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**USAID/Mauritania, Office of Food and Agriculture  
Islamic Republic of Mauritania**

# **FOOD AND AGRICULTURE SECTOR ASSESSMENT**

prepared by

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ASSESSMENT OF THE FOOD AND AGRICULTURE SECTOR  
OF MAURITANIA

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PRESENTATION

This assessment is the principal document produced by a team contracted by USAID Mauritania with Development Alternatives, Inc. and the Research Triangle Institute, respectively, under AID contracts Nos. PDC-1406-I-00-1135-00, Work Order #8, and SOD/PDC-C-0392, Work Order #9. The assessment is the product of the first phase of the effort. It represents an integrated approach to an analysis of Mauritania's rural and food sectors based on the specialized--albeit partly interdisciplinary--reports prepared by the individual team members and subsequently slightly edited by the team leader and the coordinator. The specialized reports are being submitted in three volumes, as follows:

- Assessment and Proposed Assistance Options for the Fisheries Sector.
- Analysis of Crops, Livestock and Forestry and Environment.
- Analysis of Economic, Social, Institutional and Manpower Issues.

A paper entitled "Assistance Options" was presented to the AID Mission in December, 1982 for its exclusive use and review.

Only inland fisheries are treated (briefly) in the overall assessment because marine fisheries cannot be considered part of the rural or (except for part of the artisanal catch) of the domestic food sectors, and because they are covered rather thoroughly in Mr. Cordover's specialized paper, "Fisheries Sector Assessment and Assistance Options," which was also submitted in December.

At the AID Mission's specific request, only the present report is being translated into the French language for the benefit of the appropriate readership in the public and private sectors of Mauritania.

In accordance with the Scope of Work proposed by USAID/Mauritania, the first phase of the effort was based on a quick but critical review of existing documentation--principally the voluminous RAMS material--which began during a two week preparatory phase at RTI in North Carolina.

The team, which spent approximately one month in Mauritania in November, 1982 (except for the Forestry/Ecology consultant who remained for only two weeks), was composed as follows:

- Robert Cordover, Fisheries Consultant; DAI
- Donald S. Humpal, Team Coordinator and Agronomy Specialist; Agriculturalist, DAI
- Tri Nguyen, Institutions and Manpower Consultant; DAI
- Eric B. Shearer, Team Leader; Senior Agricultural Economist, RTI

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Albert Sollod, Livestock Consultant; DAI

Pierrete Vu Thi, Sociological Consultant; DAI

Fred Weber, Forestry and Environmental Consultant; DAI

Most of the team's time in Mauritania was spent in Nouakchott reviewing additional documentation and interviewing GIRM officials, expatriate advisers, local business leaders and AID Mission personnel. Most team members were also able to make brief excursions to selected areas of the country in order to obtain some first hand impressions.

The logistical and substantive cooperation of the AID Mission and of the Embassy Joint Administrative Operation is gratefully acknowledged, as is the cooperation of officials of the Ministry of Planning and Regional Development and of the Ministry of Rural Development and its subordinated organizations in Nouakchott and in the field. Special thanks are due to the Director and staff of the Guidimaka Integrated Rural Development Project for their professional help and hospitality.

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## 2. INTRODUCTION

### The Lack of Institutional Information

The state of the Maldivian economy on the basis of quantitative measurements or indications is quite futile. Only very rough approximations exist even for such fundamental variables as crop acreages and yields, oil usage and household production, labor force, the movements of goods, services, labor positions and the catch of fish in the territorial waters controlled by the nation. Price series are non-existent or full of gaps and inaccuracies. Data on actual (as distinct from budgeted) public expenditures are meagre and almost impossible to come by. Even national income has not succeeded in being very close to the mark.

There are virtually no surveys or case studies on which to base meaningful analyses of such measures as costs of production and net production, incomes and consumption. ILO made a valiant effort to plug some of the gaps but could obviously not advance very far during the emergency Maldivian situation. Its surveys suffer from probably inevitable methodological flaws that make it impossible to base any aggregations on the data and even make it doubtful that they are either true reflections of reality at the national level or, if they were, representative at any level of generalization. This should be borne in mind in all references to ILO surveys, even though the caveat may not be reiterated.

The reasons for the primitive state of quantitative information are fairly obvious. They are but the reflection of the country's poverty, sparse and partly highly mobile population and the resultant institutional weaknesses. Not only are there few qualified statisticians and economists in the national administrations, there are almost no trained economic personnel in the field and there is little or no confidence among the general population in the motives of public employees (or foreign consultants) working hereabouts about land, production, livestock numbers and movements, incomes and consumption.

The significance of this backward state of statistical information for development planning is that it makes a mockery of well-intentioned analyses, calculations and calculations that are meant to support the planning framework of a particular program or project in terms of (1) needs, (2) inputs, (3) cost and (4) benefits. All such presentations should be given with a caveat unless they are appropriately qualified. Beyond this, the analysis of development problems and the design of new programs and projects should concentrate on qualitative factors, using quantifications (except, of course, for financial input data) only to indicate general magnitudes and to indicate probable outcomes.

The only existing consumer price index, for example, is for domestic market goods in the capital.

These problems will become clearer when the reader becomes acquainted with some of the peculiarities of the structure of present Mauritanian society and economy.

Some observers believe that the rural GDP is substantially underestimated because, it is felt, rainfed grain yields are much higher than generally reported and because the estimated value of livestock production does not account fully for the value of production of milk by cows, goats and camels. On the other hand, basic estimates of both crop acreage and livestock numbers are utterly unreliable and one does not know what portion of the assumed livestock production (slaughter, sales and herd increase) to attribute to the Mauritanian or to the Malian GDP, in view of the strong currents of transhumant migration of herds and the reportedly heavy sales by Mauritanian herders in Mali.

## II. THE RURAL SECTOR IN 1982

### A. Peculiar Characteristics of the Mauritanian Economy

The Mauritanian economy is subject to five basic constraints:

(1) the nation, artificially carved out of a much vaster economic, social and political system (of which it had been the stepchild), is only about 20 years old;

(2) almost the entire population of less than two million is concentrated in the artificially created capital (upward of 10%) and in a narrow band along the northern shore of the Senegal river. The rest of the country's rural areas--with "normal" annual precipitation of less than 100 mm--are virtually useless as a habitat for sedentary populations;

(3) nearly half of the "economically active" population--i.e. nearly all that are not nominally engaged in primary activities (agriculture, herding, fishing and mining)--is "employed" in largely non-productive jobs in the tertiary sector, and half of these are in the public sector;

(4) cross-border ethnic affinities, the nature of nomadism and the long frontiers of the south with Senegal and Mali combine to produce a lively, albeit unrecorded and largely uncontrolled, movement of goods and people back and forth across these (to the people concerned) artificial frontiers; and

(5) except for one (important) north-south artery and one (only lightly used) west-east road, there are no improved roads connecting the main farm production areas with Mauritanian and neighboring markets and supply sources.

These constraints are aggravated by the following events:

(1) Mauritania's withdrawal in the early 1970's from the CFA zone and the creation of an inconvertible -- and presently overvalued -- currency, the ouguiya;

(2) the devastating effect in Mauritania of the succession of sahelian drought years<sup>1/</sup> beginning in the late 1960's, which has meant that less than 20 years after the declaration of political independence the new country is more heavily dependent on the benevolence of the outside world than the region was under colonial rule; moreover, the droughts have produced convulsions in the traditional settlement and migration patterns;

(3) a costly war over control of the former Spanish Sahara that resulted in a net economic loss to Mauritania because the nation now has to support a large military establishment for which it no longer receives external financing;

(4) sharply declining world prices for copper -- and a less sharp decline in the price of iron ore -- the country's main exports, and the approaching exhaustion of the high-grade deposits;

(5) a series of largely unproductive public investments in industry during the 1970's when enormous funds were lavished on Mauritania by wealthier Arab countries in the misguided political belief that the country was capable of rapid industrialization; thus, precious capital was withheld from the rural areas and from the building of institutions to cope with rural problems, and a series of public enterprises as well as a swollen, unproductive public bureaucracy and labor force, have to be subsidized each year from the scanty government revenues;

(6) introduction of the "New Fisheries Policy" did not end the sequence of politically short-sighted and/or greed-motivated actions that have been effectively preventing the country from cashing in on its only remaining natural advantage -- the plentiful fish resources of its territorial waters.

## B. The Rural Sector

### 1. Macro-Economic Aspects

Another peculiarity of the Mauritanian economy is the relatively small role played by the rural primary sector in the country's GDP, in accordance with the official estimates. While the rural sector is of overwhelming importance (69%) in the employment picture, agriculture, livestock and "forestry" are officially estimated to have produced about UM 5.2 billion (115 million dollars) in 1979, or only about 20 percent of the country's total GDP. Mining (11%) and the tertiary sector including construction (56%) account for almost all the remaining domestic product. Artisanal marine fisheries and industrial deep-sea fishing contribute an estimated UM 503 million, or nine percent, the latter largely<sup>2/</sup> in the form of royalties and penalties collected from foreign fleets.

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<sup>1/</sup>For a discussion of the meaning of the "drought" in a long-term climatic context, see III-B below.

<sup>2/</sup>Data sources: RAMS AS 4; MPAT, 1982 and Carr, 1982.

The structure of the rural GDP (not including fisheries) follows that of land use: for 1979, 88 percent is estimated to have come from the livestock subsector (of which about 40% is home-consumed milk) versus only 10 percent for crops; forestry accounted for only two percent of the rural GDP.

The absolute and relative dynamics of the rural GDP have been heavily influenced by the drought, on the one hand, and by the fluctuations in the volume and prices of mining output and the growth of the tertiary sector, on the other. As late as 1969, crop and livestock production still accounted for one-third of GDP according to the accepted data, compared to the present 20 percent.

