /	/_ /	/_ /_ /_ /
2 Cantharides	/_ /_ /	/_ /	/_ /_ /_ /
3 Oiseaux	/_ /_ /	/_ /	/_ /_ /_ /
4 Maladies	/_ /_ /	/_ /	/_ /_ /_ /
5 M.Herbes	/_ /_ /	/_ /	/_ /_ /_ /

11.ETAT PREVISIONNEL DE LA CULTURE

CODE	TRES BON	BON NORMAL	IRREGULIER	MAUVAIS
___	[]	[]	[]	[]
___	[]	[]	[]	[]
___	[]	[]	[]	[]
___	[]	[]	[]	[]

الجمهورية الإسلامية الموريتانية
وزارة التنمية الريفية
مصلحة الإحصاء الزراعي

شرف - إخاء - عدالة

الدور الثاني

تحقيق لمتابعة وتقدير المزروعات

1 - الولاية _____ المقاطعة _____ القرية _____

2 - المكرر _____ إسم المنتج _____ رقم المنتج _____

3 - تاريخ التحقيق |_|_|_|_|_|_|

4 - نوع ورقم المزرعة |_|_|_| كم غذ القطيع بالمزرعة |_| القطعة رقم |_|

5 البذر الأخير : الشهر |_|_| نصف الشهر |_| (1 أو 2) مجموع البذر |_|_|

6 - حساب مساحة القطعة الثابتة : |_|_| و |_|_| الخطأ الحسابي |_|_| و |_|_|

الأضلاع	الزوايا	الأضلاع	الزوايا
|_|_| و |_|_|	|_|_|	|_|_| و |_|_|	|_|_|
|_|_| و |_|_|	|_|_|	|_|_| و |_|_|	|_|_|
|_|_| و |_|_|	|_|_|	|_|_| و |_|_|	|_|_|
|_|_| و |_|_|	|_|_|	|_|_| و |_|_|	|_|_|
|_|_| و |_|_|	|_|_|	|_|_| و |_|_|	|_|_|

7 - المساحة الكلية القطعة |_|_| و |_|_| الخطأ الحسابي |_|_| و |_|_|

8 - الكثافة الزراعية : أبعاد المربع المخصص لحساب الكثافة الزراعية : |_|_| X |_|_|

مجموع الجور داخل المربع |_|_|_|

الزراعات داخل المربع	الدليل	عدد الجور لكل زراعة

عد السيقان في خمسة جور

الجورة الأولى		الجورة الثانية		الجورة الثالثة		الجورة الرابعة		الجورة الخامسة	
تعلى	لا تعلى	تعلى	لا تعلى	تعلى	لا تعلى	تعلى	لا تعلى	تعلى	لا تعلى

التطبيق الفني : الحف |_|
الشتل |_|
المقاومة الكيماوية |_|
إستعمال الأسمدة |_|

نعم = 1
لا = 0

10 - الحالة الزراعية بالمقارنة مع السنوات الماضية

الدليل	ممتازة	متوسطة	جيدة متقطعة	ضعيفة

11 - الإصابات الملاحظة على المزروعات بالآفات الزراعية

نوع الآفة	درجة الإصابة	عدد الجور المصابة
|_|	|_|	|_|_|
|_|	|_|	|_|_|
|_|	|_|	|_|_|
|_|	|_|	|_|_|
|_|	|_|	|_|_|

1 - الجراد
2 - البعازيشية
3 - الطيور
4 - الأمراض
5 - الحشائش

Republique Islamique de Mauritanie
MINISTERE DU DEVELOPPEMENT RURAL ---------- H.F.J.

SERVICE DES STATISTIQUES AGRICOLES

SUIVI, PREVISION ET EVALUATION des CULTURES

TROISIEME PASSAGE

de la parcelle REF : /_ /_ /_ /_ /_ / C1
REG DP ST GR

Enqueteur: _____

Superviseur: _____

1.REGION _____/DEPARTEMENT _____/VILLAGE _____
2.GRAPPE N° /_ / NOM DU PRODUCTEUR_____/NUMERO DU PRODUCTEUR /_ / C2
3.DATE DE RELEVE /_ /_ /_ /_ /_ /_ / DATE DEBUT RECOLTE : Mois /_ /_ / Quinzaine /_ / (1 ou 2)
jour mois annee
4.NUMERO DU CHAMP /_ /_ /_ / C3 NOMBRE DE PARCELLES /_ / C4 PARCELLE N° /_ / C5
5.LEVE DE LA PARCELLE A LA RECOLTE

	COTE	ANGLE		COTE	ANGLE
AB	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	FG	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
BC	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	GH	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
CD	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	HI	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
DE	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	IJ	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /
EF	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /	JK	/_ /_ /_ / , /_ /_ /	/_ /_ /_ /

ERR % : /_ / , /_ /_ /_ / SUPERFICIE au moment de la recolte /_ /_ / , /_ /_ /_ / C6

6.DENSITE DE LA RECOLTE : DIMENSION DU CARRE /_ /_ / X /_ /_ / m C7

NOMBRE DE POQUETS : TOTAL /_ /_ /_ /

	CULTURE	CODE	PAR CULTURE
a	_____	___	/_ /_ /_ /
b	_____	___	/_ /_ /_ /
c	_____	___	/_ /_ /_ /
d	_____	___	/_ /_ /_ /

Pour le tableau de la droite, il faut tenir compte des codes : 1.Tige pouvant donner
2.Tige perdue

	NOMBRE DE PIEDS PAR POQUET										PAS REMPLIR		
	I		II		III		IV		V		POQS. POUVANT DONNER	TOTAL	
	1	2	1	2	1	2	1	2	1	2		1	2
a													
b													
c													
d													

7.DEGATS SUR LES CULTURES

	TYPES	GRAVITE	NOMBRE POQUETS ATTAQUES
1 Sauteriaux	/_ /_ /	/_ /	/_ /_ /_ /
2 Cantharides	/_ /_ /	/_ /	/_ /_ /_ /
3 Oiseaux	/_ /_ /	/_ /	/_ /_ /_ /
6 Secheresse	/_ /	/_ /	/_ /_ /_ /

8.APPLICATION THEME TECHNIQUE :

-T.Phytosanitaire /_ / C23 oui=1

-Emploi engrais /_ / C24 non=0

9.ETUDE DU RENDEMENT : REF /_ /_ /_ /_ /_ /
PT CH PLE

CULTURE	CODE	NBRE POQS RECOLTE	POIDS BRUT en kg.	POIDS NET en gr.	TAUX D'HUMIDITE %
_____	___	/_ /	/_ /,/_ /_ /	/_ /_ /_ /	_____
_____	___	/_ /	/_ /,/_ /_ /	/_ /_ /_ /	_____
_____	___	/_ /	/_ /,/_ /_ /	/_ /_ /_ /	_____

PT=PRODUCTEUR
CH=CHAMP
PLE=PARCELLE

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الجمهورية الاسلامية الموريتانية
- مصلحة الإحصاء الزراعي -

شرفة - آخاء - عدالة

الدور الثالث

تحقيق لمتابعة المزروعات وتقدير الإنتاج

1 - الولاية _____ المقاطعة _____ القرية _____

2 - المكرر رقم : ___ إسم المنتج _____ رقم المنتج ___

3 - تاريخ التحقيق ___ تاريخ بدء الحصاد ___

4 - نوع المزرعة ورقمها ___ كم عدد القطع بالمزرعة ___ القطعة رقم ___

5 - حساب مساحة المزرعة عند الحصاد ___ ___ الخطأ الحسابي ___

الزوايا	الأضلاع	الزوايا	الأضلاع
___	___ و ___	___	___ و ___
___	___ و ___	___	___ و ___
___	___ و ___	___	___ و ___
___	___ و ___	___	___ و ___
___	___ و ___	___	___ و ___

6 - الكثافة الزراعية عند الحصاد : أبعاد المربع ___ x ___

الزراعات	الدليل	مجموع الجور داخل المربع ___ لكل زراعة	عدد السيقان في خمسة جور من المربع: الجورة الأولى تعطي	لا تعطي	الجورة الثانية تعطي	لا تعطي	الجورة الثالثة تعطي	لا تعطي	الجورة الرابعة تعطي	لا تعطي	الجورة الخامسة تعطي	لا تعطي

7 - الإصابات الملاحظة على المزروعات

	النوع	الإصابة	عدد الجور المصابة
1 - الجراد	___	___	___
2 - الفلرسية	___	___	___
3 - الطيور	___	___	___
6 - الجفاف	___	___	___

8 - التطبيق الفني

نعم = 1
لا = 0

- المقاومة الكيماوية ___
- استعمال الأسمدة ___

9 - دراسة المردودية

الأساس: ___ مج حق قع

مج = منتج
حق = حقل
قع = قطعة

الزراعات	الدليل	عدد الجور المعدودة	الوزن عند الحصاد	الوزن عند التصفية	نسبة الرطوبة %
		___	___	___	
		___	___	___	

THE NATIONAL RURAL DEVELOPMENT COMPANY
(SONADER)
THE REGIONAL DIRECTORATE FOR THE GORGOL

The Mauritanian parastatal National Rural Development Company was founded in 1975 to enable the GIRM and the donor community to intervene effectively in agriculture without the bureaucratic and political constraints imposed on activities carried out within the Ministry of Rural Development (MDR). The SONADER's mission soon narrowed itself to concentrate on the installation and management of irrigated perimeters (small, medium and large) along the Senegal River Basin (SRB).

Very recently, the SONADER has decentralized its operaions and established nearly-autonomous regional offices in Rosso, Boghe, Kaedi and Gouraye. The Kaedi Office is ledby Mr. Ba Abdoul, an agronomist (ingenieur agronome). His staff is divided between two offices: agricultural engineering (amenagement) and crop production (exploitation).

Both amenagement and exploitation work in a sector that goes from Vinding (in the Brakna, west of Mbagne) to Toulel/Sanghe, on the border of the Guidimaka. Thus the Kaedi Regional office covers the entire Dirol Plain.

The amenagement section plans and builds the perimeters: leveling, dike construction, canals, water control gates and pumping stations. Its current program operates thanks to an IBRD/IDA soft loan. This program has met some difficulties because most of the easy to prepare sites along the river have already had perimeters installed on them. The new locations are in more rugged terrain, where leveling and diking are more difficult and time-consuming.

Partly as a consequence of this difficulty and partly as a consequence of the varied policies on perimeter construction financed by donors in Mauritania, most villages and cooperatives have refused to provide labor to do the constructionof the perimeter. Thus the SONADER has set up a construction brigade with IDA funds that does the major earth-moving and leveling work. Villagers still provide a good deal of labor, for tasks specified in a standard contract* (*see attachment for an example of this contract) for the preparation of perimeters. This represents a major change in SONADER's approach to 'amenagement', which insisted previously on hand-leveling and diking under SONADER technical supervision. It also represents a reversal of an earlier GIRM decision to reduce SONADER's role in irrigated agriculture to supervision and extension. The private construction companies which were expected to replace the parastatal simply were not up to the task. Construction was slow and quality was inadequate.

Mr. Diop Aliou, the Head of the Crop Production Service for the Gorgol Regional Office, feels that the SONADER brigade would not

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be able to carry out the construction of the Dirol Plain dike, but couldparticipate effectively as the Mauritanian representative on the quality control committee, along with representatives of USAID and American construction companies. Last year they were not able to complete their construction program, finishing only a half dozen perimeters of the 20 or so that they programmed.

The exploitation section, supervisedby Mr. Diop, who holds degrees in agronomy from the Hassan II Institute in Morocco and from the Institut National d'Agronomie (INA) in Paris is in charge of all extension and outreach activities. This includes credit, input distribution, pump maintenance, and extension.

The Mechanical Section maintains the pumps on the perimeters and determines needs for parts, fuel and lubricants. Mechanical services are provided free to the farmers, but they have to pay for pumps, parts, fuel and oil. For the first pump, farmers must reimburse 50% of the cost, at 8.5% interest. For a second pump, purchased because the first wears out or because the perimeter expands, theymust pay 67% of the cost, once again at 8.5% interest. For subsequent pumps, they pay full price. However, fuel, which costs 36.1UM/litre in Kaedi is available toperimeters at 32UM/l. Oil which costs 200-250UM/l is available at 160UM/l. Farmers pay for spare parts at cost, not including transport, handling or administrative charges.

The credit and input supply section supplies small perimeter operating groups with fertilizers, crop protection chemicals, pumps, parts and fuel/lubricants. The latter items are installed and supervised by themechanical service, but thislatetr service does not do any procurement or logistics. In addidtion, thecredit section keeps track of the debt position of each perimeter and has the duty of recovering loan payments.

Credit is one of the major problems to the small perimeter program. Even when a perimeter has a good year, the CSA is often late in purchasing the harvest. Thus farmers have stores of rice awaiting puchase, but no moneywith which topay their debts in time to get inputs for the next season. If they sell their crop on the private market,prices are lower andmost merchants will not risk their trucks on the roads that lead to many of the perimeters which are in remote, inaccessible areas.