As a result of the succession of droughts, total rural sector GDP grew at an annual rate of only five percent between 1973 and 1979, following an average annual decline of six percent between 1969 and 1973 (MPAT, 1982). This means that by 1979 total rural output had barely recovered to its 1969 level. With population increasing during that time at an estimated rate of 2.7% per year, there appears to have been a 2.7% per capita decline in rural production during the same period, i.e., per capita production in 1979 was only three-fourths what it had been ten years earlier.

## 2. Population

According to the 1977 census there were at that time 1.032 million people living in rural areas, of whom almost exactly one-third were listed as "employed". The employment figures include only a small number of women, although it is known that in nearly all ethnic groups women participate to a more or less important degree in production and marketing, as distinct from conventional "household" activities. (The latter, as in so many other countries, of course, also figure importantly in the "processing" of crude foodstuffs for household consumption, such as the pounding of sorghum and millet.) Thus, the rural labor force may well be as much as one-third higher (on a male full-time equivalency basis) than the census figure.

The census also purports to show the following breakdown of the "employed" rural population (RAMS AS-4, Table II-6):

	<u>Thousands</u>
<u>Sedentary</u>	179
Farming	103
Herding	36
Other <sup>1/</sup>	40
<u>Nomadic</u>	147
Farming (incl. oases)	23
Herding	116
Other <sup>1/</sup>	8

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<sup>1/</sup> Presumably engaged in forestry or in other than primary activities.

These data seem to indicate that a total of 126,000 rural people were engaged in crop farming and 152,000 in livestock herding, a ratio of 1:1.2. However, it would be highly misleading to base any economic calculations or assumptions on such a statistical construct. It is probably quite correct to assume that the 116,000 nomads listed as herders have nothing at all to do with farming (although one is not sure what to make of the 23,000 "farming nomads"). On the other hand, the separation of sedentary population into farmers and herders is quite artificial because (1) a very high percentage of sedentary households also own or manage some or all species of productive livestock, and (2) the separation of duties within households is, of course, neither clear-cut nor invariable.

At this point a common misconception about recent population dynamics must be cleared up. If the 1977 census is compared with the previous one (1965), it appears that the nomadic population declined from 65% to 36% of the total (RAMS AS 3, p. 21). However, an examination of census instructions reveals that the definition of a nomad had changed very significantly from one census to the next and had become much more restrictive in 1977 (*ibid.*, p.22). Thus, while the successive droughts undoubtedly had a certain sedentarization effect on nomads, it is highly unlikely that the rural living pattern changed as drastically as the census data imply.

### 3. The Food and Income Gap

That pauperization of the rural population did not reach disaster proportions was due largely to the reportedly rapid rate of recovery of the livestock economy in 1973-79 or to the fact that livestock numbers did not really decline as sharply as officially claimed (see III-2 below). An average annual growth rate of 10 percent in those six years followed an average 11 percent decline in 1969-73. Thus, officially estimated livestock output in 1979 was 11 percent above 1969, a per capita decline of "only" 15 percent.

Crop production, on the other hand, dropped an average of 23 percent per year in 1969-73 and five percent in 1973-79, for an average annual decline of three percent during the decade. This works out to a per capita annual decline of 5.7 percent, which in turn means that average availability of crops (i.e., grains) from domestic production for each Mauritanian in 1979 was only 56 percent of the level ten years earlier.

The food grain shortfall has been largely offset by foreign multilateral and bilateral donations and by commercial imports. But the utterly depressing effect on the incomes of the rural households that depend essentially on dryland grain could not be remedied. In fact, these households suffered doubly: they were deprived of the small marketable surplus that they had been able to produce; at the same time they had to draw on other sources of their thin but diversified income base (including emigration and its remittances) in order to finance the purchase of imported grain, luckily available at highly subsidized prices.

With the exception of a few pockets of vegetable and fruit growers in the irrigated Senegal valley and in the oases, crop growing in Mauritania means grains, more specifically sorghum and millet (depending on soil moisture) and a little cowpeas in the dryland areas, and rice and some sorghum and maize in the irrigated "perimeters". Production estimates during the critical past decade vary widely (at times, wildly) because there is no systematic, objective basis for evaluating either area or yields. For example, Enger (USAID/Mauritania, 1981, Annex F, Table 9) lists nine different estimates for total grain production for 1976 and 1977, ranging, respectively, from 21,000 to 69,000 tons and from 21,600 to 54,000 tons. What is surprising is that there is no agreement on the quantities of (ostensibly recorded, i.e., not including informal border trade) grain imports (*ibid.*, Table 10). Yet when all is said and done, it seems that as a result of the combined commercial, food aid and informal imports, there has been, on the other hand, no starvation in Mauritania nor is there any indication that unsalable stocks were accumulated at any one time.

Most sources conveniently avoid discussing the subject of market surplus of domestic grain production.<sup>1/</sup> All that can be said on the subject on the basis of available information and opinion is that (1) there appear to be slight market surpluses of sorghum and millet during years of "normal" rainfall, (2) there is virtually no market surplus of these grains during drought years, and (3) a considerable proportion of the rice produced in the Senegal valley is marketed. (Available sources do not even indicate the total amount of rice bought by government agencies.)

#### 4. Food Consumption and Income Sources

There is as much controversy about the level of per capita consumption of grains as about other variables. The latest donor-accepted, country-wide weighted average for planning purposes is 150 kg., considerably below that of neighboring countries. Previous, lower national averages had reflected mostly the low level of grain consumption among nomads (around 50 kg or even less).

As pointed out earlier, the proportion of nomadic population has been declining substantially owing to the droughts. Such scant consumption and nutrition studies as exist, including the RAMS surveys (see below), point out that (a) there is no evidence of widespread sub-nutrition except from the weight-height ratios of one to three year old children, and (b) while protein intake appears satisfactory per se, an unusually - even for sub-Sahara Africa - a large proportion of the

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<sup>1/</sup>Martin (1982) in a footnote to Annex Table 17, on page 146, attributes to a 1981 FAO study on food security an estimate of around 20%, which appears to be, in turn, based on RAMS data. The table contains 1976/77 and 1978/79 data but it is not explained to what production level the 20% factor should be applied. The marketing estimates in the table are absurd because they indicate a 25% marketing factor for the 1976/77 drought year but only 18% for the following, normal year, when estimated production was nearly doubled.

protein intake is assumed to be burnt up as energy because of the exceptionally low caloric value of the carbohydrate intake. There is also said to be clear evidence of fairly wide-spread marasmus.

As in other African countries, grain consumption patterns appear to be shifting away from the traditional sorghum and millet<sup>1/</sup> to rice and wheat, largely as a result of the growing importance of imports - especially of food aid - in the national diets. (In 1980-81, for example, about 90% of food aid imports were in the form of wheat -- see Martin, 1982, p. 281.) Most analyses of consumption and availabilities of food grains throw all cereals together, in the somewhat naive assumption that they are quite interchangeable. This assumption can be valid only in times of acute local shortages bordering on starvation. In point of fact, among the dryland rural population - sedentary and nomad as well as urban dwellers - millet and white sorghum are by far the preferred foodgrains; rice and wheat are making sizeable inroads in the towns - especially in the capital - where the bulk of the imported grain is normally distributed.

A breakdown of average national availabilities of the different grains for the years 1975 to 1977 - attributed to a 1979 CILSS colloquium is given by Enger (USAID/Mauritania, *op. cit.*, p. F 60). It is quoted here, faute de mieux, even though the per assumed capita average for all grains is an extremely low 120.2 kg:

Millet and sorghum	69 percent
Rice (milled basis)	14 percent
Wheat (grain equivalent)	12 percent
Maize	5 percent

Counting rice imports (all commercial) and a small quantity of commercial wheat imports, sixty percent of the total tonnage of cereals imported during those years consisted of millet and sorghum. However, almost all of the sorghum imports (little millet is imported) are of the red variety and this type is much less appreciated by the Mauritanian consumer than the traditional white sorghum. In fact, there is a wide price margin between the two on the open market. Moreover, as discussed in VI-F below, GIRM price policies call for the sale from GIRM stores of imported sorghum and wheat at virtually the same subsidized price; this constitutes a much more generous subsidy for the urban middle and upper classes, especially for those who have developed European-style consumption patterns, than for the low-income consumer.

Despite their lack of proven representativity, the average income and consumption data derived from the RAMS surveys (AS 5 and 6) can give an interesting insight into the economic dynamics of rural households.

The high degree of income diversification is striking: overall, less than one-third of total household cash income came from farm production. (For reference purposes only, the mean per capita cash income in

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<sup>1/</sup>Owing to rainfall and soils, there is no traditional consumption of starchy roots and tubers (manioc, yams, etc.) in Mauritania, except in the most humid areas.

1980 was 12,195 UM, or some \$100 less than average estimated per capita national income.) Fully 22% of the overall average household cash income came from wages; one-third came from transfer payments and trading profits, evenly divided between the two.

Substantial differences were confirmed in the levels and patterns of cash incomes as between nomadic and sedentary households. The average income of the latter was 50% higher than among the nomads who, in turn, derived 60% of their cash income from livestock sales. Oddly, the sedentary households obtained a mere six percent of their cash income from crop sales; this would seem to confirm the important assumption, discussed above, regarding the marginality of crop marketings. In fact, even among the sedentary households, livestock sales brought in more than twice as much cash as crop sales.<sup>1/</sup>

The occupational structure of incomes is given as follows (RAMS, AS 6, p. 18):

<u>Income Source</u>	<u>Sedentary</u>	<u>Nomadic</u>	<u>All Households</u>
	--- percent ---		
Production	23	70	31
Services	44	11	36
Transfers	33	19	33

These data, of course, underline the much greater access that sedentary populations have to wage labor and tertiary sector activities; they also indicate that, in relative terms, both depend almost equally on remittances from household members who work and live elsewhere.

While the survey data seem, on the one hand, to belie the reported reluctance of herders to sell their stock, on the other hand they do confirm the nomadic herders' legendary propensity to save: the value of herd increase saved was two to three times as high as that of their total current cash income. (RAMS, op. cit., p. 21). Since their cash incomes were only one-third below those of the sedentary households, their total income was obviously higher if the increase in herd size is included.

Perhaps the total estimated value of per capita household consumption is a better measure for assessing and comparing welfare levels in Mauritania because of the reportedly high degree of self-sufficiency of the rural household. Interestingly, the difference between per capita cash income and consumption is only 13% in the case of the sedentary households, whereas it is nearly 50% among the nomads, bringing the latter to within 11 percent of the sedentary consumption level. In other words, if the survey data can be believed in this sense, the nomad-herders derive one-third of their total consumption value from their own livestock herds - mostly milk (see below). Moreover, the

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<sup>1/</sup> However, note observation on sample composition below.

nomads purchased less than half of their consumption needs,<sup>1/</sup> versus 86% for sedentary people.

The overriding importance of food in the life of the average rural family is indicated by the finding that 82 percent of the sedentary households', and 86 percent of the nomads', consumer expenditure, was allotted to food. The food consumption pattern was found to be as follows (RAMS, op. cit. p. 18):

<u>Foodstuff</u>	<u>Sedentary</u>	<u>Nomad</u> <sup>2/</sup>
Cereals	135 kg.	84 kg.
Millet/Sorghum	50%	
Rice	43%	
Wheat	6%	
Other	1%	
Fruit and Vegetables	24 kg.	5 kg.
Meat	33 kg.	5 kg.
Beef	47%	
Sheep	18%	
Goat	3%	
Camel	29%	
Poultry and Other	3%	
Milk and Dairy Products (milk equivalent)	29 l.	166 l.
Sugar	14 kg.	7 kg.
Wood for cooking	538 kg.	445 kg.

It is striking to what degree the nomads appear to compensate with milk the otherwise starvation level intake of meats, fruit and vegetables and cereals.

One result of the survey could be interpreted as either substantively significant or methodologically disturbing: only one-half of the sedentary households in the sample turned out to be cereal producers. Unfortunately, the RAMS report does not attempt to tabulate the two subgroups separately and does not indicate what the main source of income, ethnic or social status, etc. was for the non-cereal growing half. One can only speculate that (barring a sample design or execution problem) the sedentary rural population in 1980 depended even less on crop growing

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<sup>1/</sup>RAMS believes that this, in fact, reflects an underestimate of the degree of nomadic self-sufficiency.

<sup>2/</sup>No breakdown of cereals and meat consumption is given.

than is commonly believed. The report also does not indicate such key statistical measures as standard deviations, and it admittedly was unable to capture the large seasonal variations in consumption levels and patterns. The only indication of the great variability in the data are the regional and ethnic tabulations, although at those levels the sample increasingly loses statistical representativity. The average proportion that the main food groups represented in the total value of food consumption ranged widely among the country's five regions, as follows:

Cereals	3% to 32%
Fruit & Vegetables	0% to 10%
Meat	0% to 27%
Dairy Products	17% to 95%

### III. ENVIRONMENT, SETTLEMENT PATTERNS, SOCIO-ECONOMIC RELATIONS AND THE DROUGHT

Analyses of Mauritania's climate inevitably point out that the high variability of rainfall introduces great risk to crop and livestock production systems. This variability is typical of arid lands. In the rainfall belt between 600 mm and 350 mm, two-to-five-fold variation can be expected in rainfall, and five to ten-fold variation is often found between the 350 mm to 100 mm isohyets (Le Houéron, 1979, p. 88; RAMS SS 2, p. 16). While drying cycles cause drought in arid and semi-arid environments, patterns of existence have to be--and are--adapted to large fluctuations in weather: land use and associated production technology must reduce exposure to climatic risk in a highly variable rainfall environment, or ways must be found to avoid or overcome the rainfall uncertainty.

#### A. The Major Ethnic Groups

The major ethnic groups of the country have perforce adapted their production systems to the variation in space and time of the natural resource base. They have also altered local environments through development of oases, dams and dikes, and irrigated perimeters to permit more intensive and secure use of arid lands than would otherwise be possible. At the same time, most of the rural population continues to depend on extensive utilization of rainfed and flooded crop land, rangelands, and fuel and food gathered from native vegetation. While the degree of dependence varies, the nature of the link between the environment's production potential and the needs of the human populations involved means that Mauritania's peoples share five important general traits while exhibiting certain diversities of culture, language, social, behavior and specific economic activity.

1. The rural population can be characterized as agropastoral--households depend on both crop and livestock production for subsistence and cash income.

2. As pointed out above, the income sources of rural households are highly diversified: the sum of wage earning, trade, and remittances tends to play a larger role in the economy of the sedentary household than do agricultural production activities.

3. Mobility is central to the well-being of all ethnic groups and most rural households. Seasonal mobility--transhumance and short-term migration to seasonal jobs--is important to herders and farmers. Longer term migration, to urban areas and other West African countries to seek jobs and trading opportunities, or to Europe to seek employment and better skills, provides very sizeable remittances to many segments of the rural population.

4. The Arab-Berber Moors and the Black African ethnic groups are hierarchically organized along caste lines which traditionally identified occupation and socioeconomic class, except among the Fulani.

5. Land tenure and use customs are most structured and most strictly applied to lands where water-related risks are smallest owing to favorable natural conditions (higher rainfall, seasonal water courses, bottomlands, floodlands, high ground water and springs areas) and/or man-made improvements (grazing areas with wells, oasis date palm plantings, irrigation systems, small dams and dikes in the oueds, etc.)

The local variants of these general traits are the result of a combination of factors of ecology, ethnic production systems, and economic strategies. Among the Moors agropastoral activities are organized along the lines of caste specialization. Bidan nobles herd livestock attended by vassal and former slave groups. However, they also maintain strong ties to sedentary Bidan who administer the cities, towns, and the country as a whole and lead Moorish religious life. Individuals from both groups engage in livestock trade and commerce throughout Mauritania and in neighboring countries. The traditionally dependent Haratine groups are sedentary cultivators who work the oasis, oued and dryland farming areas. Bidan control of labor and land resources was traditionally maintained by excluding the dependent groups from land ownership. Sharecropping arrangements concentrated food commodities and wealth in Bidan hands for use and redistribution, and political and military power was used to extract tribute from other groups. Haratine labor provided a measure of food security, produced revenues from the high value date crop, and enabled the Bidan to engage in preferred economic activities.

Colonial rule, accelerating urbanization, population growth and drought have changed the social structure of Moorish culture. Now, Haratine have much less rigid ties to Bidan groups. Labor needed by the Bidan herders and landowners must be increasingly paid in cash rather than employed in the patron-client exchange relationships of the past. And there is increasing tension where the cultivators' and herders' interests overlap, particularly in the wetter areas where much effort must be allocated to protect crop lands from foraging livestock.

The Soninke of the dryland and river valley systems in the southern part of the country are Mauritania's other most highly organized ethnic group. Renowned as grain cultivators and keepers of multiple-year

security stocks, they also raise cattle, goats and sheep as well as horses and donkeys. The animals can be herded by members of another ethnic group, the Fulani, or by the Soninke themselves. The relatively wet environments they occupy permit them to invest in livestock both as a source of capital accumulation and as a productive resource. Despite the greater productivity of their agricultural systems, both their historical military tradition and their current economic circumstances have led to very high rates of migration of young men to metropolitan France and, to a lesser extent, to other African countries in search of employment. This has produced very high rates of remittances for the Soninke communities. But it has also caused a structural gap in the labor supply. Much of Soninke agriculture is now dependent on the labor of women, children and older men. Wage labor demands high compensation.

While Toucouleur society was traditionally organized along hierarchical lines, the system broke down during the colonial period. Although they are essentially cultivators of the dryland and river floodland environments, the Toucouleur also have important investments in livestock, especially small stock and beasts of burden, but also in cattle, which serve as a reasonably high return type of savings. The household generally furnishes labor for crop production and small stock herding. Cattle are often entrusted to the Fulani who belong to the same linguistic group. Because crop and livestock activities do not provide sufficient income for most households, trading, off-farm jobs and migration are important survival strategies for this ethnic group.

The Fulani (also known as Peulh or Fulbe) are predominantly herders of cattle, sheep, and goats. Their ethnic identity is bound up with the herding lifestyle. At the same time the Fulani population has sedentary elements who produce crops in some of the dryland environments. Before the drought the Fulani were said to control 75% of the large cattle herds in the country.

Because they are socially quite homogeneous, the caste distinctions found among the other major ethnic groups do not exist among the Fulani. Their status depends more on wealth. Their ability to maintain a transhumant existence depends to a great extent on the availability of, and access to, grazing areas in neighboring countries. They are also dependent on the viability of cattle as an investment for the more sedentary groups (Toucouleur, Soninke and Wolof) that engage the Fulani as herders. Fulani also engage in trade, both to fill subsistence grain needs and to earn cash income. They represent one of the links in the interstate trade of livestock with Mali and Senegal. The transhumant Fulani benefit from the loose tenure arrangements on dryland crop and range lands, but they are involved in disputes over access to water points and grazing sites.

#### B. The Nature and Effects of the Drought

There has been much debate about whether there is a trend towards a drier climate in the Sahel. As indicated by the recent World Bank report on Sub-Saharan Africa, a drying trend cannot be conclusively supported by available information (World Bank, 1981, p. 13). Preliminary analyses of rainfall data from 1941 to 1982, while also not conclusive, show cyclic wet and dry trends at most of the 22 locations studied (Ketata, Agrhymet, personal communication, 1982).

The most plausible interpretation of the varied periodicity and phasing of the cycles is that general climatic deterioration has not occurred. This leads to the crucial conclusion that the depth and severity of the effects of the 1970's drought period are probably a result of the sharp increase of land use intensity due to the unusually high rainfall during the 1950's and most of the 60's. Rainfed cropland area expanded, and it is known that the livestock population increased greatly during those two humid decades. The heavier the land use, the more likely it is that rainfall perturbations will disrupt dryland production. In sum, available evidence leads to the hypothesis that the magnitude of the drop in livestock and crop production during the recent drought period was due basically to the resource base overload of the 50's and 60's.