Repayment rates are only around 60-70% in the Gorgol and Boghe regions, although Gouraye and Rosso have better records. Last year, in the Kaedi area, only 12 out of 25 perimeters carriedout the campaign. The others failed topay their debts and thus could not obtain inputs to undertake plantings.

The final activity of the Exploitation Service is agricultural extension. The SONADER recently decided todivide the region into four zones to encourage better supervision of the agricultural cycle. At the same time, the parastatal is trying tomove the farmers towards more technical and managerial autonomy by keeping he number of extension agents to a minimum. The four zones of the Kaedi Offcie are:

Waly: 1 conducteur, 1 mechanic, 1 apprentice mechanic, 1 PCV for 12 perimeters

Cive: 1 ex-OMVS observer, one locally trained agent, 2 assistant mechanics, 1 PCV for 11 perimeters

Kaedi: 1 ex-OMVS observer, 1 ex-CNRADA observer, 2 locally trained agents, 1 mechanic, 2 apprentice mechanics for 20 perimeters

Vinding: 1 ex-CNRADA observer, 1 locally trained agent, 2 assistant mechanics for 5 perimeters

The SONADER regional office has just requested 3 more PCV's to help out with extension. They hope these people will arrive soon.

The Dirol Plain is in the SONADER Kaedi zone. This zone includes perimeters in Rindiso, Belinabe, Sintiou, Dioke, Roufi Aoudi, and Nere Walo (I&II).

To supervise these agents, most of whom have a relatively low level of training, Mr. Diop has one assistant, Mr. Guisse Kasso, an ITA from Tunisia. Last year they had part-time help from a FED expatriate, who came largely to deal with vegetable gardening. They expect a Belgian from the FED to join them on a long-term basis this year. They expect to install 17 more perimeters this year and 20 in 1988 without any increase in staff. However,they do intend to purchase motorcycles for their extension agents. Most of them are now on foot. All of Mr. Diop's staff now share with him the use of one land rover station wagon.

Other plans for the new zones include placement of spare pumps, in caseof breakdowns at crucial moments in the crop cycle; rice mills, to the the burden off the central mill in Kaedi and tomake residues available for animals in the villages; private or cooperative-run input supply stores; and, eventually, tractor stations.

The Kaedi Regional Officeof the SONADER is quite autonomous vis-a-vis Nouakchott, where the Director General sits. The Director General, Mohammedin Baba ould Ahmed , is the immediate superior of the Regional Director but the other SONADER cadres in Nouakchott have only technical links, not supervisory, with their

counterparts in the regional offices. Nouakchott is supposed to centralize information and resources and then coordinate their distribution. However, these tasks are not done to the satisfaction of the regional offices for the moment. Part of the problem is that the parastatal decentralized itself without defining functional responsibilities very carefully. Thusnoone knows exactly what services the Nouakchott office provides to the Regional offices or which regional reports should go to which Nouakchott bureau.

The Director General regulates the use and distribution of funds. Eacg regional office has its own bank accounts, into which donor and GIRM monies are deposited. The Regional Directors and the Director General co-sign all checks on these accounts. The SONADER, as a development agency, has no pretensions to financial autonomy or self-sufficiency. Except for the soils laboratory and the topographical service, it has no sources of income except donor grants and loans and GIRM budget support. This latter comes either as counterpart contributions to donor funded activities or as direct budgetary support when needed.

Collaboration between the SONADER and the Dirol Plain Project (MRVDP) seems potentially fruitful. The SONADER is not statutorily locked into irrigated agriculture. They have played a role in the R'kiz recessional project, and are working onoasis development projets in the North. The Kaedi Regional Office seems enthusiastic about the idea of improved recessional agriculture. Collaboration might include:

a. placing SONADER extension agents in Dirol Plain villages to carry out project extension tasks. This would avoid forcing the project to hire its own staff and would open the way for project agents to work with those farmers on the plain who are already doing irrigated work. This would also increase the number of agents at the disposal of the SONADER Kaedi zone and permit them to do their work better. The project could pay for these services with local currency funds.

b. PCV's for the MRVDP could be provided under the on-going SONADER/PC prgram, avoiding the necessity of starting up a whole new PC program for a small number of volunteers.

c. SONADER technicians can assist with quality control and supervision of Mauritanian contractors building the dike and can help train villagers for maintenance responsibilities.

d. If and when village groups turn to irrigation in the plain, the same extension agents can work with them and profit from the relationships built up overyears of recessional agricultural collaboration.

e. The SONADER can provide a representative to sit on or chair the Technical Coordinating Committee for the MRVDP in Kaedi.

SONADER ENGINEERING SERVICE
KAEDI REGIONAL OFFICE

The engineering serive (Service d'Amenagement) of th KaediOffice of the SONADER is run principally by two Belgian engineers funded by the FED. Mr. Alain Baes is in charge of rehabilitating the Gorgol Perimeter (PPG) and Mr. Hubert Castellan is in charge of the small village perimeter (PPV) construction program. Baes has no counterpart and is trying to repair the damage done in the 1981 flood and toprotect the banks of the Senegal and Gorgol Rivers to keep them from eating into the perimeter dike. Mr. Castellan works with Mr. Seck Abdoul, a Mauritanian Engineer. They run the IDA-financed construction brigade, which is equipped with machines from the defunct SEGEMAR. Thislatter was the SONADER's construction company, based in Boghe. Castellan and his staff went to Boghe and found that nearly all the equipment there was inoperative.

As no new equipment was funded, the Brigade now works with a D-9 bulldozer, a grader and a fuel tanker. They also have a tracted sheeps-foot compacter and a small tracted water tank but both are inoperative. They have no front-end loader and no dump trucks. Thus they are overwhelmed by the amount of work they have to do just to keep up with theirpermtere construction program. There is no question of the SONADER doing the construction of the dike for the project themselves.

They do seem interested, however, in participating in the control of the work done by a Mauritanian contractor in collaboration with an American engineer whowould be responsible to USAID. In addition, they see no problem in having the SONADER train and supervise the people who will do the maintenance and operation of the dike and the flood-gates. We will have to talk to their supervisers in Nouakchott about it, but they think the idea is workable.

Although the Service has not been kept adequately informed of the progress of the Dirol Plain Project, and has not seen any documents since the 1984 version of the LeBloas report, they have tried to adapt their program to that of the project. Thus, their program called for teh construction of five perimeters along the river in the project area. Two of these would have cut across the dike near the mouth of teh Dirol and have already been dropped from theirprogram. Three others, further upstream, beyond thepoint at which the river has begun to eat dramatically into the banks of teh Fonde, will fit in, using the dike as one of tehri walls. They will leave all diking work on these perimeters until the Dirol dike has been completed.

Castellan agrees that a dikeof 11m50 with a road on top is probably the best engineering andpractical solution. He has independently calculated the post-Manantani flood at a maximum of

10m61 at Oulom Hattar. He based his calculations on a flow of 2500 cubic meters/second at Bakel and the natural bed of the river. He emphasized teh importance of the road if these is to be any access to the flood gate during the rainy season or the flood.

He also mentioned that the African Development Bank isplanning a medium sized perimeter at Dabbe,on the other side (West)of Mbagne. They intend to build roads to permit year-round access to the perimeter. We do not yet know where those roads will go.

SO. NA. DE. R.

DIRECTION REGIONALE DE KAEDI

BP. 144 - TEL: 272

CONVENTION D'AMENAGEMENT D'UN PERIMETRE IRRIGUE

ENTRE LA SO. NA. DE. R. pour le projet PPV/IDA/15-71 MAU Volet-KAEDI

Représenté par le Directeur Régional de la SONADER DE KAEDI

ET Le Groupement Coopératif de :

Représentée par :

- Le Président _____
- Le Vice-Président _____
- Le Trésorier _____
- Le Trésorier Adjoint _____
- Le Secrétaire _____
- Le Secrétaire Adjoint _____

Il a été convenu ce qui suit :

A - ENGAGEMENT DU GROUPEMENT DEMANDEUR

ART. 1 : Le Groupement de _____ demande par la présente convention à la SONADER de participer à l'aménagement d'un périmètre irrigué sis à _____.

ART. 2 : Le Groupement de _____ déclare que les limites dudit périmètre ont été déterminées d'un commun accord avec toutes les personnes concernées sans préjudice de revendications ultérieures.

ART. 3 : Le Groupement de _____ s'engage à garantir l'entière disponibilité du périmètre dès la signature de la présente convention qui suppose que tous les problèmes fonciers ont été préalablement résolus.

ART. 4 : Le Groupement s'engage dès la signature de la présente convention à mettre en valeur la totalité du périmètre et à appliquer tous les conseil du service d'encadrement de la SONADER, destinés accroitre la production et améliorer l'organisation du Groupement.

.../...

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- assurer l'entretien du réseau et exécuter les travaux collectifs de réfection
- Respecter les calendriers culturaux
- Respecter le tour d'eau
- Suivre les instruction techniques relatifs à la conduite de la culture
- s'acquitter de ses dettes dans les délais fixés
- etc...

ART. 5 : Le Groupement s'engage à fournir la main d'oeuvre ordinaire de chantier pour le terrassement et les ouvrages. Il assurera en outre la participation d'au moins 15 manoeuvres pendant toute la durée du chantier à raison de six heures (6 h) de travail par jour. A cet effet une liste d'au moins 40 personnes dont [illegible] présentée à la signature de la présente convention.

La main d'oeuvre fournie par le groupement effectuera les travaux suivants :

- Préparation des parpaings
- Préparation et gachage des mortiers et béton
- Remblais compactés d'ouvrages
- Mise en forme des remblais
- Confection des canaux tête morte, primaire et secondaire
- Construction de digues
- planage et préparation des parcelles
- Manutention diverse (pièrres, sables etc...)
- Renforcement et curage des canaux lors de la mise en eau
- Installation des GMP,
- Fourniture de piquets et de main d'oeuvre lors des travaux topographiques.

ART. 6 : Le Groupement s'engage à effectuer régulièrement les travaux d'entretien nécessaires à une utilisat[illegible] eau et des ouvrages et à assurer le bon fonctionnement du matériel de pompage.

ART. 7 : Taille des parcelles.
Le groupement s'engage à présenter à la signature de la présente convention la liste de 40 attributaires (0,5 ha par attributaire).

B - ENGAGEMENT DE LA SONADER :

ART. 8 : La SONADER s'engage, sous réserve du respect des articles 1, 2, 3, et 4, à participer à l'aménagement du périmètre dans les limites définies par les articles 9, 9, 10.

.../...

ART. 9 : Topographie

La SONADER met gratuitement à la disposition du groupement son équipe topographique pour définir les travaux de planimétrie et d'altimétrie du périmètre.

ART. 10: Aménagment

En matière d'ouvrages, la SONADER effectue les travaux suivants :

- construction du bassin de réception
- construction des supports de citerne
- confection et pose d'ouvrages préfabriqués et buses

En matière de terrassement, la SONADER effectue les travaux suivants : exclusivement en cas de nécessité technique :

- canaux ou trongons de canaux, tête morte ou primaire en remblai compacté
- préplanage selon nécessité
- Remblai poussé sommaire au droit des canaux primaires et secondaires.

Autres prestations :

- fournitures du petit matériel de chantier (Pelles,pioches, dames, brouettes...)
- fournitures de matériaux de construction (ciment, fer, etc)
- fournitures de citerne à gas-oil et ustensiles de manutention
- fournitures et supervision de l'installation d'un groupe motopompe et ses accessoires jusqu'à la mise en fonctionnement de l'unité.

Par ailleurs la SONADER assurera la conduite de ces travaux jusqu'à la mise en eau du périmètre.

ART. 11: Vivres

La SONADER fournira des vivres proportionnellement au taux de participation des paysans aux travaux d'aménagement.

C - FINANCEMENT DE L'AMENAGEMENT :

ART. 12: La SONADER prend en charge dans le cadre du financement du projet PPV/IDA 45-F/MAU (volet Kaédi) tous les travaux qu'elle effectue y compris les matériaux de construction utilisés pour les ouvrages.

ART. 13: Le groupement prend en charge les équipements mentionnés ci-dessous qu'il remboursera conformément aux prescriptions d'un contrat séparé qui sera établi à cet effet.

- Le groupe motopompe et ses accessoires (aspiration, et refoulement)

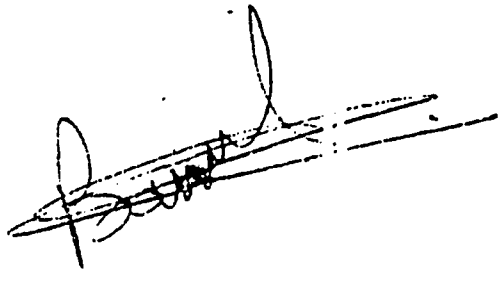
Il prend également en charge l'entretien de ces équipements.