The lagging crop production recovery relative to the rate of livestock herd regeneration suggests that other factors besides rainfall may be involved, including such things as labor force reduction through migration, and lack of food grain price incentives (owing to food aid programs, subsidized consumer prices and free distributions) and more attractive returns from investment in livestock.<sup>1/</sup> Sorting out the weightings to attribute to the factors underlying the reported decline in per capita food production would require much better demographic, production, and marketing data, and more detailed analysis of the weather and hydrologic data, than are available to date.

Figure 1 gives the history of the estimated cereal production of Mauritania from 1962 to 1982, compiled from various sources. RAMS refers to an IFPRI Food Security Program study which shows a declining "trend" in cereal production of five percent annually between 1961 and 1977 (RAMS AS 4, pp. 37-42). Elsewhere, RAMS refers to a CILSS study that shows "the regression and stagnation of surface areas cultivated in cereals and the corresponding production variations from 1948 to 1974" (RAMS AS 1, pp. 145-148). However, examination of the data presented in these references tends to support the model of a growing crop subsector from the 1940's through the early 1960's, when production leveled off and fluctuated around 90,000 MT until the onset of the drought. Production since the early 60's is perhaps best described as representing variations around two means--one the 90,000 MT average, reflecting rainfall above the long-term average, and the second around 40,000 MT, reflecting a return to more "normal" long-term precipitation and river flood levels after the severe dry year of 1972.

The drought has also greatly accelerated the tendency of the servile classes of the different ethnic groups to break away from the dependency which tied them to the ruling groups, mostly through migration to the urban centers. In the rural areas this has brought about much tension as the ruling groups see their privileges, i.e., the customary fees and tithes from the cultivators, melt away. The exodus of the labor force has obliged some landowners either to work the land themselves or to ease the terms of the sharecropping arrangements (RAMS AS 8-2, pp. 30-32).

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<sup>1/</sup> Nevertheless, one suspects that lagging crop production recovery may be as much a statistical as a real phenomenon stemming from under-estimation of crop areas and yields and from poor data assembly and analysis.

The succession of dry years may have permanently weakened the productive bases of dryland agriculture, not only from the point of view of soil moisture and fertility exhaustion, but also because of the withdrawal, through emigration, of a significant part of the skilled labor. Unfortunately, no data are available to support this and a number of other contentions related to the dynamics of the farm sector arise.

The drought affected livestock numbers as well as their distribution. Figure 2 gives some indication of the rapid drop in cattle numbers that purportedly occurred from 1968 through 1973. It also indicates that cattle herds were rapidly reconstituted beginning in the mid-70's.

The RAMS documents underscore the existing confusion about the total number of cattle in Mauritania. The estimates, none of which were generated by RAMS, ranged from 1.186 million (1960) to 2 million head (1979) (RAMS SS 3, pp. 11-12; also, SS 3, p. 110 and AS 1, p. 129). It is also unclear whether the national cattle population had been restored to its pre-drought level (of 2 million--RAMS SS 3, p. 112 or of 2.5 million--RAMS AS 1, p. 128).

Losses from distress sales and mortality during the drought were undoubtedly important to individual cattle herders in some regions of Mauritania. However, given the mobility of the herds, the statistical loss of 46 percent of the national cattle population by 1973 does not mean that this percentage of the herd was slaughtered or died. Many herds remain out of the country longer than they do in Mauritania, especially in years of very low rainfall. During the post-drought drought, some herds remained out of the country for the duration, and part of the rapid rise in animal numbers which occurred after 1974 may merely reflect the repatriation of herders and their animals (RAMS AS 1, pp. 127-130).

The geographic distribution of cattle was strongly influenced by the rainfall pattern which existed before the drought. The drought shifted cattle, sheep and goats away from the more degraded agricultural areas of the southwest into the less affected southeastern rangeland (RAMS AS 1, p. 133). In 1975 the highest concentration of cattle was south of the 450 mm. isohyet in the rainfed cultivation zone (RAMS AS 1, p. 154). Fulani cattle herds reportedly ranged north to the 350 mm isohyet, while Moor herds predominated in the 150 to 350 mm. rainfall zone (*ibid.*, p. 187). (This segregation of habitat by herder ethnicity was not verified by RAMS.)

Figure 3 shows that the effect of the drought on other livestock species is even more difficult to interpret than it is for cattle. The goat and sheep population reached its drought low in the same year (1973) as the cattle population. Whether there was in reality a very

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<sup>1/</sup> For an appreciation of the correlation between pre-drought rainfall and cattle distribution, compare maps on rainfall (AS 1, p. 26a, Figure 2-2) and cattle (SS 3, p. 17).

rapid recovery and record numbers in 1978, or whether the statistics are misleading, has not been resolved by any study.<sup>1</sup> Camel, horse and donkey populations remained fairly stable throughout the drought.

In 1967 small stock were more evenly distributed than cattle and ranged over most of those parts of Mauritania that received more than 200 mm of rainfall (ZAIMS 12 2, p. 18). Camels had approximately the same range as small stock. They were concentrated in the western region and, to a lesser extent, in other areas north of the 350 mm. isohyet (ZAIMS 12 2, p. 17).

The available data on livestock numbers do not support the magnitude of the shift from nomadic to sedentary lifestyle that appears from the comparison of 1964 and 1977 census data (see above). In any case, a reduction in nomadism does not imply an equal reduction in herd mobility. It is now generally agreed that Sahelian systems must remain mobile for production purposes in order to cope with large and rapid changes in the vegetation which are caused by erratic seasonal rainfall.

Social analyses of the impact of the drought on the livestock subsector led to the observation that, in order to survive, herders were forced to sell animals remaining after the worst years of the drought. Ownership of many herds passed into the hands of traders and other servants, with the pauperized nomads becoming salaried herders for the new livestock owners or resorting to migration to the urban centers<sup>2/</sup> (ZAIMS 11 1, p. 22; ZAIMS 11 2-2, p. 54). Although most social scientists<sup>2/</sup> agree on the emergence of this phenomenon, no figures are available to measure its extent. One would assume that, if we are dealing with a widespread phenomenon, concentration of herd ownership in the urban middle class must have had a significant effect on the distribution of wealth and income at least among the Moors. In the Fulani groups, on the other hand, there are traditional forms of redistribution, such as animal "loans", in which the borrower may keep animals for long periods and benefit from their products. These distributional mechanisms have probably prevented concentration of wealth among favored segments of the Fulani population.

The drought also accentuated the tendency of servile groups to break away from their role of herders for the Bidan livestock owners. However, this movement had been an ongoing process in the past four decades with the settlement of the Haratine as cultivators in the South, and through migration to the urban centers.

The loss of qualified labor, coupled with the loss of animals during the drought, has obliged livestock owners to seek alternative patterns of organization, such as hiring Fulani herders or taking care of their own animals, with children guarding them in the home area.

<sup>1</sup> Since sheep and goats may have been accorded a lower priority than cattle by the GIRV, figures for these species are even more uncertain than those for cattle.

<sup>2</sup> ZAIMS, Dr. John Grayzel, AID/Nouakchott; Cheikh Abdel Wedoud, Institut Mauritanien de Recherche Scientifique.

As for the Fulani, even though their skills as herders have helped them to survive the drought, they have been affected by the shrinking of the barter trade with farmers of milk products for grain because of the sharp drop of grain production. Thus, the Fulani had to sell their milk products in nearby urban markets and buy their grain in the same urban markets or in neighboring countries. Furthermore, some groups, seeking a more secure type of farming than dryland agriculture, have encountered difficulties in gaining access to flood recession or irrigated agriculture because of increased population pressure on these more valuable types of land after the drought.

According to GIRM estimates 80% of the tree cover in the Sahelian pastoral zone disappeared between 1968 and 1980, while along the river losses are estimated to have been as high as 60% of the total tree population. However, these figures are suspected to refer only to the forêts classées.<sup>1/</sup> No reliable inventory has ever been taken of the past or current tree and shrub resources in the country.

Fuelwood consumption has been estimated to result in wood removal at the rate of 900,000 cubic meters annually, but it is not known how much is derived from Senegalese sources.<sup>2/</sup> There does appear to have been a shift in charcoal making from the Rosso area to the Boghé area during the drought, presumably as preferred tree species (mainly Acacia nilotica) were overexploited in the former.

In 1974-75 it became apparent that massive dying of gum trees occurred throughout the traditional gum producing areas of the country (see map, RAMS AS 2, figure 13). Local foresters and some of their expatriate colleagues feel certain that the main cause of this phenomenon has been excessive cutting to stimulate gum formation. The dying off, however, was so consistent and widespread (including Mali and Niger) that other causes could not be ruled out. Analysis of several specimens in the field by a group of international experts sponsored by the National Academy of Science showed no sign of disease. Local people believed that the tree deaths were simply a natural consequence of the drought. In fact, further south both naturally occurring and planted stands of Acacia senegal were not affected.

Natural regeneration has not so far occurred in these Sahelian stands, although there are reports that further south (Selibaby) natural reproduction has been observed recently in fenced areas.

Fishery production of the Senegal River Valley varies enormously from year to year depending on rainfall and the consequent inundation of the river floodplain. Fish reproduction follows the flood cycle: the rich, shallow waters of the flooded plain provide food and suitable environment for growth and reproduction and thus an increase in the

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<sup>1/</sup> Extract from CILSS, Bilans et Programmes, Banjul, 1982, Section 3.5, page 84.

<sup>2/</sup> Ibid.

harvestable biomass of fish. As the floodwaters recede, the fish are concentrated and many of the more than one hundred species are harvested in the year-round fishery.

The irregular fluctuation of the annual flood causes the inland fish harvest to vary from year to year by a factor of ten. (RAMS SS 5, page 39) calculates the potential harvest from 200,000 ha of floodplain on the Mauritanian side of the river at 60 kg per ha, or a total potential catch of 12,000 tons per annum when the entire floodplain is inundated.

The estimated Mauritanian harvest in 1968 was 10,400 tons. This was about 30% of the total catch, the rest going to Senegal on the other side of the river. The long series of drought years since then, with fish stocks unable to increase to their potential, and overfishing on these constricted stocks, has resulted in sharply decreased catches. The 1980 catch was reported to be only about 800 tons (ibid., p. 47).

Regardless of whether the drought is considered as a sudden calamity or as a reversion to longer-term climate patterns, combined with demographic and world economic factors its socio-economic effects have been profound. One of the most marked effects is the further deepening of Mauritania's vital dependence on informal flows of goods and people into and out of neighboring countries as well as on the good will and munificence of the outside world. The dimensions of this dependence will be briefly examined below.

#### IV. FOREIGN DEPENDENCE OF THE ECONOMY

As was indicated earlier, Mauritania is at present--and for the foreseeable future--highly dependent on official external assistance merely to help its population to survive. The country's capability to produce foodgrains is estimated by the GIRM to be only 30 percent of its total consumption during a "normal" rainfall year; estimated production has dropped as low as 17 percent of consumption during the worst drought years. The total estimated grain production for the past<sup>1/</sup> six years has been equivalent to only 25 percent of total consumption. Therefore, Mauritania has had to make substantial commercial imports of foodgrains to meet about half of the perennial deficit. The rest is made up by "food aid". The World Food Program and the U.S. P.L. 480 together account at present for about one-half of total external food donations, which have averaged about 54,000 tons annually during the last six years, valued at about \$22 million; this is equivalent to four percent of the country's GDP.

Beyond food aid, the country is also completely dependent on external donations and highly concessional credits for its capital investments in

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<sup>1/</sup> Perhaps "disappearance" is the more appropriate concept in Mauritania because there are sizeable, if unmeasured, two-way leakages of grains across the borders with Senegal and Mali.

economic development and social infrastructure, as well as for recurrent government expenditures. Only 15 percent of public investments disbursed in recent years has been financed from GIRM budget. Moreover, fully 40 percent of central government operating expenditures have been provided by official external donations and loans during the 1976-80 period (entirely grants during 1976 and 1977, mostly loans by 1980). Central Government revenues amounted to only 6.5 billion UM (about 135 million dollars)--18 percent of GDP --in 1981, made up mostly from import duties, fishing royalties and penalties, and taxes on income and profits, in that order.

With a GDP estimated at CFAF 47 billion (US\$130 million) in 1968, the country received a total of CFAF 55 billion of foreign grants and loans in 1960-69, or an annual average of CFAF 5.5 billion. This amount exceeded by far the total current budget. Receipts, which increased gradually, went from CFAF 2.5 billion in 1960 to CFAF 5.7 billion in 1968.<sup>1/</sup>

Current budgetary receipts increased slightly in the 1970's: from UM 2.8 billion in 1973 to six billion in 1979, or an annual average of 4.7 billion. Increased budget expenditures brought the cumulative budget deficit for 1973-78 to UM 18.7 billion (it increased from UM 155 million in 1973 to 5.9 billion in 1978, but declined to 4 billion in 1980). If extra-budgetary expenditures are included, the deficit increased from UM 363 million in 1973 to UM 10.8 billion in 1976 and declined to UM 8.2 billion in 1980.

In 1975-80, Mauritania received a total of UM 128 billion of external loans.<sup>2/</sup> At the end of that period, the total amount of annual debt service obligations exceeded UM 15 billion. By August 1980, the external public debt outstanding (including only the debts with an original or extended maturity of over one year) amounted to more than US \$1.1 billion (of which only US \$590 million had been disbursed). US \$18 million of debt service payments were in arrears. Since 1977, the ratio of debt to GDP has been about 80 percent in current prices, and the debt service to exports ratio has varied between 16 percent in 1978 and 38.5 percent in 1980. The debt service ratio of 27.7 percent for 1975-80 was 10 percentage points higher than the accepted international standard of 18 percent. (RAMS, OP 2, pp. 25-27 and 56-63). Besides, since 1976 there has been an unspecified but substantial amount of accumulated internal debt. (MPAT, 1981, Partie I, pages 6-7.

The major part of the external loans and grants has been used for investment projects which have generated a need for recurrent costs beyond the capacity of the meager State budget. Not surprisingly, it

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<sup>1/</sup> Brian Curran and Joann Schrock, Area Handbook for Mauritania, the American University, 1972, pp. 106, 135, 138.

<sup>2/</sup> In 1973-80, the country also received foreign grants amounting to nearly UM 16 billion (RAMS OP 2, Page 19).

has been extremely difficult for the Government to honor its commitments for counterpart funding and to continue to operate and maintain the investments in development projects.

All open economies are, of course, dependent on foreign economies to a greater or lesser degree, in the sense of formal export and import trade. Mauritania, as was indicated earlier, has a less formal but perhaps more crucial dependence on the resources and markets of neighboring Senegal and Mali, especially as regards its nomadic livestock herders but also for its riverine sedentary population. The inconvertibility and overvaluation of the ouguiya and a series of legal restrictions that -- though difficult to enforce -- must nevertheless be effectively circumvented, combine to subtract a substantial volume of traffic from recorded channels and official exchange transactions. The system has developed its own ad hoc exchange rates that change in accordance with fluctuations in supply and demand but are always unfavorable to the ouguiya in terms of its official valuation. It is immaterial to ask which nation benefits more from these informal flows; what matters is that the populations concerned evidently benefit in the aggregate because the system tends to exploit those natural comparative advantages that governments often attempt to negate through legal artifices.

The informal cross-border economy takes the form not only of livestock moving seasonally to greener pastures and/or better markets and grains and of consumer goods being exchanged, valued at tens of millions of dollars annually. It has of late been perhaps even more important as a safety valve for unemployed and underemployed Mauritians who find jobs or small business opportunities in neighboring countries and beyond and who send back substantial remittances to their households of origin. There are no estimates of the exact magnitude of this phenomenon. RAMS surveys indicate that as much as 16 percent of the average rural household income came from interregional and international financial transfers in 1980, and the study points out that:

"in contrast to what happens in other countries, transfers are made from urban areas and foreign countries into the rural areas." (RAMS, AS 6, pp. 17-19)

L. Colvin estimates that there were 110,000 Mauritians abroad during 1976 (quoted in SOW, 1981, p. 77), yet, the Central Bank of Mauritania figure for official inward remittances during 1981 was only \$7 million.

## V. RECENT DEVELOPMENT EFFORTS AND EXPERIENCES

Virtually all of the important multilateral and bilateral assistance programs have sponsored--or have attempted to sponsor--rural development projects of one sort or another in Mauritania during the past decade. Lamentably, as in most other LDC's, rather than being planned, designed and implemented in a coordinated fashion, the projects have tended to be competitive with one another. In view of the extreme institutional and fiscal constraints, this is particularly unfortunate in Mauritania. The situation is reflected in a high degree of project failure, if not during implementation then as regards impact and benefit-cost relations.

This chapter reviews briefly the most important activities that have been taking place--or are about to take place--in the various fields into which rural development tends to be classified: irrigation, dryland and recessional farming, forestry and environmental protection; livestock and "integrated rural development" and inland fisheries, with an eye to identifying both positive and negative features that might point the way towards more effective development projects in the future.

#### A. Irrigation Development

Of the draft Fourth Plan's three major objectives for the rural sector, one--self-sufficiency in food--is based in large measure on a long-term strategy to meet cereal needs through the development of irrigated agriculture (MEF, March 1982, pp. 5-6). SONADER (the Société Nationale pour le Développement Rural), a parastatal formed in 1976 to manage the construction of irrigation facilities and to bring them up to full production, is the agency responsible for implementing this fundamental objective.

The originally proposed targets for the 1981-85 period called for expansion of irrigated perimeter area at a rate of about 2,400 hectares annually, for a total projected area under irrigated crops of about 15,000 hectares by the end of 1985. The target for the average yield of rice, the priority crop for the irrigation schemes, was five tons per hectare on an annual basis (i.e., including some double-cropping), for a total output goal of 75,000 tons of rice by 1985 (SONADER 1981a, p. 3 and Table 1). However, these were cut back substantially, based on GIRM and external aid agencies' evaluations of progress to date. For example, the multi-donor Gorgol Noir Project originally envisaged a 3,600 ha perimeter; this was recently reduced to 2,500 ha for financial and technical reasons.

The future of irrigated agriculture in Mauritania is tied to the construction of the Diama and Manantali dams and implementation of the rest of the ambitious three-nation OMVS river basin development program. While the GIRM originally projected that 100,000 hectares of land in Mauritania could be irrigated by 1995, the OMVS plan schedules a maximum of 62,000 hectares to be reached around the year 2028 (Gannett, Fleming, Cordry and Carpenter, Inc. undated, p. 17).

Irrigated agriculture began in Mauritania in the 1960's. Estimates of facilities constructed by 1981 vary from about 4,000 to more than 7,000 hectares. Both small and large-scale perimeters have been constructed. Small-scale perimeters (10-20 ha) are organized as pre-cooperative water user groups. Large-scale perimeters (700 to 1,800 ha) were originally intended to be managed as mechanized farms. Current plans are to subdivide the large perimeters into smaller water management units which will be labor, rather than capital-intensive. Small and large perimeters all depend upon pumps to deliver river water to canals or ditches.

Construction and performance of the irrigated perimeters have lagged seriously behind expectations. While the pace of construction increased from 100 ha a year during 1960-77 to about 400 hectares a year

around 1980, the current rate of development of about 600 hectares is only one-fifth of the planned target (SONADER, 1981a, pp. 1-3; Carr 1982, p. 7). As regards productivity, the small-scale perimeters generally have higher yields and land utilization and cropping intensities than the larger schemes. Overall average paddy yield in 1980 was about 3.2 tons per ha (MEF, op. cit., p. 3) or about 36% short of the 5-ton-per-ha yield expected at full development. Facilities utilization averages about 67%, only 45 percent of the target coefficient (see Chapter VI).