D - VALIDITE DE LA CONVENTION :

La validité de ce document couvre une période maximum de 9 mois à compter de la date de sa signature.

FAIT A _____ le _____ 198__.

LE DIRECTEUR REGIONAL
DE LA SO. NA. DE. R. KAEDI



LE GROUPEMENT

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VISA DE L'AUTORITE REGIONALE,

ENVIRONMENTAL PROTECTION INSPECTORATE
KAEDI (IPN/KAEDI)

The Inspection de la Protection de la Nature in Kaedi (IPN/Kaedi) is responsible for forestry protection and promotion throughout the Gorgol Region. They have sector offices in Maghama, Mbout, and Monguel, as well as a post in Cive. The Dirol Plain area within the Gorgol is covered directly from the IPN offices in the regional capital. The IPN is manned by an ITA (roughly equivalent to a technical AA or AS degee) from the Pan African Development Institute in Cameroun (IPD). His asistant is a graduateof the C cycle of the ENFVA. In addition, they have a group of trained workers who have operated the nursery for years and who have had a good deal of on-the job-training.

The main tasks of the IPN are to prevent farmers and herders from cutting down trees without authorization, be it for charcoal, construction, forage, or artisanal uses; and to maintain a nursery for the distribution of trees. Most of these trees are distributed free on National Tree Day in July of every year, when each village, urban meighborhood or family , and administrative or commercial entity in the country has to plant a certain number. The nurseryalsoproduces trees for projects andother clients who do not wish to establish their own nurseries. These clients have included the SONADER, the FAO, Africa '70, the PPG and others. They charge 20UM per tree. The trees are available to clients at the nursery in plastic sacks. Transport is at the cost of the client.

The nursery produces seedlings of a number of local and exotic species including:

- o acacia senegal (gum arabic tree)
- o acacia nilotica (gonakier)
- o eucalyptus camaldulensis
- o prosopis spp.
- o azidirachta indica (nim)

There is no 'Pole Vert' in Kaedi. The nearest office in the Gorgol is in Sanghe, near he border with the Guidimaka. There is also a station in Mbagne, headed by a former DRIG forester named Barry. They have made plantings in Dawolel, among other villages.

Mauritanian rules call for each rural development project to include reforestation and nature protection activities in its plans. The Dirol Plain Project (MRVDP) can collaborate with the IPN/Kaedi to fulfil this requirement, without burdening itself with forestry technicians, infrastructure or material. Collaboration could include:

- o local currency to order up to 100,000 trees from the Kaedi nursery. Species might include A. senegal, A. nilotica, nim, and prosopis;
- o technical advice from IPN staff on setting up village

nurseries, windbreak plantings, dike protection, riverbank protection and plantations of economic species;

- IPN participation in monitoring and evaluation activities, seminars and farmer field days, where environmental themes can be introduced; and
- training both in the field and in Kaedi for villagers and PCV's who may be interested in agro-forestry activities.

The MRVDP could provide local currency to support whatever costs these activities engender for the IPN.

THE COMMISSARIAT FOR FOOD SECURITY
CSA
KAEDI

The CSA in Kaedi works only in the Gorgol Region. It has two sections. Mr. Sarr Brahim is in charge of rice (superviseur regional pour le Paddy) and Mr. Mohammed Jamal is in charge of traditional cereals.

The CSA buys paddy from the perimeters in the region at 18.5UM/KG, hulls it and sells it to the SONIMEX for 24UM/kg. The SONIMEX in turn sells it to wholesalers at 30UM/Kg and they resell it to consumers at 33UM/kg. These are all officially fixed prices. At the current time they seem to act more as ceiling than as floor prices. Informal observations in the market show that free market prices are either at the official level or lower. Commerce in cereals, including rice, is free in Mauritania but only the CSA can sell rice to the SONIMEX.

The CSA has a budget for buying 2,000T of paddy this year. In 1986, they bought 300T of traditional cereals (mostly sorghum, though maize is sometimes included as well). The price has been at 21UM/kg for several years.

There are local centers for traditional cereals purchases (Mbagne, Bababe, Monguel, Maghama, Mbout) but only Kaedi and Boghe buy paddy in the Brakna and the Gorgol. The CSA does monthly market studies of non-fixed prices.

The PP will present an anlysis of CSA purchases of traditional cereals during the 1987 campaign.

THE ECONOMIC CONTROL OFFICE
BCE KAEDI

The department of Kaedi, like all other departments throughout Mauritania (the department is the administrative entity just below a region and is governed by a Prefet appointed from Nouakchott), has a price control office and a list of goods for which the local government sets maximum prices. The office, known as the Bureau de Controle Economique (BCE), makes spot checks and regular studies of prices in stores and markets throughout the department.

The listof prices for Kaedi is attached to this report. The head of the BCE, Mr. Diagana Tidiane was absent and a Controller, Mr. Sidi Mohammed, provided what information he could. He said the list of prices had not changed since 1985 and that market prices are often below fixed prices, rather than the contrary.

The Departmnt has a Local Price Committee, headed by the prefet and including representatives of both merchants and consumers. This committee shold be meeting soon to review the prices and to see if other items should be added to the list.

Sidi Mohammed thought that the BCE did monthly studies, but we will have to await the return of Diagana Tidiane to see where they are. He has been in Kaedi for only a couple of months and has not seen them.

Potential for collaboration with the BCE islimited, but if inflation begins to reduce the valueof sorghum crops, the MRVDP will have to work with them to seek to redress the situation.

LISTE DES PRIX DES PRODUITS HOMOLOGUES

DESIGNATION DU PRODUIT	PRIX DE GROS	PRIX DE DETAIL
Poisson (Kg)		
- 1ere qualité		~~100~~ 80 um /kgs
- 2eme "		~~60~~ 40 " /kgs
Viande : (Kg)		
-Bovin + Chameau		~~150~~ 120 um /kgs
-Mouton + Caprin		~~180~~ 150 " /kgs
-Biaffteck Super marché		~~220~~ 180 " 150 " /kgs
Latage :		
- Lait concentré sucré PM ~~MK~~ de 786	1000/K	16/Bte
- " " " GM de 379g	31/Bte	33/Bte
- " " " non sucré PMK 96 b (170g)	1344/K	15/Bte
- " " "GM 410gs	18/Bte	19/bte
- " en poudre 45kgs	~~3200/Sac~~	~~175/Kg~~
- " " de 25kg	3200/Sac	134/Kg
- " " Bte de 2270gs	356/Bte	358/Bte
- " " Marque célia et autre/Kg	145/Kg	147/Kg
- " en ~~Mxxxxx~~ paquet (frais)	282/K	28/Kg
CONCENTRES DE TOMATE :		
- Boite de 400gs	56/Bte	58/bte
- " " 800gs	106/Bte	110/Bte
- " " 2200Gs	270/Bte	273/Bte
PRODUITS FAMO (à base de céréales)		
- Macaroni		19/~~Kgs~~ paquet
- Cous-cous Marocain en carton		~~20~~/Kgs
- Vermicelle en paquet		20/Kgs sachet
- Spaghetti en paquet		19/Kgs paquet
- Cous-cous Marocain en sac		20/Kgs paquet
- Petit plomb en carton		45/Kgs
RIZ (kg)		20/kg
-Riz Brisé	30/	33
-Riz entier ordinaire	49	52
-Riz entier super en paquet ou sachet	94	97
SUCRE :		
Pain de 2kgs		164/Kg
-		72

394x

DESIGNATION DU PRODUIT	PRIX DE GROS	PRIX DE DETAIL
THE :		
-8147 et G 501	690/KG	70/100Grs
- 9371 et G101	681/Kg	69/100grs
-9370 et G 661	627/Kg	63/100grs
-9369 et 8135	584/Kg	60/100grs
-G 601	713/Kg	90/125Grs
HUILE :		
Huile d'arachide raffinée en bouteille	95/LITRE	97/LITRE
Huile en fût		95/Litre
OIGNONS :	39/KG	41/KG
POMME DE TERRE :	37/KG	40/KG
FARINE DE BLE :	sac de 50kg-1400/Sac	30/KG
BLE :		21,5/KG
SORGHO :		21,5/KG
BOISSONS GAZEUSES :		
-Limonade Gazelle Bouteille de 33cl	472/Caisse	22/Bouteille
-Spark Orange " "30cl	472/ "	22/Bouteille
-Coca cola " "30cl	472/ "	22/boutielle
-Fanta " "30cl	472/"	22/Bouteille
-Coca Cola emballage perdu	597/k	27/~~[illegible]~~ lunité
EAU Minérale :(1,5l)		-
Pain de Boulangerie(230grs)		10/Miche
Gaz :		
- Bouteille de 12,5kgs		600/Bouteille
-Couping Gaz G 200		60/Cartouche
-ALLUMETTES(Bte de 60 Brins)		5/Bte
BOUGIES de 20 K de 150 Unités		10/un
Savon de Ménage :		
-Savon ordineaire 500grs	35/Morc	39/Morc
- " " 300grs	21/"	23/"
- " " 200grs	16/"	18/"
CIMENT HYDRAULIQUE de Mariania		520/sac
CARBON DE BOIS sac de 50kg	80	12/Kg

AFRICA '70

Africa '70 is an Italian NGO funded by a grant from the Italian Ministry of Foreign Affairs. Its name comes from its origins in the late sixties when young idealists thought of the 70's as a decade of progress, justice and so on. They have retained the name throughout the eighties and will do so, presumably, into the future. Mrs. Vergari Donatella is acting as Director of Africa 70 on an interim basis, while they await the arrival of a new Director.

Their principal activity is the Integrated Development of Kaedi Project. They limit themselves, for now, to the urban agglomeration and work in three areas:

- o habitat
- o agriculture
- o artisanry

In habitat, they have conceived a development plan for the city of Kaedi and have presented a draft to the local government. The final version should be finished in August and at that time they will plan those interventions that Africa 70 will undertake. So far, in this domain they have renovated an old colonial house for their office, using local materials and artisans. The example has already spread to other old building in town. They have also repaired or improved some wells and have planted a good number of planted nim trees along the streets of town.

In agriculture, they have concentrated on vegetable gardening. They have worked with 19 groups of gardeners, including about 1,000 individuals. They have access to land on the Pilot Perimeter of the Gorgol (PPG). They intend to set up a supply center for agricultural inputs: seeds, fertilizer, tools, chemicals, etc. They wouldlike to form a union of Kaedi Cooperatives to run this enterprise. During their first season, they gave away seeds and tools to participants. The tools had been produced by local artisans. Next season, they will sell seeds and tools, but share the cost of fencing with their groups. They have worked with the CNRADA and carried out some experiments on their gardens in the PPG.

In artisanry, they have worked primarily with local blacksmiths.

There are 6 Italians on the team in Kaedi. In addition, they receive regular short term visits from qualified experts in specific fields. The permanent members include a team leader, an accountant, 2 architects, a mechanic/artisanry specialist, and an agronomist (Marco Rufato). They began in 1985 and are funded through 1989.

If their cooperative agricultural supply enterprise gets going, our farmers from the plain will be able to purchase inputs there. If this puts a burden on their revolving fund or if our farmers

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need supplies that the store does not carry, we may have to invest some local currency in increasing their stock. This would be much less onerous than having to set up a supply house on our own and less risky than doing it through individual merchants.

In a general sense, Africa 70 seems very disposed to work with all those who are trying to help in Mauritania.

PARTNERSHIP FOR PRODUCTIVITY
PFP KAEDI

Partnership for Productivity (PfP), an American PVO, came to Mauritania in 1985 to undertake operations research on the Dirol Plain to prepare the way for a major USAID-funded recessional agriculture project, which would follow if PfP's achieved positive results. Unfortunately, the program endedprematurely without leaving adequate written records but the PID team was fortunate to meet with Stefan Buzdugan, the PfP Chief of Party (COP) for Mauritania and to discuss with him what his group had done here.

In 1985, PfP proposed a modes half million dollar program to USAID to accomplishten objectives using operational research methods. Ayoung team came out in April 1985, but accomplished little until Mr. Buzdugan arrived in August 1985. They did a quick survey, then began work in September. They thus were present for half of the 1985-85 recessional campaign and for most of the 1986-87 campaign.

Their basic goal was to improve recessional agriculture of traditional crops - sorghum and niebe (cow-peas). They found no extension system working on the plain at all and thus set out alone to accomplish their ten tasks, including:

1. maximal use of moisture from the flood: People werelosing this moisture by not planting on time because of land tenure problems, labor problems, and so on. Planting on time is vital to maximize yields. Thisis a no-cost improvement.