A wide range of donors fund SONADER-managed projects. FAC, FED, IBRD/IDA, Dutch Aid, German Technical Assistance, USAID, PVO's and several Arab development funds provide grants and loans for sector level operations. Dutch assistance supports the Rosso sector, the CCCE/FAC aid Boghé, FED and IBRD/IDA support Kaedi, and IBRD and USAID finance Gouraye sector small scale perimeter development. The Peoples' Republic of China funds and operates a state farm--with a small-holder scheme attached--at Mpourié next to Rosso which, at 1,800 ha, is the largest single scheme in the country.

The French established research activities in irrigated agriculture in the mid-60's. In 1974 Mauritania created the National Agricultural Research and Rural Development Center, CNRADA, with headquarters in Kaedi. CNRADA's mandate is to organize, execute and disseminate all research concerning agriculture and rural development. To date, research has focused on irrigated crop production, with the greatest effort devoted to rice cultivar and cropping practice trials and vegetable and fruit tree variety trials. Limited work has also been done with irrigated wheat, sorghum, cowpeas and soybeans. Recent support by FAC, FED, GERDAT, and UNDP/FAO provided technical assistance to carry out station trials. While on-farm trials are planned, few have been done.

Irrigation development has faced a number of problems, including SONADER's institutional deficiencies, lack of technical manpower, lack of credit and marketing institutions, organizational problems in the village perimeters, and a series of technical problems such as initial site selection and construction, cropping packages, operation and maintenance of pumps and conveyance structures. These problems are discussed in more detail in Chapter VI.

Date palm cultivation in the oases is a special case of inland irrigated agriculture. Research on date palms began in the late 1940's in Mauritania. The RAMS study on oasis agriculture found that research has thus far concentrated on biological control methods for date scale to the exclusion of more effective chemical control measures, basic agronomic practices, economic management of oases and understory crop development (RAMS SS 4, pp. 129-134 and 152-157). The USAID-funded Oasis Development project has been designed to address these concerns on a sample of existing palm grove sites. While habitat exists for expansion of palm groves to another 5,000 ha, this can occur only if cheaper means of pumping water from boreholes are found (RAMS SS 4, p. 2). Additional neglected research areas are social organization--how to intervene without further tipping the balance of benefits towards absentee owners, land tenure questions, training and extension needs, and marketing procedures.

## B. Research and Extension for More Productive Rainfed and Recessional Farming

All dryland agro-ecological zones of Mauritania have been assigned ambitious expansion objectives in the draft Fourth Plan. It calls for expanding productive area and output in each zone by 50% to 100% by 1985 (MEF, op. cit., p. 6). Compared to the irrigated subsector, however, very little investment in research to increase crop productivity has taken place. In the following pages, past efforts and experience of projects involved in rainfed, oued and flood recession agriculture are discussed.

Rainfed agriculture is confined to Southwest Mauritania and a narrow band of land between the Senegal River valley and the 350 mm isohyet. Efforts to improve production in these areas have concentrated on animal traction, crop protection and cropping practices. Some applied research in varietal selection and cropping practices has been done as part of integrated agricultural or rural development projects. (See E below).

The earliest research on rainfed agriculture took place at the Kankossa station between 1959 and 1972, but did not lead to significant advances. In the mid-60's an IRAT station was established at Kaedi, but lack of funding and personnel, and the competing needs of the irrigation research program, allowed little research on rainfed farming to be started. Thus, for the last two decades rainfed agriculture projects have had to depend largely on research results from Bambey, Senegal, which has a higher and less variable rainfall than all but the southernmost edge of Mauritania's rainfed zone. Only recently have FED, SAFGRAD, and ICRISAT programs provided funding for varietal selection of dryland crops in Mauritania.

In the late 60's and early 70's rainfed projects were generally confined to efforts to expand grain area through the use of draft animal power. Initial results were positive and large areas were planted, but the animal traction technology quickly lost its appeal for a combination of technical, economic and social reasons that have not been sufficiently studied. More recent efforts in the Assaba and Guidimaka regions include a FAC-funded project to supply animal traction equipment, a War on Want Rural Development Project working in ten villages in the Guidimaka to increase food production, and the USAID financed Guidimaka Integrated Rural Development project. The last two projects stress applied testing of animal traction and crop technologies in their agricultural programs. Higher yielding sorghum and millet cultivars have been identified but longer testing is required before these can be confirmed as adapted for wider distribution. More immediately useful results have been obtained from improved cultivation practices (thinning, weeding, contour ridging) which appear to have general application in the wetter rainfed zones. Animal traction has again been shown to permit rapid increase in cropped area, but economic viability has yet to be closely analyzed.

Problems facing these projects are the high costs of extension delivery to project beneficiaries and the lack of an institutional foundation to ensure continuity in research and extension efforts.

Crop protection projects are funded by FAC, UNDP/FAO and USAID. They aim to strengthen the Mauritanian Crop Protection Service through research in integrated pest management, supply of equipment and pesticides, training, and technical assistance. Currently, the Crop Protection Service has the capacity to treat about 4,000 hectares annually and to carry out control campaigns against granivorous birds. This level of activity does not permit control of insect pest outbreaks or significant reduction of bird and disease damage to crops across the major dryland production zones. Both technical and institutional breakthroughs will be required to make a tangible impact on the enormous crop losses caused by pests.

Oued recession agriculture has also received little agronomic attention. Crop protection services are provided in some of the more important oued areas. Government and donor attention has been concentrated on rehabilitation and construction of new dams to expand surface area rather than on productivity improvement. The draft Fourth Plan lists five projects for new dams (MFE, March 1982, p. 19). FED, UNSO, USAID, and the German development bank have all contributed to design and feasibility studies for projects in the Hodhs, Assaba, Brakna, Gorgol and the Tagant regions. These donors have also prepared projects for execution of the designs; implementation is underway in the Hodhs, Assaba, and the Tagant. Funding for the USAID Rural Lands Reclamation Project, designed to work in the Brakna and Gorgol regions, has been blocked pending resolution of problems in design and implementation procedures.

### C. Environmental Protection: Research and Action

The draft Fourth Five Year Plan calls for regeneration of the natural environment as one of its three primary objectives for the rural sector (MEF, 1982, p. 3). Priority areas include reforestation, protection of infrastructure from sand invasion through greenbelt establishment and dune stabilization activities, protection and management of rangelands, rehabilitation of degraded gum arabic stands, and conservation of wildlife. All of these activities are under the management of the Nature Protection Service, SPN, which manages forest and game reserves and enforces reserve and nationwide species conservation laws.

Recent efforts in environmental protection have been undertaken with donor assistance as discrete projects and as components of a few integrated rural development and two livestock projects. Chief among the subsector-specific projects have been the Nouakchott Greenbelt project, assisted by the Lutheran World Federation, a CEAO financed nursery project, a FED funded study of gum tree regeneration, and USAID's Natural Renewable Resources project. The Nouakchott Greenbelt project has made good progress in developing what are, under Mauritanian conditions, relatively inexpensive (\$500 per hectare) establishment techniques using access control and natural regeneration but no irrigation after planting. About 300 of the targeted 1,000 ha have been planted. The nursery project has constructed nurseries each with a 250,000 tree capacity in Nouakchott, Rosso, Kiffa, and Aioun. These nurseries are to provide seedlings for reforestation and for shade tree and other amenity plantings. To date most seedlings have been used for plantings in

reserves and national arbor days. Household amenity plantings have had the most success; elsewhere, tree survival rates have been extremely low, for example, around 5 to 10% for the trees planted during arbor day.

The FED-supported study of gum arabic rehabilitation has led to a proposed two year experimental project to examine the feasibility of regeneration techniques including protection, sowing and transplanting, on a total of 1,300 hectares. The AID-funded Natural Renewable Resources project had proposed an extremely ambitious program encompassing:

- inventory of the natural resource base to provide data for a 20 year national resource management plan;
- creation of a planning unit in the NPS;
- stabilization of sand dunes in two rural commercial centers and three major oued recessional agriculture sites;
- development of forest reserve management plans for two inland and five river valley forest reserves;
- regeneration of gum arabic (Acacia senegal) stands at two sites in Brakna region;
- range management interventions in Gorgol and Brakna regions and development of a detailed range management plan for south-western Mauritania, and,
- in-country formal and informal training for cadres, field technicians, farmers and herders and participant training abroad.

The natural resource inventory was completed, nursery infrastructure constructed, and the range management program started before the project was terminated at the end of 1982 for lack of effective national institutional support.

Nurseries and village and farm level forestry activities have been carried out as part of integrated rural development projects in Guidimaka, Barkéole, and Rosso. The Guidimaka IRD project includes an ecology activity which has been testing extension approaches and technologies for simple agro-forestry and sylvo-pastoral activities. In conjunction with World Bank and FED funded livestock projects, the SPN has also helped open 5,000 km of firebreaks in rangelands in the Southeast and Southwest.

Most efforts of the SPN have not been resounding successes in a technical, economic, institutional or social sense. While suffering from the same organizational, managerial, human resource, and financial strictures that greatly reduce the effectiveness of all Mauritanian public agencies, the NPS is further constrained by an outmoded legal code and a field staff which is almost totally oriented towards enforcement of conservation laws. Without a more economically viable and

socially acceptable resource management plan, resource use legislation, and resource management-oriented staff, the SPN is unlikely to improve its performance.

#### D. Livestock Improvement

Mauritania's strategy of food self-sufficiency includes reconstitution of the national livestock herd and an increase in the herd offtake rate for large stock from 10 to 15% (MEF, March 1982 p. 6) through improvement of herd fertility and marketing infrastructure.