2. seed availibility: seeds are a majorproblem. People now plant any old seed - a mixture of the varietiesoflastyears harvest. Germination is poor. PfP introduced field selection and treament with chemicals. They then returned the seed to their farmer-leaders. This process was low cost. They purchased the seed at 25UM/kg (note: this is 4UM above the CSA proce and twice the April 1987 market price), added 3UM worth ofprocessing and certain emrchants were selling it at 35UM/kg in their boutiques in Mbagne and Kaedi. PfP says that the proce of sorghum seed can go as high as 55UM/kg at certain seasons. (note: lcoal merchants say the price of sorghum almost never gets beyond 25UM/kg).

3. improve vegetable gardens: this activity is an alternative or a complement to recessional agriculture. It is useful if there is a lack of land because the flood is bad. PfP tried itsprogram in 3 villages: Bagoudine, large and prorgessive; Dawolel,on the river; and Oulom Hattar, small and poor. These places already had gardens which PfP helped them plan and reorganize using better techniques: density, cropmaintenance, efficient useof water (smaller quantities, higher frequency). They used no chemical fertilizers and nopesticides. They are too costly. PfP felt that they can produce vegetables all year round. They introduced plant nurseries in nethouses, with planting trays with compartments. These latter provide adequate space for each plant and avoid stress on the young plant that could lead to poor yields from mature ones. They also introduced tropicalized seed varieties and used manure to improve soil structure. Mr. Buzdugan fels that the Kaedi vegetable market is far from saturated.

4. small machinery for mechanization: animal traction is limited because there is no forage. Tractors are not economically viable. PfP brought in rotary tillers which are economically viable. These will help increase area cultivated. An 8HP Italian model was the best.

5. Credit program: PfP surveyed existing programs. They found that the SONADER program is xactly the same as the FND program. Neither are geared to the eneds of small farmers. Theylend only

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tolarge operators with tractors. PfP beganlending out 10-15,000 to small farmers for seeds, fertilizer and tools. They intended a 1 to 2 year pay back period. There were noloans for large iems such as motor pumps and tillers. The revolving fund was too small for it. They lent out less than $1,000. They expected the first pay-backs this summer.

6. new irrigation methods: change schedule to high frequency irrigation. This avoids erosion. Also control the time of day at which water is on the plants. Drip irrigation could work if done with private individuals, not with cooperatives. Sprinkler irrigation requires expensive equipment thatis not available easily. US companies are not interested in the West African market.

7. water pumps for vegetable gardens: PfP tried out electric pumps, with generators. These go down in the wells and are viable for large gardens. (note !!!???) They also tried motorpumps. These are viable for shallow wells only. They then tried solar pumps. This seems to be the best system. A small system costs $2,000, which is about the same as a small diesel pump in Dakar. They have not yet installed one of these systoms, but there is one in Kaedi, ready to be tried. Belgian-made manualpumps are also feasible. They cost about $15,000/pump.

8. wells: on the Dirol Plain, wells go down to about 12m. Water enters from the bottom. If watercan enter from sides and bottom, this will increase the wells' capacity two or three times. Thus PfP tried out perforated well-casings with gravel filters. A new well with these casings costs about 15% more than an old style well.

9. Fruit tree production and reforestation: use only trees with immediate practical roles toplay.

10. rehabilitation of existingirrigation systems. workingon the PPV's that Dirol villagers participate in now.

PfP's message is that extension and credit are the keys to any successful program.

Note: since PfP left no reports behind, a post=facto evaluation of their activities should be carried out as soon as possible. Mr. Buzdugan did not leave a clear impression of the difference between things PfP had tried and whose usefulness was demonstrated and things that he thought oght to succeed if PfP had enough time to work through them

THE GOVERNOR OF THE BRAKNA REGION

The Brakna Region includes the Department of Mbagne, which administers about 2/3 of the area in which the Mauritania River Valley Development Project (MRVDP) will work. A line drawn from the small hill which separates the villages of Oulom Nere (Gorgol) and Oulom Hatar (Brakna) to point just east of Roufi Aoudi divides the Brakna Region (Capital : Aleg) from the Gorgol Region (capital: Kaedi). Although most of those parts of the the Dirol Plain which will be afected by the MRVDP are in the Department of Mbagne, the Plain itself is about 150 kilometers from Aleg and only about 15-25 kms from Kaedi. Thus there has been some argument in the past about where the MRVDP should be based, Kaedi, Aleg, or elsewhere, wuch as Mbagne or one of the larger villages on the plain. The previous governor the Brakna lobbied hard for Project Headquarters to be established in Aleg, a grim town with neither electricity nor reliable water, no adequate housing and a climate more suitable for the foreign legion post which it used to be than for an agricultural project.

Thus, on March 26, the Team Leader paid a visit to Aleg to request an audience with the new Governor, Mr. El Hassane ould Moloud, to inform him that the team was here and working out of Kaedi. The Governor was very welcoming, saying that he was delighted that we had not forgotten him. His administration in Mbagne had informed him of our visit there and of our presence in his region. After a brief explanation of the project and what it sought to do, he asked where the team would be based. The team leader explained that Kaedi had been chosen because of:

- o proximity to the plain;
- o the presence of other agricultural institutions/activities in Kaedi, including the CNRADA, the ENFVA, the SONADER, the AGRES II Project, etc.; and
- o the existence of amenities, including electricity, water, and housing.

The Govenor agreed with this analysis, but asked that he or his representatives be included on the Project Cordinating committee. This seems sensible. He will probably name the Prefet of Mbagne to represent him. He also asked to be kept informed of how the project plans and implementation progress.

The Project base should clearly be in Kaedi rather than in Aleg or Boghe for the reasons cited above. In addition, one might note that setting up Project HQ in Mbagne or in one of the larger Dirol Plain villages, such as Niabina or Bagoudine, would create both logistical and political problems. The expense of the construction of a base where expatriate and/or Mauritanian technicians could live would add significantly toProject costs. USAID would have to ild an all-weather road to wherever the base was located, in addition to housing, water, electricity, etc. Finally, there will be enough problems with accusations of favoritism and unfairness among groups living on or farming he

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plain in any circumstances. Choosing one village as a focus of investment and construction would only make things worse. Most of the inhabitants of Mbagne do NOT have fields on the plain. Thus it would be uncomfortable living there, as well.

Kaedi seems a logical, economical, proximate and politically neutral site for Project Headquarters.

THE CENTER FOR COOPERATIVE TRAINING
(LE CENTRE DE FORMATION COOPERATIVE)

The Center for Cooperative Training (CFC) in Boghe, 105 kilometers from Kaedi by the Dieri road, is a government facility, operated by the Ministry of Rural Development. It is funded by the Oecumenical Council of Churches (COE) and by the fees paid by the organizaions which carry out training programs there. These latter include their primary client, the SONADER, as well as the FAO, the MDR and other donor and national groups.

The CFC is staffed by five technicians, assigned by the MDR. The Director, SY Hady, is a "technicien superieur" (equivalent of an Ingenieur Technique Adjoint = ITA from Bambey or a technical AA degree). He has been with the center since 1982, approximately the time when the COE began providing support for an organization which had existed since the early '60's. His second in command (Directeur adjoint) is Niang Ali Gaoulel, an 'Agent de la Cooperation' (equivalent of a graduateof the B Cycle of the ENFVA). In addition there are three other trainers, graduates of the C and B cycles of the ENFVA.

The main task of the CFC is to provide training for four categories of cooperative member:

- o presidents of cooperatives
- o treasurers
- o cooperative store managers
- o water pump mechanics

The CFC staff provide the training in the organizational and managerial aspects of the courses, but call on specialists for technical training, such as that of the mechanics.

The CFC has lodging, equipment, classroom space, pedagogical materials, kitchen/refectory facilities to accomodate up to 45 trainees at one time. When the SONADER, for example, asks the CFC to organize a course, they pay the CFC 500UM/day/trainee for lodging, food and classroom space, as well as the use of the CFC staff. They provide their own trainers, at their own expense, when they need specialists, such as mechanics or vegetable gardening specialists. One of the newer members of the CFC staff is a vegetable gardener.

The CFC works closely with the two cooperative unions of the BRAKNA Region (Aleg/Boghe). The Union des Cooperatives Maraicheres (UCM) and the Union des Cooperatives Rizicoles (UCR) include some groups from the Trarza Region (Rosso) as well as from the Brakna. The COE provides the CFC with a revolving fund, which they lend out to participating cooperatives to finance the establishment of Cooperative Stores, where members can purchase consumer goods as well as production inputs at advantageous prices. This fund is loaned out without interest, thus is decapitalizing as time goes by. So far repayments have been made as planned. The CFC also trucks the goods out to the cooperative

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stores and supervises the accounting and management of these stores, after the managers have been chosen by the Cooperative members and trained at the CFC.

The CFC mandate covers three regions: Trarza, Brakna and Gorgol. They thus can carry out training for the MRVDP if called upon to do so. The CFC has no expatriate staff, although expatriate trainers do come to help with certain courses. These may be sent by the CCE or by the organization which sponsors the course. They have run courses for women on vegetable gardening, management, nutrition, etc. Recently they had about 40 women for an FAO-sponsored course in the context of the "World Battle Against Hunger".

Given the existence and seeming usefulness of the CFC (there is a lot of demand for their services), along with the presence of the ENFVA and its facilities in Kaedi, there seems to be no reason for the MRVDP to establish any kind of in-house training facility or to hire training staff. Instead, the project will budget local currency for management and technical training at both of these institutions for the farmers on the plain. These would include members of vegetable gardening groups, dike maintenance groups, recessional production groups and individuals who might benefit from specific technical courses.

20 trainees per day x 180 days per year x 5 years x 750UM/day = UM13,500,000 for LOP. This is equivalent to 10 3 week courses per year.

UNITED NATIONS DEVELOPMENT PROGRAM
PNUD NOUAKCHOTT

The United Nations Development Program in Nouakchott coordinates a large number of small and medium sized development projects throughout Mauritania. They are interested in riverbasin development and agriculture, although not exclusively, and perhaps to a lesser degree than the other donors. As is usual with PNUD offices, they see themselves as in country to respond to the expressed needs of the host/member government and not to espouse development policies or priorities of their own.

Michael Askwith, the Deputy Resident Representativo, discussed the Dirol Plain activity enthusiastically, expressed PNUD interest in coordinating activities in the Kaedi area and the suggested I see the peole responsible for PNUD-sponsored projects in related domains:

- o Vicenzo Avitabile of the FAO Seed Multiplication Project in Kaedi;
- o Jorge Torrealba of the FAO Agricultural Extension Project in Nouakchott;
- o Willem Zijp, the adviser to the Direcor general of the SONADER in Nouakchott; and
- o Sr. Diaz of the Agricultural Statistics Bureau in the Ministry of Rural Develoment.

The DirolPlain Project should work closely with these organizations and, at one remove, with the PNUD in Nouakchott. However, close coordination with the PNUD main office will not be necessary.

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THE WORLD BANK
IBRD
NOUAKCHOTT

The IBRD is represented in Nouakchott by Etienne Baranshamaje. Ba Demba, a US-trained agricultural economist takes care of all rural development programs for him. IBRD loans to Mauritania in the rural sector have concentrated on irrigated agriculture. The Bank played a large role in financing the Foum Gleita dam and perimeter. The dam is now completed and the project will end this June. Most IBRD agricultural activity now centers around a small perimeter (PPV) program through the SONADER in Boghe, Kaedi and Gouraye. The bank has co-financed this program with the FAC, CCCE, Italy, the FED, FRG, USAID and certain Arab donors.

The operating costs of dams in Mauritania are veryhigh, even after writing off the investment costs. The donors must keep pumping money into their perimeters (witness the case of the PPG!) even after construction has ended. They have done this sofar without addressing the structural deficiencies of the program.

Last July, the SONADER began restructuring itself in the Gorgol. We have to look carefully at the role of institutions in the rural areas, find a cost-effective way of doing extension, determining the role of pricing policy, and of agricultural policy. The country needs a rural sector policy whic can lead to sustainibility. The private sector must play a key role in this process, and we must establish a system of rural credit. The SONADER is too fat, too centralized. Land reform should be implemented, not just discussed. They have a new law. They should try to implement it selectively to generate test cases.

The IBRD isplanning to call a Consultative Group (CG) meeting in early 1989 to look at the results of the $900,000 study they are commissioning on the post-Manantali Mauritanian agricultural sector. They will look at the viability of agriculture in Mauritania in general, at constraints, at policy. They will try to pre-identify investment proposals.

The IBRD feels that the USAID Dirol Plain Project is a key element, for in the next couple of years, it wil help determine the role that recessional agriculture, which is cheaper andless disruptive than irrigated agriculture, can play in the country's agricultural future. For thisw reason, they hope to be kept informed of developments in the planning and implementation process.

EUROPEAN DEVELOPMENT FUND
FED/NOUAKCHOTT

Mr. John Mace Resident Representative of the European Development Fund (FED) in Mauritania said that the FED is veryinterested in the issue of recessional versus irrigatedagriculture, particularly in thecontext of the post-Manantali studies that the IBRD is now undertaking.