The GIRM livestock service has concentrated on preventive medicine and the development of water infrastructure to extend grazing areas. FED and the World Bank have supported livestock projects aimed at improving pastoral water supply and veterinary services, respectively, in the Southeast and Southwest. In the early 1970's FAC financed a slaughterhouse, a feedlot, and a tannery, all of which have been operating far below capacity because of their location and the failure of the anticipated export markets to materialize.

#### E. Integrated Rural Development

Given the high rates of urban migration experienced during the drought years, which continue to overburden urban services and employment opportunities, GIRM policymakers include the reduction of the rural exodus as the third basic objective for the rural sector in the Fourth Plan (MFE, March 1982, p. 5). Increasing attention is to be paid to joint intervention on a number of fronts to try to improve both productivity and the quality of life in rural areas through integrated rural development approaches.

The integrated rural development (IRD) projects to date have concentrated most of their resources on crop, livestock and environmental activities, with secondary emphasis on social and physical infrastructure and service delivery. The War on Want's Rural Development project in the Guidimaka region is one such project, as are the AID-funded Guidimaka IRD project and the Barkéole Region IRD project financed by the Lutheran World Federation. Each of these is perhaps better characterized as an integrated agricultural development project. All are oriented towards the improvement of production systems, but they go beyond the approaches used by individual technical services of the Ministry of Rural Development in order to deal with the problems of water supply and construction of public infrastructure such as schools, dispensaries, and community centers.

The IRD projects are remarkable for three reasons. First, they provide a model, if only an embryonic one, of how public agencies, separated by the training of their personnel and their technical objectives, can develop interdisciplinary field approaches. Unfortunately, donor-assisted project resources are far greater than the domestic resources that Mauritania can afford to apply to small area programs; hence, the model may not be best suited to the country's needs and resources. However, high costs for the initial generation of efforts may be justified if the investment shows how lower cost approaches could be applied to a

second generation. Second, these projects have made possible the first major on-farm tests of new production technologies. As such they have initiated an applied research process that can be built upon if funding is continued until Mauritania's CNRADA can take over. Third, participation by the rural population is at a much higher level than in other project approaches, partly through the application of innovative communication processes with farmers and herders.

The major drawback to the IRD approach is that the projects tend to replace the poorly funded and staffed local agencies of the central services with a structure that tends to disappear when donor funding is withdrawn. How IRD projects can overcome this institutional hurdle is perhaps the key question to be answered before significant further investments in this approach are undertaken by the GIRM and donors.

#### F. Inland Fisheries and Fish Farming

RAMS (SS 5 page 87) and CILSS (1977) proposed the damming of 1,000 to 2,000 hectares of beli or vindou (natural depressions) to maintain year-round water for inland fisheries. Development costs were estimated to be 10,000 UM (\$200 at the current rate) per ha and annual operating cost 2,500 UM (\$50). At a proposed harvest of 500 kgs per ha, 1,000 hectares of lake would support 200 fishermen, each earning about 40,000 UM (\$800) per annum. RAMS operating costs did not include maintenance, amortization of development costs, fishing equipment and lake management to assure such a high productivity. Annual costs per hectare might be closer to 23,000 UM (\$460) which would require a break-even price of 46 UM/kg (42 cents per pound) for the fish harvested. Moreover, unless such natural depressions could be located east of Kaedi, it is doubtful, even if yields could be sustained at 500 kg/ha, that such a fishery could effectively compete with the marine artisanal fishery and its associated marketing and distribution network. The technological risks are enormous. The maintenance of a 1,000 ha fertilized lake at the peak of fish productivity, without risking either eutrophication or overproduction of competitive fish and invertebrates, would be very difficult.

It is highly questionable whether a 10 million UM investment in a single 1,000 ha lake, which might produce a maximum of 500 tons per year with great risk, is a wise investment. Experience indicates that it would be far more profitable to continue to encourage artisanal marine fisheries and improve the distribution system to the interior.

RAMS SS-5 (page 92) suggested that 4,000 hectares of ponds could be constructed along the Senegal River Valley between Koundi and Maghama at a total cost of 203 million UM, an average cost of 50,000 UM (\$1,000) per hectare. A Peace Corps estimate in 1980 was US \$3,250 (162,500 UM) per hectare (Morrison, 1980), while another volunteer reckoned to have spent the same amount on an 850 m<sup>2</sup> pond.

Operating costs were assumed to be 22,500 UM/ha (\$450) per year by RAMS (p. 93) and 95,500 UM (\$1,900) by Morrison for a 6 month crop. Discussions with Peace Corps Volunteers on the Senegal side of the river indicate that only one crop per year can be expected; between November and March there was no growth amongst their fish, probably because

temperature in the pond fell during these months to below that required for optimum feeding. Neither RAMS nor Morrison considered labor costs for maintenance, composting, feeding, water control, harvest and repairs. For RAMS, the major cost was water (89% = 20,000 UM) while for Morrison water was 12%, or 11,500 UM, and feed costs were 88%.

A realistic estimate, assuming no cost for family labor or for transportation, as well as a whole series of technical preconditions, might be as follows:

Water pumping cost	20,000 UM
Fertilizer 18/kg x 200 kg	3,600
20 year amortization of capital cost	8,125
Harvest labor	800
Small net, 60,000, 3 yrs.	20,000
Feed	30,000
Fish fry, 6,500 at 5 UM each	32,500
TOTAL	<u>115,025</u> UM/ha

In view of the costs, and the technical imponderables and risks, the same question must be raised as for inland fisheries: does it make sense to invest heavily in a high risk production technique which might provide a few tons of fish, when a near-shore, renewable marine fish resource of perhaps 40,000 tons per annum (Doucet 1981) exists along the coast?

#### VI. PRINCIPAL CONSTRAINTS FOR ACHIEVEMENT OF AGRICULTURAL SELF-SUPPORT AND POSSIBILITIES AND PRECONDITIONS FOR OVERCOMING THESE CONSTRAINTS

Official and unofficial reports and studies on the Mauritanian food situation are unanimous in forecasting that the country will not be able to close its food gap before the end of this century, if at all, in view of the projected population increase and the probable trends in agricultural output. (RAMS; USAID, 1981; Martin, 1982, etc.) This pessimism is founded on the following reasoning:

(1) even if rainfall should return to the favorable pattern reflected in the 1940-60 average, there is no possibility that the combination of larger acreage and yields would allow the country to produce the quantity of sorghum and millet it consumes, even at the low current assumed per capita level, let alone the increasing demand for wheat induced in large measure by food aid programs;

(2) as discussed below, even the most optimistic of the realistic projections of irrigation development indicate that irrigated farming will not be able to close the gap in the next 20 years.

Indeed, most projections (see, for instance, USAID/Mauritania, 1981 Annex F) assume that not only will Mauritania be unable in the foreseeable future to produce enough grain to satisfy its consumption requirements,

but it will not earn enough foreign exchange from exports to get along without food aid until, at best, some time in the early 21st century.

Quantitative estimates of the food gap, as can be expected, vary wildly as a function of disparate assumptions regarding domestic production, population and per capita consumption trends. RAMS forecasts total import requirements by 1990, for example, of between 56,000 and 190,000 tons, depending on domestic production and assuming per capita consumption of 145 to 165 kg; Enger (USAID/Mauritania, *op. cit.*, p. F-46), on the other hand, forecasts import needs of between 83,000 and 187,000 tons, on the basis of per capita consumption of 124.5 kg. Enger assumes that commercial imports will cover a uniform annual level of 80,000 tons (*ibid.*, Table 25), leaving a margin, based on his other assumptions, of zero to 100,000 tons for food aid requirements in 1990, depending on the level of domestic production.

Evidence to date does not leave much room for optimism with respect to industrialization in the foreseeable future. The only radical change in the country's basic economic outlook would, it appears, have to come from new mineral discoveries--including oil--and/or substantial increases in the relative world prices for its mineral exports. Unless and until one or both of these fortuitous events take place the primary development effort will need to be concentrated increasingly in the rural sector. In the pages that follow, we will attempt to summarize the basic and contingent constraints--i.e., the natural ones and those added by man--that impede faster rural growth, and to suggest some realistic approaches toward the attenuation, if not the removal, of some of the constraints.

We have classified the constraints into disciplinary categories for greater analytical simplicity; nevertheless, wherever pertinent and possible, we have tried to indicate the interdisciplinary relations and linkages.

#### A. Rainfed and Dryland Farming

Rainfed cultivation on the dieri (sandy) and heavier intermediate soils of Mauritania is dependent on local rainfall. While year-to-year variations in total rainfall in general set the upper limits of rainfed crop production, rainfall distribution will greatly affect surface area planted and yields in any year. Estimates of area cultivated vary from 50,000 to 110,000 hectares (RAMS SS 2, p. 45). Yield estimates for cereal crops vary from a low of 240 kg/hectare for millet (RAMS SS 2, p. 63) to a high of about 800 kg/hectare for sorghum under traditional management in the Selibaby area according to Guidimaka project personnel. In response to the variability of rainfall within seasons farmers plant various cereal cultivars with different maturities as well as intercrops with short growing seasons (cowpeas and roselle), and especially drought resistant plants (seed melons), which enable them to obtain some output during all but the driest years. The risk of yield and crop loss due to unfavorable weather variation means that intercropping aimed at optimizing production will be maintained by farmers.

Recessional cultivation of the river valley floodlands (walo) depends upon rainfall throughout the Senegal river basin. Crop areas and yields are determined by the height, timing, and duration of the flood peaks in the main river channel and in the large seasonal tributaries (e.g. the Gorgol). The RAMS report (SS-2 pp. 37-40) shows that gross area flooded and surface area cultivated are linked and vary considerably from year to year. Sorghum yields reportedly vary from 330 kg to 1,600 kg per hectare (RAMS, OP 5, pp. 135-136).