FED aid to Mauritania under the third Lome convention has been prorgammed for the period 1985-89 but noprograms have begun yet. The program includes 61 million ecus for Mauritania, of which 6.5 million are in a risk-capital fund controlled from Luxembourg by the European Development Bank (EDB). The remaining 54.5 million ecus are programmed for Mauritania. Approximately 70% of these funds (or 38m ecus) will fund integrated rural development activities in the Kaedi area. Activities will include agriculture, feeder roads, water supply for both irrigation and people, health/education, cooperatives and rrual credit. In a word, anything the can make the area more viable economically and productively (especially food production) may make its way into the FED program. The FED goal is toencourage people to want to live and work in the Kaedi area. The Kaedi area, as defined by the FED,includes the Dirol Plain and the Foum Gleita irrigated and recessional zones.

The FED notes that significant problems have recurred as themes throughout the history of rural development efforts in the river valley. Peasants generally havelittle interest in or control over the changes that effect them. The SONADER dictates techniques, costs, crops, to them and they obey. The river valley needs a healthier structure, which canrespond more directly to farmer aspirations and needs than the SONADER has in the past.

Because the Diama Dam is operational and the Manantali Dam should come on line in the next year or two, all agricultural programs in the river valley will center on irrigation. But these programs must take the Mauritanian context into account:

a. until teh post-Manantali studies are finished and the dams operating, it is hard to know exactly what to do. Thus the FED is not starting up any major prorgams yet. They have contributed $200,000 to the post-Manantali study project.

b. the GIRM wants to concentrate on the consolidation of existing perimeters. This is also CILSS and IBRD policy. Thus the FED has resisted efforts to get it to expand the Boghe Pilot Perimeter. It is prviding funds and personnel for the rehabilitation of the Gorgol Pilot Perimeter (PPG).

c. Available water exceeds available manpower and skills in Mauritania. With the dams, land will become available ten times as fast as we can prepare and manage it. Even if we were to try to do so, it would cost up to $50m/year, which is the entire annual PREF agricultural budget for any given year.

d. Irrigation agriculture in Mauritania is extremely costly. We don't even really know how muchit costs, but it is extraordinarily costly. Thus, we must ask if it is a viable alternative in Mauritania. Itis changing thelifestyles of the people who produce from the irrigated perimeters and of those who eat the products. Is this desirable, given the costs?

In summary, irrigated agriculture in Mauritania is:

- o fragile and dangerous
- o expensive
- o requires discipline and management
- o requires high degree of maintenance
- o requires imported inputs
- o requires policing
- o requires high labor inputs
- o requires heavy investment
- o is intensive

What does one do while waiting for irrigation, for the new quantities of water that the dams will make available?

- o consolidate what you alreadyhave
- o begin environmental protection efforts

The FED has just closed its "Projet Poles Verts" which attempted reforestation of small sites in selected areas throughout Mauritania. The success of this project was mixed at best.

Mr. Mace suggested contacting Mohammed Sarr, at the MDR in Nouakchott, who was the Chief of the Green Poles Project; and Mr. De Regt, his Dutch agricultural engineer, who is in the FED offices. (527-24 or 527-32).

FRENCH BILATERAL ASSISTANCE
FONDS D'AIDE ET COOPERATION
FAC NOUAKCHOTT

The French work in Mauritania through two official agencies. The Fonds d'Aide et Cooperation (FAC) provides grants for technical assistance and for certain development projects. The Caisse Centrale de Cooperation Economique (CCCE) provides loans for economcially viable (in theory) development projects.

One of the major French efforts in the Senegal River Basin (SRB) is the R'kiz recessional agricultural project. It is the only major project in Mauritania currently working on recessional agriculture and lessons learned there should be of crucial importance to the design of the Dirol Plain Project (DPP). The R'kiz lake is flooded from the Senegal River each year, but in recent history, the flooded area has diminished dramatically. Droughts and water use upstream from the lake have cut the available annual water supply.

The FAC/CCCE have funded and carried out engineering works including dams and flood gates to regularize water supply for recessional agriculture on about 2,500ha. All irrigation is gravity-flow and thus is not costly and the earthworks themselvescost less than 2 million french francs (FF). At current rates, this is about $400,000. Their goal was the production of 3,900T of sorghum each year from these fields. An RFP was produced and the contract was let to a Franco-Mauritanian group, which included the Societe LeFevre of Dakar and EGB of Nouakchott.

The construction was finished in June 1986, in time for the 1986-87 walo season. About 2,000 ha were flooded, of which 1,500 were planted. Some farmers were skeptical of the project during its firstyear, thus did not cultivate their fields. Current estimations of the results of this first campaign predict a harvest of between 5,000 and 6,000T. Given the food needs of the local population, this shoulod generate a marketable surplus of between 3,000 and 3,500T.

This approach to recessional agriculture, carried out by the Bureau Central d'Etudes d'Outremer (BCEOM) seems very advantageous compared to large scale irrigated agriculture. The technical assistance team includes an experienced French agronomist, Mr. Baltzer, who arrived in early 1986. Helives in R'kiz, although his family lives in Rosso. Hehas withhim two young Eurpean Development Volunteers (VED). The VED is a Franco-German assosiation a bit like the Peace Corps. They have set aside a 60 hectare perimeter for trials and demonstrations of irrigated rice agriculture. This year, the rains came too late to try rice, so they grew maize on their perimeter instead.

The main problems theyhave had so far are those traditional in improved agriculture in Mauritania: social hierarchies and ethnic differences. R'kiz is controlled by Beidanes, although some Peul and some Haratine also live near there. The Peul's withdrew from any interest in improving theland of the lake, saying that the Beidanes would never give them any of the land to cultivate. This has led to a situation where there is a serious labor availability constraint, which has kept certain fields from cultivation. The Peul say they wouldlike towork on theland, but the Beidanes refuse to give them access even to the land they have not cultivated themselves.

The people on the plain have requested that the flooded are expand beyond the 2,000 ha but the projectteam has refused. They say that the people must first resolve theirconflicts and use all the land that is now flooded before thinking of expansion. The beidanes now use haratine labor to cultivate the land for them. The 2,000 ha is about as much as available haratine labor can

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farm.

The French have no otheractivities in the Trarza. In the Boghe area (Brakna) they support a PPV program that has not worked at all well during the year it has been underway. The people have refused to do the PPV site improvements by hand. They want mechanized help with it.

In the Foum Gleita area, the FAC provides four people as technical assistance for the exploitation of the irrigated area.

In Kaedi, the French finance the Projet d'Encadrement des Eleveurs du Gorgol (PEEG - see sheet on this project) and are financing the construction of a new set of buildings for the CNRADA. This complex, in between the FAO and the ENFVA is nearly finished. It includes 7 villas, three of which are funded by USAID. They will also equip four laboratories including soils, plant pathology, and entomology.

The FAC provides an expert on cereal crops to the CNRADA (Mr. Debos). This man isleaving and will be replaced soon. There is also a vacant post for a scientific adviser to the driector. The FAC would like to see a permanent link between the CNRADA and a French research establishment like the GERDAT or the CCIRAD or the CNARC.

FAO AGRICULTURAL EXTENSION PROGRAM
PVA/RIM

The United Nations Food and Agriculture Organization (FAO) has implemented a UNDP-funded agricultural extension (PVA) program in four regions of Mauritania since mid-1985. The PVA is to complete its first phase in mid-1988, when it willprobably be renewed, establishing new centers in different geographical regions.

The FAO furnishes five experts to the PVA,including two Africans. These include:

Chief of Party (also an agriculturalextension expert
Communications Specialist
Cooperative Organization Specialist
Women's activities specialist
Training specialist

Each of these experts has a Mauritanian counterpart from the Directorate of Agriculture (DirAg) in the Ministry of Rural development. These counterparts do not work full-time on the project, but participate in weekly planning meetings and contribute their knowledge and opinions as appropriate. The counterpart of the Chief of Party (Joge Torreabla) is Diallo Adama Yero, the Chief of the Extension and Training service of the DirAg.

The PVA works exclusively through the DirAg Inspectorates in the regions of Gorgol (Kaedi), Trarza (Rosso), Assaba (Kiffa) and Eastern Hodh (Nema). Each Inspectorate assigns a predetermined number of cadres to the PVA. These cadres receive a motorcycle, fuel, a repair allowance and a bonus for xtra work. The bonusses are UM3,500/month for Inspectors and Heads of Zones (e.g. Mbout) and UM3,000/month for the others.

The PVA prepares the extension themes on a regular basis,in collaboration with the Inspectorates and its experts help rpepare materials to encourage the effective propagation of these themes, which range from cooperative management to agricultural techniques to farm management. The PVA does not seem toprovide any material support to the Inspectorates beyond training and planning/programming.

Since the PVA is limited to the Gorgol Region, its potential impact on the Dirol Plain seems limited. If, during its Phase II operations, the PVA extends itself to new zones, it might bepracticial to finance the transport and bonuses of the agents with Dirol Plain Project Counterpart Funds and use PVA-trained DirAg agents as the project extension service. This would only be possible if an agreementon common planning andprogramming for the specific context of teh Dirol Plain could be signed among the DirAg, the FAO and USAID.

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MINISTRY OF RURAL DEVELOPMENT
PLANNING CELL

The Planning Cell (CP) of the Ministry of Rural Development (MDR) is the instrument of quality control for studies, analyses, evaluations and monitoring of all MDR Projects in Mauritania. n a sense it is the entry to the MDR for all such documents, including Project Planning documents, and the exit for all that will lead to implementation activities. The ministry willnot approve documents that have not been vetted by the CP (in principle, at least). The CP is supervised by the Cabinet of the Minister, which means the Director of the CP reports to the Secretary General (SG) of the MDR.

The Director of the CP is Baro Amadou Bashiro, an agronomist (Ingenieur agronome), trained in France and in Canada. He has also served as Director of the CNRADA. He has three experts working under him. The two expatriates have MDR-named Mauritanian counterparts.

The CP works in three main fields of analysis:

- o Agricultural Engineering,where Diallo Ahmed Yahya is both expert and counterpart;
- o Agricultural Ecomics, where the expert, Mr. Legrontec, and IBRD-financed Frenchman should arrive soon owork with his US-trained counterpart Diop Demba (MS in Ag econ from MSU); and
- o financial analysis, where Mr. Chea is the IBRD-funded French expert. His counterpart is Sidi Ahmed ould el Bou, aFrench trained agronomist (ingenieur agronome).

The CP also has a well-staffed administration, headed by Ahmed Malloum ould Sidi, who acts as Administrative ssistant to the Director. Malloum used to work as the Human Resources Offcer's assistant at USAID. There are also a Secretary for the Director, an accountant, four secretaries (including 1 arabisant), fur drivers, two errand boys, and 1 watchman.

The CP will coordinate the MDR's input to the planning of the Dirol Plain Project and should have a seat on the Coordinating Committee, once the Project is underway.

AGRICULTURAL STATISTICS SERVICE
AGRICULTURE DIRECTORATE
NOUAKCHOTT

The Agricultural Statistics Service (SSA) of the Directorate of Agriculture (DirAg)of the Ministry of Rural development (MDR) is helped by the FAO/UNDP/UNSO-funded Agricultural Statistics project. Mr. Angel Diaz is the Chief Adviser to the SSA, whose Directoris Cheikh ould Dih. The head of the SSA's technical Bureau is Anne Mamadou. He must controlthe qualityof all statistical information that comes out of the SSA. The SSA also has a computer bureau that has one Olivetti and two Apple IIe's. They are very satisfied with the latter, not very satisfied with the former, even though it is IBM-compatible. The SSA also has a Documentation Burau, headed by an Arabisant, Cheikh ould Hafed. Mostof the work is done by his assistant, Dicko Mohammed.

There is a non-function Bureau for coordination with the the Animal Husbandry Directorate, as well as four regional services: Boghe, Kaedi, Selibaby and Aioune. (see notes on the aedi Agricultural Statistics Office).

The goal of the projectis help create structures to permit themonitoring and evaluation of activities in the agricultural sector in Mauritania. They also do specific studies on request from GIRM organs or from donors. Thus, in 1985-1986 they did a study of the Dirol Plain for USAID. They want the collection of statistical data on Mauritanian agriculture to lead to concrete actions to improve GIRM and project performance. They wish avoid the sterile collection of meaningless numbers that contribute only to annual reports.

The Project wants to pursue four themes on a priority basis:
- o harvest results (underway)
- o prices and markets (next year?)
- o wages in the agricultural sector (later)
- o specific studies for and monitoring and evaluation of specific projects, such as the Dirol Plain.

The SSA feels that it needs a model to simulate the conditions of Mauritanian agriculture, something with simple software that its technicans can operate. They had hoped that the "Filiere Cerealiere" study would provideelements for such a model, but they have been disappointed.

The SSA is prepared to cooperate with monitoring and evaluation of the Dirol Plain Project through gathering appropriate statistics. The DPP wouldprovide local currency for transport and per diem, as well as administrative costs. Questionnaires, interveiw schedules, timing and personnel qulaifications will be the subjet of discussion among DPP, USAID, and SSA specialists. The SSA ralizes that it has to satisfy the needs of particular project goals indoing this sort of study. Its standard quaestionnaires will have to be modified. Nonetheless, to maintain comparativity throughout the country, they would apply the standard questionnaires as well.

Using the SSA in this way will enable the DPP to carry out intensive monitoring and evaluation activities without the necessity of long-term TA. Short-term TA personnel could contribute periodically to the analysis of data and to the improvement of questionnaires and other instruments. In addition, this would strengthen the SSA and ensure that DPP statisics would be comparable with those gathered throughout Mauritania. It might be necessary to puchase n IBM-compatible computer for the service, as well as some appropriate software

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THE PEACE CORPS

The United States Peace Corps (PC) has worked in Mauritania since the midsixties, except for the period between 1968 and 1973 when international political events led to a rupture of most US-Mauritanian relations. Their programs have traditionally concentrated on agriculture, health, and small-scale infrastructure, such as wells. Today the PC has 60 volunteers in Mauritania. More than half of them are in Agriculture, working ither with the SONADER or with vegetable production programs. They live in rough conditions in small villages from the Guidimaka to the Trarza and up into the Adrar. They speak Poular, Ouoloff, Hassaniya or Soninke and generate secondary projects in forestry, fruit trees, animal husbandry, small infrastructure and other related fields.

The PC has good working relationships with USAID, the GIRM, and with other donors working in the field in Mauritania. PC participation in the Mauritania River Valley Development Project (MRVDP) will enhance the project's ability to establish and maintain efective contact with farmers and farmer groups and to get its messages through to its beneficiaries. After discussions with the Associate PC Director (APCD) for Agriculture, Jude Andreasen, the PID team recommends that a group of 4 volunteers live in villages on the Dirol plain and participate in the implementation of the project.

These volunteers will belong to the PC agricultural program in Mauritania. Their primary field of expertise and training will be in traditional crop agriculture, especially recessional agriculture. They should have some real agricultural experience and/or training before entering the PC as they will have to carry MRVDP messages to participants in the fields of:

- o land preparation
- o seed treatment
- o improved practices (spacing, thinning, etc.)
- o crop protection
- o fertilization
- o seed selection/harvesting
- o storage/marketing

In addition, these volunteers will train villagers to install, follow and evaluate on-farm adaptive trials recommended by the CNRADA and the AGRES II Project.

Finally, the volunteers will help the people of the Dirol Plain organize themselves to finance and carry out the maintenance of the water control structures that the MRVDP will build to regularize recessional agriculture.

If the volunteers work on both rain-fed and recessional

traditional crops, they will occupy themselves from approximately July through approximately April of each crop cycle-year. They will thus have time to plan and carry out, with MRVDP support, secondary projects in related fields. Although the MRVDP will permit a certain amount of flexibility in the choice of secondary activities, priority will go to those undertakings which enhance the economic potential of the villages where they work. Such activities might include:

- o agro-forestry
- o fruit trees
- o truck gardening
- o cooperative management
- o animal husbandry (health and/or production)

Each volunteer will cover between 4 and 5 villages on the plain and a population of between 3,000 and 5,000 people. While exact village stations will be determined later, most of the PCV's will certainly be in the Mbagne Department of the Brakna. Nonetheless, given the Dirol Plain's proximity to Kaedi, the PC Volunteer Leader in Kaedi will take care of liaison with the APCD/Agriculture who will have the responsibility for these volunteers and will work closely with the MRVDP staff which will also base itself in Kaedi.

The MRVDP will provide the volunteers with:

- o technical supervision
- o transport, in the form of 125cc off-road motorcycles
- o fuel, lubricants and maintenance for the motorcycles
- o tools and materials to carry out the tasks the project requires of them
- o access to a local currency fund to finance secondary projects approved by the MRVDP and subject to MRVDP policies and accounting procedures.

In addition, PCV's will attend MRVDP seminars and training sessions. The MRVDP will fund a course in cooperative management for them at the Center for Cooperative Training in Boghe and will provide through the project staff, specialized training appropriate to successful project implementation. The APCD Agriculture will sit on the MRVDP's Coordinating Committee. The MRVDP and the Peace Corps will meet regularly to take all appropriate measures to ensure satisfactory performance on both sides.

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CONFEDERATION OF EMPLOYERS IN MAURITANIA
CGEM NOUAKCHOTT

The Confederation of Employersof Mauritania (Confederation Generale des Eployeurs de la Mauritania -= CGEM) was founded in the early 1960's in Nouakchott, but became an important player in the country's economic drama only in the early 1980's when private enterprise became a respectable occupation. The CGEM's primary role is todefend the interests of Mauritanian businesses against any group which attacks those inetrests. This includes lobbying for pro-business policies in the GIRM as well as opposing the exigencies of the Natinal Labor Union (Union des Travailleurs Mauritanians - UTM) which has its offices next door.

The CGEM espouses policies which promote the economic and social development of the country. In addition, they undertake certain public interest projects. These have includedthe construction of markets in Central Nouakchott, Rosso, and Nouadhibou. They are prepared to do whatever is necessary to promote private enterprise and claim to have played a vital role in eliminating the Mauritanian Cereals Office (OMC) monopoly on grain marketing in the country and finally to the demise of that organization in the early 1980's.

The CGEM is financed entirely bycontributions from member enteprises. Although many businesses do not belong to the Confederation, most have joined, at least in Nouakchott. The minimum contribution is UM40,000/year. For largerbusiness, the rate is calculated as 0.02% of their annual gross income. They receive no GIRM subsidy, but do get grants from friendly countries where similar confederations exist. These are mostly Arab countries.

The CGEM is composed of eight federations, whose members are all in the same general line of business:

- transport
- commerce
- construction/public works
- industries/mines
- banks/services
- fishing boats
- fishing industries
- agriculture/livestock

There areno GIRM officials assigned to workin the CGEM. The Secretary General (SG), Mohammed Ali ould Sidi, is on leave of absence from the SNIM-SEM. His technical adviser, Camara Seydi Boubou, is a former Director of Public Administration, whoworked for the SNIM for several years after retiring from government service. Both are paid entirely from CGEM funds. The SG is named by the National Board of the CGEM (Bureau National), which is made up of about 20 businessmen. The board is heavily dominatedby Moors from Nouakchott. Given the currentmake-up of the private sector, this is neither surprising nor unfair.

The CGEM does not have regional representations, although some of the federations do. In Kaedi, there is a Federation of Commerce. In general, the Mauritanian private sector is very wary of investment in agriculture. The exception to this rule is the group of private entrepreneurs who have established irrigated perimeters around Rosso. There are none in the Gorgol or Brakna. One problem discouraging such investment is the lack of a national code for agricultural enterprises. The CGEM has lobbied for the establishment of such a code. This code would define incentives, protections, conditions for investments in farms, dairies, transformation industries and so on. Entrepreneurs are beginning to get interested, but so far there has beenlittle movement.

Kaedi is not considered a priority area by the CGEM. There are no real industries there now, just commerce and transport. Grain trade is not seen as a major economic activity, even though it is completely free and open to all comers, with no price controls at all. The Kaedi abattoir is closed, a parastatal paradigm of bad planning and failed implementation.

The CGEM is willing to work with the Dirol Plain Project to identify oppuntunities for investment in the Kaedi area. They would be able to publicize these oppunrtunities among those members with available capital. They would also help with the bureaucratic process of facilitating investments. They are most interested in processing industries. They say that there is plenty of transport in and around Kaedi and plenty of merchants. There is a Commerce federation there already.

In the earlystages of the project, oppurtunities to work with the CGEM seem limited. As production increases on the plain and as Kaedi develops in response to the activitiesof the many projects now working there, the CGEM may begin toplay a mor eimportant role.

ETABLISSEMENT CHAITOU ET FILS
MERCHANTS IN KAEDI

The Chaitou and Sons merchant conglomerate in Kaedi includes the Supermarche near the old movie theatre, the gas station near the central market and the general supplies store across the street from the gas station. In addition they have a construction business and investments in Nouakchott and other cities in Mauritania. At least once a week a rented truck brings goods from Nouakchott to Kaedi and they also receive goods by the bi-weekly Air Mauritania flights.

Chaitou et Fils are not really an agricultural input supply store. Far more of their business seems to come fromconstruction supplies, automotive aprts and supplies, and fuel. However, tehy do deal in certain inputs on a regular, in-stock basis and have ordered other inputs on receiving requests from the GIRM agencies or from donors.

Their stores generally carry vegetable seeds of European or Senegalese origin, of unknown age and unselected varieties. These sell at 25-30UM/package, depending on how many you buy. The envelopes are standard home-garden size, with an ounce or so of seed. The FAO recently ordered medium-heavy-duty cyclone fencing from them, about 1m80 high in rolls of 25m for 8750/roll.

They also keep tools in stock, bothlocally made items from the artisans group formed and supported by Africa 70 and from Nouakchott. Their opinion on the relative merit and cost of these tools varies. The shovels and rakes are costly and not as good as the ones from Nouakchott. On the otherhand, their hoes (mattocks, really), watering cans and cultivators are of good quality and cheaper than those which come from Nouakchott (see prices below).

They do not keep fertilizer in stock, but canorder it from Nouakchott. It is cheaper from Dakar and they can bring it in informally from there if the order is big enough. They do not have a license for the importaton of agricultural inputs now, but one of the sons is now in Nouakchott trying to obtain one. For now they do all their importing through Etablissements Fahwhaz n Nouakchott. The fencing and theseeds they sell alsocome from Nouakchott.

Tool Prices: (including handle,unlessotherwise noted)

local rake - 450 (welded re-bar - looks fragile)
Nouakchott rake - 420 (stamped piece of metal - looks fragile)
local manure shovel - 900
local hoe with 1m20 handle - 700
Nouakchott hoe with 1m50 handle - 900
local hoe, larger model - 1100
Nouakchott shovl - 600
local shovel - 600 (this is a handbeaten shovel which takes a long time to make. Africa 70 is ordering machines tostamp out the parts which should cut the time and increase production, thus lowering costs. On va verra)'
local watering cans - 600 each if you order more than 100
700 each one by one
Nouakchott watering cans - 700 each
local binette (steel handle) - 400
Nouakchott binette - 600

Chaitou Fils will occasionally sell other agricultural items. They have now in stock a small chinese-made diesel driven water pump that someone sold to them new (20 cubic meters/hour, 20meterhead. They want 145,000UM for it. They often have small Honda diesel-driven waterpumps for sale.

There is a motor-driven grain mill withotu motor for sale for 150,000UM. They have a set of grain scales, a chain saw, other

odds and ends. Some of this is in response to orders that were made and not honored, some to people who brought things back from Europe then could not use them and sold them to Chaitou, others to speculation on their part.

For a while, they were selling locally made rice hullers, which could be attached to a motor. A Kaedi-based Senegalese artisan made them to be sold for about 100,000UM. Chaitou has ordered some sprayers, which theyhope to sell locally. He has 5 litre, 10 litre and 20 litre models coming. Some of them are hand pumped, hers have motors. He does not have the prices yet.

The Chaitou Fils construction division has a contact with the SONADER do do some prefabricated concrete articles for irrigated perimeters. They do 40 cm x 1m and 20 cm x 1m casings (buses) for canals and primary and secondary gates for water entry and blocking. The casings are delivered at 1600UM and 1100UM respectively and the primary gates at 2500UM (2m x 0m30 trapezoids).

The general attitudeof Chaitou Fils is that they'll do anything anyone wants them to do as long as they can make somemoney from it. They seem dynamic and have worked well with a variety of donors in the past. They do not own their own heavy transport.

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THE PALIKABA

KAEDI MERCHANTS

The Palikaba, also known as "eleveners" because of the way they arrange the beads in their rosaries, are an islamic brotherhood founded in this century by the eponymous Diakhite Kaba, known as Palikaba. The heir to his saintly mantle now lives in the Ivory Coast, but one of his sons, Yacouba Diakhite, heads up the Kaedi chapter of the brotherhood and another, Hamalah Diakhite, represents the group in Nouakchott, where he works in the Agricultural Directorate of the Ministry of Rural Development (MDR). The Palikaba members are primarily Soninke from Kaedi, although they have adherents throughout Mauritania.

More than 300 adults, men and women, live in the compound of Yacouba Diakhitenear the Kaedi central market. The order has a store, warehouse and residences there. Others live throughout Kaedi, especially in Gataga, the oldest quarter of the town. The Palikaba have the reputaion of well-organized, solidary merchants and farmers. Their principal activities fall into three main arenas: transport, agriculture and commerce.

In transport, they were among the first groups to invest in trucks to haul goods between Kaedi and Nouakchott and among towns and villages outside the capital. They now possess,in working order, 3 10 ton Mercedes trucks, one 30 ton semi-trailer truck, and 7 cars for transport of passengers. All the drivers and mechanics come from within their group.

In agriculture, they were among the first farmers to accept fields upon the Gorgol Pilot Perimeter (PPG). Land tenure and social stratification issues kept many of the toucouleur land-owners from claiming their rights on the PPG until several years after the perimeter became operational. The Soninke of the Palikaba took the oppurtunity to obtain a lage number of parcels in the bestparts of the PPG and have largely held on to them over the years. They remain a dominant force in the PPG's management structure.

In addition. they obtained two of the numerous Iraqi tractors that the GIRM received as a gift in the early 1970's when relationships between the two countries were good. When these relations soured a few years later,part sfor these tractors became unavailable. hwever, in the meanwhile the Palikaba were the first to make commercialplowing services available on the PPG. When the SONADER first brought tractors tohelp the farmers of the PPG prepare their fields, they leased them to the Palikaba, who kept them running with their own mechanics and drivers. Now there are a number of private tractor owners, who rent out their machines to farmers on the PPG and the SONADER runs its own tractor rental service, too. One of the old Iraqi tractors is still running and the Palikaba use it regularly on the PPG. It is probably the last of these still contributing to Mauritanian agriculture.

In commerce, the Palikaba specialize in grain trade and in agricultural inputs. They purchase sorghum, niebe and millet from farmers at prices below those of the CSA, but they pay cash on the spot. They do not have import authorizations yet, so they must buy from suppliers in Nouakchott or bring things in from Dakar (where they are generally cheaper than in Nouakchott) informally. For two years, the Agricultural Directorate used them as seed purchasing agnts. They then delivered the seed they bought (sorghum, millet, niebe) to destinations established by the MDR. They did not sell that seed themselves. They also obtained a load of fertilizer from the MDR and brought it toresell in Kaedi. Theysold about 200T to the PPG, but there is not that much demand for it, since they give no credit. Mostfarmers who use fertilizer work on irrigated perimeters and

can get it at subsidized prices from the SONADER.

Currently (at the time of the walo harvest) they are paying 50UM/moud (4kg) to farmers who are bringing their grain in to town to sell to them. The CSA price is 84UM/moud. They say that during the bridge at the beginning of the rainy season, the price may go up to 90 or 100UM/moud in bad years. It rarely goes below 40UM/moud, even at the worst of times. During theperiods of "soudure", they send trucks to the Guidimaka to buy sorghum and bring it back for sale at higher prices in Kaedi.

The Palikaba are currently negotiating an agreement with Africa 70 to run the agricultural supply store that the Italian NGO intends to establish to furnish tools, seeds, ertilizer and other inputs to market gardeners around Kaedi. They are rehabilitating a buidling on their compound to meet the needs of this store.

The Palikaba representative in Nouakchott is trying to obtain an authorization to import agricultural inputs from Senegal and elsewhere. This requires specialpermission as these inputs are now exempt from all customs duties. If they can obtain this permission, the input supply situation in Kaedi, which is quite inadequate at this time, may improve dramatically.

The Palikaba areprpared to work with any organization which needs and can pay for their services. They are alsoopen to the exploration of business oppurtunities whichpresent themselves as projects go about their work. Such oppurtunities may spring from the Dirol Plain Project:

a. cereals purchasing at predetermined points on the plain
b. sales of inputs for gardening and recessional agriculture
c. tractor rental for the preparation of recessional fields
d, retail or wholesale consumer goods sales to villagers or cooperative groups on the plain.

The Palikaba are conscious of the potential pitfalls of Soninke merchants working in Toucouleur fields and know they will have no claims to any land on the plain (they stated this spontaneously). However, the project should follow the evolution of the agricultural input store and of the ability of the CSA to purchase cereals on the plain in quantity and at the appropriate time. The Palikaba may present potential private sector alternatives to solving some basic logistical questions.

ETABLISSEMENT CHAITOU FRERES
MERCHANTS IN KAEDI

Chaitou Freres, relatives and competitors of Chaitou Fils in Kaedi, have a general merchandise store across the paved steet from the central market. Most of their shelves carry automotive supplies, office supplies and groceries. Theydo not stock any agricultural inputs apart from the usual packets of vegetable seeds (25UM/packet) and hand-tools (see prices below). But,like ther competitors in Kaedi, they can order whatever they need from Noouakchott or Dakar and have it in Kaedi within a reasonable length of time.

In 1986, the deliveredagricultural supplies to the FEDin Kaedi for 3ml UM. This included 60T of fertilezer (urea and 10-10-20) at 30UM/kg, 100,000 plastic bags for nursery seedlings, assorted hand tools, and large quantities of vegetable seeds at 4500UM/kg. They delivered all of this within 90 days of the order. They have an old Citroen T-46 dump truck which staggers back and forth between Kaedi and Nouakchott with their merchandise. They also rent trucks as needed.

Their hand tools are all from Nouakchott: (pices with handles)

shovels - 550UM
spades - 1200UM
picks - 850UM
rakes - 420UM

Although they do not carry much in stock, they say they can order anything and deliver at competitive prices. They often carry cement, but construction has diminished dramatically in Kaedisince the GIRM decided to cut in half all the rents it paid for private houses for its officials. IN addition, they levied a 20% withholding tax on all rents paid out for those same houses. Even so, cement is hard to get. The factory in Nouakchott recently raised its price from 9800UM/ton to 12,000UM/ton.

BANQUE MAURITANIENNE POUR LE DEVELOPPEMENT ET LE COMMERCE
BMDC KAEDI

The BMDC was the first bank to open an office Kaedi and remains, over ten years later, the only bank here. Mohammed Sidi ould Khnafer, the branch manager, has spent a bit over a year here. He has been with the BMDC for the eleven years since he finished his baccalaureat and passed a test for admission to the BMDC staff. He has been promised more formal training but has not hadmore than in-house courses so far.

The BMDC in Kaedi is entirely dependant on the main offices in Nouakchott. They communicate by telephone (with difficulty) and occasionally use the post office telex machine. But most of their exchanges take place through the twice weekly Air Mauritania mail flights and the regular mails. The Kaedi branch makes no decisions on loans, lines of credit, delinquancies or anyother banking function. They evaluate the situation and send their appreciation to Nouakchott for decisions.

In the mid 1970's the BMDC, which is linked to and assisted by a Tunisian bank, received the responsibility of setting up an agricultural credit program for the country. They hired a number of agronomists and social scientists to carry this out. Results were unsatisfactory and in 1981 the FND wascreated. It began realoperations in about 1984. Now the BMDC undertakes NO agricultural credit operations at all. If someone comes in asking for a loan for something that smells even faintly of agriculture, the Kaedioffice will assess the dossier and pass in on to Nouakchott as they would any other loan. But Nouakchott will send it to the FND. We suspect that this may be, at least in part, because of the preferentially low interest rates set for agricultural loans. On the other hand, the FND is not allowed to extend credit for commercial loans, construction loans, or industrial loans.

Although the BMDC has heard talk of an FND office in Kaedi, they do not expect this to happen this year. This office may by in combination with the BMDC office or it may be separate.

The GIRM sets all interest rates throughout Mauritania through the agency of the Central Bank (BCM). The BCM has isued a longlist of various rates for various types of loans. The most recent one came out in February of 1985 (27/2/85). Thus rates havenot changed in over two years.

General Commerce: 11.5%/yr if authorized by the BCM
15% if not authorized by the BCM
Deposits: from 7% for deposits of 50,000Um for 6 months
to 11% for deposits over 3.000.000UM for more than 2 years. There are many graduated leveles between these two depending on size and duration of deposit.
transport loans: (short-term)
11.5% if BCM approved
15% if not BCM aproved
agriculture or animal production:
8.5% if BCM approved
12% if not BCM approved

The Kaedi BMDC provides all normal banking services. The projet could open accounts here and the bank would operate transfers between Nouakchott and Kaedi by mail, which can take between three days and several weeks, depending on paper-work within the bank, flights to Kaedi and Post Office efficiency.

The BMDC is unlikely to contribute to the success or failure of the Dirol Plain Project.

ANNEX G

DIROL PLAIN PROJECT

TERMS OF REFERENCE FOR PP PREPARATION

PROJECT IDENTIFICATION DOCUMENT

Prepared by

Development Alternatives, Inc.
624 9th Street
Washington, D.C. 20001

TERMS OF REFERENCE FOR AGRICULTURAL ECONOMIST

MRVDP PP DEVELOPMENT

The agricultural economist will devote approximately 15 weeks to PP preparation, starting as early as possible in the period allocated for the work.

The agricultural economist will conduct the studies mentioned below and deliver the following:

- o contributions to the body of the Projectpaper as required by the team leader;
- o Economic Analysis Annex nclvding calculation of IIR's, B/C rations and NPV's for all project components.

PHASE II STUDIES TO BE CONDUCTED

REFINED ECONOMIC ANALYSIS OF THE PROJECT COMPONENTS
- OBTAIN BETTER YIELD DATA BY INUNDATION DURATION
- OBTAIN INFO ON MACRO RIVER MANAGEMENT PLANS (GIBB)
- CONDUCT REFINED ANALYSIS USING COMPUTER ANALYSIS
- INCLUDE ANALYSIS OF IMPROVED AGRONOMIC PRACTICES
- INCLUDE ANALYSIS OF TECHNICAL ASSISTANCE NEEDED
- INCLUDE ANALYSIS OF NORTHERN AND SOUTHERN PLAIN AS ONE UNIT WITH FLOODS ABOVE 9.5 METERS IGN AT THE DIROL CREEK
- REFINE MAINTENANCE COSTS ESTIMATES
- PRODUCE MATERIAL IN FORMAT CONSISTENT WITH USAID GUIDELINES
- GENERATE FORECAST OF PRICES AND YIELD LEVELS BY YEAR BASED ON GOVERNMENT POLICY AND ADOPTION RATE OF IMPROVED AGRONOMIC PRACTICES
- EXPAND EXPLICIT IDENTIFICATION OF NONMONETARY IMPACTS
- ANALYSIS OF ALTERNATIVE ENERGY REQUIREMENTS

RISK ANALYSIS OF THE PROJECT
- RISKS DUE TO VARIATION IN RIVER MANAGEMENT
- RISK RELATED TO HOUSEHOLD CONSUMPTION AND NUTRITION
- RISK RELATED TO MULTI-INCOME SOURCE HOUSEHOLDS
- RISK RELATED TO MAINTENANCE REQUIREMENTS
- SENSITIVITY OF ECONOMIC ANALYSIS TO DATA QUALITY
- IDENTIFY ACTUAL BENEFICIARIES
- RISKS RELATED TO LAND TENURE ARRANGEMENTS
- RISK RELATED TO OTHER AGRICULTURAL ACTIVITIES ON THE PLAIN FISHING, LIVESTOCK, GARDENING, IRRIGATED AGRICULTURE

REGIONAL ECONOMIC OEGANIZATION ANALYSIS USING HOUSEHOLD DATA
- DETAILED ANALYSIS OF THE LOCAL GRAIN MARKETING SYSTEM
- GENERAL ANALYSIS OF CONSUMER SERVICES SECTOR IN ALL VILLAGES
- PRELIMINARY ANALYSIS OF LOCAL FINANCIAL INSTITUTIONS
- REFINED ESTIMATION OF CONSUMPTION MULTIPLIER TO IDENTIFY

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CONSTRAINTS AND COMPLEMENTARY INTERVENTIONS NEEDED
LABOR AVAILABILITY AT THE REGIONAL AND HOUSEHOLD LEVEL
CREATE MAPS FOR LAND TENURE AND ECONOMIC ORGANIZATION

AGRICULTURAL POLICY ANALYSIS

IMPLICATIONS OF DIROL PLAIN PROJECT ANALYSIS RESULTS FOR RECESSIONAL AGRICULTURE ELSEWHERE IN THE SENEGAL RIVER VALLEY

IMPACT ANALYSIS OF PRICE POLICY AND FOOD AID ON THE PROJECT

COMPATIBILITY ANALYSIS OF ENHANCED RECESSIONAL AGRICULTURE AND PUMP IRRIGATED AGRICULTURE

Appendix N.

Dirol Plains Project
Detailed Terms of Reference for PP Phase Engineering Tasks

Item	Description	Days
1.	Visit similiar structures in area	5
2.	Collect, review historic construction costs	2
3.	Prepare design criteria	2
4.	Reconfirm water availability/structure size	2
5.	Reconfirm flood frequency/check overtopping	2
6.	Reconfirm area served	2
7.	Confirm material sources	2
8.	Supervise foundation boring	2
9.	Compute factors of safety	
a.	Sliding from high downstream water	2
b.	Sliding from high upstream water	2
c.	Against uplift	2
d.	Against piping	2
e.	Against earthquake	2
10.	Structural and hydraulic design	
a.	Calculate all forces acting on structure	2
b.	Determine concrete dimensions	2
c.	Determine reinforcing steel	2
d.	Check hydraulics through gates	1
e.	Design baffel blocks, apron	1
11.	Select/design gates/hoists	3
12.	Prepare structure operationg criteria	2
13.	Prepare construction drawings	
a.	Plan	2
b.	Elevations	3
c.	Sections	3
d.	Details	2
e.	Review	2
14.	Compute quantities	2
15.	Prepare cost estimate	2
16.	Prepare construction specifications	5
17.	Prepare maintenance plan and costs	2
18.	Review, coordination, travel	7

Subtotal	72 man days
At 26 days/mo.	2.7 man months
Contingency 10%	0.3 man months
Total	3.0 man months
Home office review and final drafting	
Printing	1.0 man month
Grand total	4.0 man months

Work to be carried out by Civil/Water Resources Engineer, French speaking, 15 years experience in similiar work. Approximate time

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ANNEX 1

DIROL PLAIN STUDY

TERMS OF REFERENCE FOR HYDRAULIC STUDIES

These terms of reference cover two main interrelated subjects, namely: the Senegal River hydrology in the project area and the hydrology of the Dirol Creek.

A. SENEGAL RIVER HYDROLOGY (Project area)

Studies will consist of field and office work as detailed below:

1. Field work

The following staff gauges should be tied by precise leveling (1st order) to the IGN reference level bench marks:

i) ORSTOM Staff gauge at Kaedi (port) to the following benchmarks: OMVS nos. 26-A, SRE 33, and IGN Mlle 50.

Approximate leveling distance, 3.0 km.

ii) SONADER Staff gauge at the "point-vanne" in Kaedi same benchmarks as in i) and cross check the elevation of a benchmark on the wall of the pumping station nearby, known to be 14.00 IGN.

Approximate leveling distance: 1.7 km.

iii) ORSTOM staff gauge of Diorbival on the left bank (Senegal) to be tied across the river and Diarambol forest to a benchmark along the proposed dam site at the Dirol Creek mouth.

iv) Rehabilitation (if required) of a staff-gauge at SALDE and rattachement to the nearest IGN benchmark.

2. OFFICE WORK

2.1 The main task will be to update and review the statistical analysis of maximum and typical flood water levels (15, 30, 40,

50 days) at Kaedi undertaken by Rochette in the "Monographie du Fleuve Senegal" (ORSTOM, 1974).

It will permit:

The addition of revised water levels during the latest dry spell up to 1986-87.

Evaluation of proposed dams and dikes, and their effect on water levels in the project zone.

2.2 The management study of Manantali and Diama dams undertaken by Gibb - EDF - Consult is expected to be availbale in mid 87. It should provide various proposals for water releases at Manantali to cope with power generation, agriculture, and navigation water requirements.

The hydrologist will work out a statistical analysis of maximum and typical water levels of the project zone for various management scenarios of Manantali dam which will be presented in the above mentioned report. It will encompass intermediate and long term predicted development in the Senegal River valley.

2.3 The ORSTOM "Flood Propagation Model" is well adapted to update water-level correlations and timing between Bakel and the project area. It proposes the following steps:

a) Calibration of the model between Bakel-Kaedi-Dirol and Salde (para. 1) to determine water levels of various frequencies at the Dirol.

b) Assessment of Manantali Dam management impact on water levels at Bakel and correlation to the Dirol, making use of the Flood propagation model.

Notes: The leveling as detailed in para. 1 is made part of the

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present study to prevent undue delays. If it is included in a separate topographic study must have first priority.

b. HYDROLOGY OF THE DIROL CREEK BASIN

1. Field work

Making use of the field investigations undertaken by ORSTOM, complementary information and data will be gathered to determine the following:

Morphology and physical characteristics of the basin related to rainfall runoff coefficients.

Gathering of historic basin water yields and flow patterns of the Dirol Creek through interviews with the local population.

Installation of flood staff gauges to determine peak flow values at the Dirol outlet, Atene, and downstream Tamourt Gellouar.

Field reconnaissance and transfer to topographic map areas with different rainfall-runoff coefficients, retention zones, and delineation of sub-basins.

2. OFFICE WORK

2.1 Rainfall

The following steps should be followed:

- Assemble and assess all annual rainfall data directly relevant to the upper catchment area and extend the data for longer usable statistical series.

Compare with dry periods.

Carry out a statistical study for each station and draw corresponding isohyets for various frequencies.

2.2. Basin yields

Data obtained in para. 2.1 combined with physical and morphological parameters of the basin shall permit the computation of rainfall-runoff coefficients for various frequencies. Results abstracted from the ORSTOM publication: "Ecoulement annuel dans le SAHEL TROPICAL AFRICAIN" will be applied to the above parameters.

An evaluation of climatological data shall also be made to work out a water balance study of the basin.

This study should commence as early as possible after acceptance of PID report and be sub-contracted to a hydrological consultant familiar with the Dirol Plain.

TERMS OF REFERENCE

AGRONOMIST

DIROL PLAINS PROJECT PAPER

1. Total time 4 weeks (Minimum 3 wks; Maximum 5 wks)

2. Observe and report agronomic practices and crop fields at similar projects such as R'Kiz and Funglayte.

3. Outline a proposed agronomic activities calendar covering the first two years of project life.

4. Give detailed descriptions of inputs and equipment required for agronomic research, demonstration, and extension.

5. Project all production inputs and equipment needed by farmers for agronomic innovations during the first two years of project life.

6. Observe and report relevant work done on agricultural research stations in Mauritania.

Terms of Reference: Dirol Plain Project Paper Social Scientist

The social scientist will prepare a project social analysis according to the outline in AID Handbook three.

S/he will, in collaboration with a team of Mauritanian social scientists, conduct a survey of the villages most closely involved with agriculture on the Dirol Plain. This survey will establish the socio-economic base-line against which project accomplishments will be measured. They will also investigate land-lease and share-cropping arrangements, interviewing at least a 10% sample of households to determine the number, geographic distribution, and conditions of share-cropping arrangements used in the previous cropping season, and the relative benefits to land-owners and share-croppers or lessees. This study will serve as a baseline for later evaluation of the equity impact of the project.

S/he will arrange for a survey and registry of land rights, but only in areas likely to be expropriated for infrastructure or otherwise requiring compensation to the owners. The areas to be continued under cultivation have already been inventoried by Park et al, and a complete registry might be counterproductive at this time.

S/he will attempt to determine the effect of seasonal or permanent out-migration on labor availability on the Dirol Plain and analyze the quality of the labor regularly available for recessional agricultural tasks.

S/he will work with farmers to initiate formation of a cooperative capable of managing water regulation and infrastructural maintenance. If possible, this cooperative should be the administering agency from project inception. S/he will assure that farmers, the apprpriate GIRM agencies and USAID are mutually informed of each other's legal and logistic requirements and scheduling.

The Mauritanian social scientist will devote six months to the above work. The expatriate social scientist will make two one month visits to Mauritania, the first at the beginning of the PP period and the second at the end.

TERMS OF REFERENCE

INSTITUTIONAL ANALYST

FOR MRVDP (682-0237) PROJECT PAPER

The institutional analyst will make two visits to Mauritania during PP preparation, the first, during month one and the second during the final month of PP writing. S/he will furnish:

- o contributions to the text of the PP as determined by the team leader;
- o the administrative and institutional annex; and
- o the sustainibility anaylsi (in conjunction with the team economist.

Specific tasks will include:

- o contacting those collaborating institutions identified during PID preparation, completing necessary information on them and finalizing proposed methods of establishing coordination and collaboration;
- o preparing draft orgainzation charts of those institutions, as well as for the MRVDP itself;
- o drawing up pproposals for using personnel from collaborating institutions as counterparts for MRVDP TA personnel;
- o working with PP team social scientists to prepare for teh formation of Dirol Plain village institutions to undertake tax collection, flodgate maintenance, and other agricultural and economic development tasks; and
- o establishing a detailed institutional plan to include the participation of all possible collaborators in the Kaedi agricultural sector and in Nouakchott, as well as among the traditional institutions of the Dirol Plain.

ANNEX H

DIROL PLAIN PROJECT

LIST OF CONTACTS

PROJECT IDENTIFICATION DOCUMENT

Prepared by

Development Alternatives, Inc.
624 9th Street
Washington, D.C. 20001

LIST OF CONTACTS

Nouakchott:

USAID:

George Eaton, Director
Walter Boehm, Deputy Director
James F. Jackson, ADO
Barnett Chessin, Executive Officer
Nancy Hooff, Project Design Officer
Harouna ould Hanafi, agronomist
Jim Bedner, Food for Peace Officer

PEACE CORPS:

Richard Toliver, Director
Jude Andreasen, APCD/Agriculture

MINISTRY OF RURAL DEVELOPMENT:

Sy Adama, Director of Agriculture
Michel Balensi, Advisor to the Director of Agriculture
Diallo Ahmed Yahya, Planning Cell
Diop Demba, Planning Cell
Ahmed Malloum ould Sidi, Administrator, Planning Cell
Ely Salem, Adviser for Land Tenure Affairs
Thiaw Amadou, Director of Environmental Protection, a.i.
Tall Abdoulaye, Head of Agricultural Credit Service
Mohammed El Moktar, Assistant Director of Animal Husbandry
Ly Ibrahima, Chief of Animal Husbandry Inputs Project
Dr. Gaye, Head of Animal Production Service
Patrick Pruvot, Adviser to the Minister
Ba Bocar Soule, Director of Oasis Projects
Diallo Amadou Yero, Chief of Extension and Training Service
Anne Mamadou, Chief of Technical Office, Agricultural Statistics Service
Soumare Abdoulaye, Crop Protection Service
Diarra Sadio, Entomology Laboratory

SONADER:

Kane Amadou Abdul, Technical Director
Mme. Janina, Headof Soils Laboratory
Diop Amadou, Head of Studies Bureau
Ahmedou, Director of Soils Labrostory

Confederationof Employers:

Mohammed Ali ould Sidi, Secretary General
Camara Seydi Boubou, Technical Adviser

DONORS:

Jean Louis Riddell - FAO
Michel Baltser - FAO/R'Kiz Project
Etienne Baranshamaje, IBRD
Ba Demba - IBRD
Jorge Torrealba - FAO Extension Project
Michael Askwith - UNDP
John Mace - FED
Mohammed Fekih - FAO
K. Choueiri - FAO
Angel Diaz, FAO Agricultrual Statistics Project

Brakna:

El Hassan ould Mouloud, Governor
Niang Gaoulel, Assistant Director, CFC

Gorgol:

GOVERNANCE:

Isselmou ould Mohammed Vall, Governor
Sidi ould Brahim, assistant Governor (administration)

SONADER:

Ba Amadou Abdul, Regional Director
Diop Aliou, Heaof Crop Production
Mr. Smickens, FED adviser to Crop Production Service
Alain Baes, FED engineer in charge of rehabilitationof the PPG
Hubert Castellan, FED Engineer for the construction of PPV's

ENFVA:

Lam Hamady, Director
Sidya ould Abdallahi, Director of Studies
Diallo Pap Mohdy, Orientation adviser
Conte Boubacar, Headof Irrigation Section
Bal Mohammed el Habib, Head of Forestry Section
Bathily, Head of Agriculture Section

AGRICULTURAL INSPECTORATE:

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Gacko Mamadou, Assistant Inspector
Sidi Mohammed ould el Vagha, FAO extension project
Kane Abdul Karim, Chief of Mbout Sector

CNRADA:

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Diarra Mamadou, Director
Hamath Ngaide, Technical Director
Ba Mamadou Lamine, Head of Fruit and Vegetable Section
Bathily Mohammed, Pre-Extension
Wone Abderrahmane, loose end
Mark Lynham, COP, AGRES II
Robbie Ackerman, Administrator, AGRES II
Chris Atkinson, Management consultant, AGRES II
Sidi o/ Rachid - Food Crops

PEEG:

Jean-Luc Francois, co-Director
Dr. Wane, Co-Director

CNERV:

Diouwara Adama, Head of Antenna

ENVIRONMENTAL PROTECTION INSPECTORATE:

Mohammed ould Hamsa, Inspector

BMDC:

Mohammed Sidi ould Khnafer, Head of Agency

CSA:

Sarr Brahim, Regional Paddy Supervisor

BCE:

Sidi Mohammed, Controller

MERCHANTS:

Chaitou Freres
Chaitou Fils
Palikaba - Yacouba Diakite

AGRICULTURAL STATISTICS SERVICE:

Diallo Baidi, Chief
Kamara Moussa, Assistant

ANNEX I

DIROL PLAIN PROJECT

BIBLIOGRAPHY

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ANNEX: BIBLIOGRAPHY

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