In a year with high peak floods, up to 60,000 hectares of walo land may be cultivated on the Mauritanian bank. At minimum recorded peak, only 3,000 hectares may be cultivated. In an average year, walo area may reach 45,000 hectares or more.

Some measure of control of the height of the flood peak height is expected when the Diama dam near the mouth of the Senegal is completed.<sup>1/</sup> Additional control of timing and duration and better peak control are anticipated after the construction of the Manantali dam upstream in Mali. The dams are planned to modulate annual flooding, first reducing year-to-year variations in flooded area and then decreasing flooded area as irrigation infrastructure is developed. But there are a number of imponderables. There is no certainty with respect to the completion dates of the construction; it is not known to what degree flow management will be possible with only one upstream dam on the Senegal and one on the major tributary, the Gorgol, nor how much downstream channel infrastructure will be required to manipulate flooded area and protect irrigated perimeters. These uncertainties make it difficult to predict the overall impact on the future area under flood recessional farming. This complicates analysis of investment in control structures on discrete floodbasins (cuvettes or channels parallel to the main river channel, narigots and minor seasonal tributaries). One development to watch closely in this regard is the Fom Gleita dam on the Gorgol Noir which will affect about 7,000 hectares of walo land in the Gorgol river valley (RAMS SS-2, p. 40). Management of this hydrologic system is likely to come about much sooner than overall control of the Senegal's flood patterns.

Large annual variations will probably continue to occur for at least the next decade over most of the Senegal river valley floodlands, and these fluctuations will thus continue to be the single most important factor in walo recessional production for the foreseeable future.

Oued recession agriculture is practiced in most of the agro-ecological zones of the country that support crop or livestock activity. It consists of the retention of water behind small dams or dikes placed in the oueds (seasonal streams fed by small watersheds) in areas receiving a minimum annual rainfall of 100 mm. The area cultivated each year will vary with the volume of runoff collected in the oued.

The principal constraints to development of oued recession agriculture are economic, institutional, social, and health related. As noted

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<sup>1/</sup>The Diama dam is also designed as a barrier to salt water intrusion.

by Carr (1982), rates of return to investment are low for dams which are constructed according to engineering standards of donor organizations which emphasize long life and reduced maintenance needs. On the other hand, lower engineering standards affect the useful life of the structures and increase recurring maintenance costs. Génie Rural would require institutional strengthening to be able to carry out design, quality control of construction, and maintenance supervision. Next, questions have been raised about who would benefit from dam development because of the hierarchical nature of the social groups involved and the conflicting claims on the improved land and water resources following construction of water retention works. At the same time it is expected that significant attention and resources would have to be devoted to mitigating human parasitic disease problems (schistosomiasis, malaria, guinea worms) to avoid adverse health effects.

However, many of these same problems have to be addressed in irrigated areas as well. Part of the problem in analyzing costs and returns from investment in recessional dam areas, relative to full control irrigation efforts in the river valley, is that fuller cost accounting (economic, environmental and social) may have been applied to the former than to the latter.

Combined with insect, disease and vertebrate pest attacks which can reduce harvestable area by up to 50% in some years, the climatic conditions of Mauritania impose great risk on all forms of dryland agriculture. With no real control over the surface areas cultivated from one year to the next, households cannot afford to base their subsistence solely, or even principally, on crop farming. Except for small favored areas with more than 450 mm of average rainfall in the southwestern portion of the country, it is unlikely that most farmers can afford to take the risks involved in adopting techniques requiring substantial cash investments such as fertilizer and animal traction, as recommended in the RAMS reports.

#### B. Irrigated Farming

An FAO study in 1975 showed that Mauritania has an irrigable soils potential of about 210,000 ha (RAMS SS 1, p. 15, 18). Long-term OMVS plans have scheduled a maximum of 62,000 ha to be developed in Mauritania by 2028.

In the long run, the OMVS target is probably reasonable. In the short-run, however, based on recent experience, annual irrigated area expansion is unlikely to exceed 600-900 hectares. The constraints are formidable, despite the favorable physical potential.

Indeed, as the figures in Table 1 show, a great deal of additional production can be obtained in the short run at relatively low marginal cost by increasing the very low rate of physical utilization of four of the existing five perimeters.

Table 1. Summary of Constructed and Cultivated Area Under Irrigation in Mauritania, 1980-81 Crop Year

<u>Irrigation Sector</u>	<u>Facilities Constructed (Ha)</u>	<u>Cultivated Area (Ha)</u>	<u>Utilization Rate (Percent)</u>
Rosso	3,899	2,667	68
Boghé	1,590	508	32
Kaédi	1,365	900	66
Gouraye	261	237	91
Totals	7,115	4,312	61

Source: RAMS SS-1, 1981, Annex 1-4.

The utilization rates shown in the table do not consider double cropping and thus underestimate the effective cultivation intensity. The Rosso sector cannot be double cropped owing to salt intrusion problems over most of its area. Cultivation intensity coefficients, including double cropping figures obtained from SONADER for the other three sectors, show only a slightly improved picture (Table 2.)

Table 2. Adjusted Percent Utilization 1980-81, Irrigated Perimeters

<u>Irrigation Sector</u>	<u>Gross Utilization Rate (Percent)</u>	<u>Cropping Intensity Coefficient</u>	<u>Effective Utilization Rate (Percent)</u>
Rosso	68	1.00	68
Boghé	32	1.05	34
Kaédi	66	1.25	83
Gouraye	91	1.84	167
Total Weighted	61		67

Sources: RAMS SS 1, Annexes 1-4; Rosso, Boghé and Kaédi cultivation intensity (C.I.) from discussions with sector personnel, SONADER; Gouraye sector calculated from SONADER data cited in William Scott, 1982, Table 1, page 5.

Most irrigation planners in Mauritania have assumed that full utilization of constructed facilities would occur and that the coefficient of cultivation intensity would be about 1.5 at full development (i.e., half the area would be double-cropped), for a typical effective utilization of 150 percent. The weighted overall present utilization rate of 67 percent is thus only 45 percent of the target.

Yields of rice also vary substantially among the different perimeters. The overall average yield in 1980 is estimated at only 3.2 tons per hectare. Field observations indicate that the yields ranged from

two to 6.5 tons in the small-scale perimeters, while the maximum perimeter average in the large scale projects was said to be no more than four tons (with a minimum of two tons). The 1980 average is equivalent to only two-thirds of SONADER's "full development" target of five tons.

There seems to be a consensus among technicians working with the irrigation programs that the newer perimeters generally have greater cultivation intensities than older ones. The aggregate figures in Table 2 seem to bear this out. Rosso, with the oldest perimeters, has the lowest cropping intensity (though this is enforced by the annual salt intrusion), while the Gouraye sector, with a preponderance of new perimeters, has the highest cropping intensity. Existing information does not permit detailed analysis of this situation. Some learning has apparently taken place so that initial design and construction problems have been reduced, more reliable pumps and motors have been identified, and extension procedures have been refined. New perimeters have benefited from the trials and errors of past irrigation efforts begun in the 1960's. Also there is probably an environmental factor influencing the relative success of new perimeters, especially in the Gouraye sector, where rainfall is significantly higher than in the other sectors, thus reducing water needs during the rainy season.

One troubling factor mentioned by many sector personnel was the inability of members of peasant groups in some older perimeters to repay their capital and production loans. A complicated set of problems is probably involved (siting, construction, land tenure, shifts in loan terms, substandard motor and pump performance, poor maintenance support, decline in soil fertility, salt buildup, etc.). Unfortunately, no assessment of the financial viability of small scale perimeters based on actual performance over time has so far been made, and there is very little information about on-farm yield trends under recommended production practices. Deterioration and increased down-time of pumps is frequently indicated as the chief culprit for the poor irrigated perimeter performance, but no specific down-time analysis has been made.

Given the lack of farm management data for a sample of perimeters stratified by age, it is difficult to explain the causes behind variations in cultivation intensity and crop performance. This problem can be exemplified by an examination of the SONADER/AFRICARE small-scale perimeter experience (Table 3).

Table 3. Evolution of Gouraye Sector Cultivation Intensity on Small Irrigated Perimeters of the SONADER/AFRICARE Project

	<u>1978</u>	<u>1979</u>	<u>1980</u>	<u>1981</u>	<u>1982</u>
1. Area Constructed (ha)	79.5	79.5	213	290	290
2. Area Cultivated (ha)	47.3	115.3	316	535	432*
3. Cultivation Intensity (2:1)	0.6	1.45	1.48	1.84	1.49

\*Actual 1982 rainy season and projected 1982 dry season area.

Source: Cultivation intensity calculated from data given in Scott, 1982. p. 5, Table 1.

The reduction in cropping intensity was attributed to the inability of four of the nine village perimeters concerned to receive additional agricultural credit in 1982 because of prior indebtedness. This, in turn, is attributed to reduced returns due to breakdowns of the pumps which SONADER could not repair in a timely manner.<sup>1/</sup> Discussions with SONADER personnel indicate that this is a generalized problem in all sectors due to motor and pump inadequacies, difficulty of access during the rainy season, lack of stocks of spare parts, cumbersome procurement procedures, and cash flow problems resulting from slow loan reimbursement and delayed payments for marketings. In addition, investigation by national headquarters has uncovered institution-wide budgetary constraints to effective field operations (shortfalls in GIRM counterpart contributions to donor-assisted projects and insufficient operating fund allocations)<sup>2/</sup> which systematically reduce SONADER's capacity to execute projects. Thus, institutional problems may be the cause of the micro-level phenomenon of cropping intensity reduction in 1982. However, there is probably enough diversity among individual cases to account for a wide variety of causes.

The perimeter level information gap will--it is expected--be reduced by donor-assisted OMVS programs (such as the USAID/OMVS Integrated Development and Agricultural Research Projects, and the World Bank Technical Assistance Project II). The design, operation and maintenance problems will be addressed by donor assistance to individual sector SONADER projects (Dutch assistance to Rosso, CCCE/FAC assistance to Boghé, FED aid to Kaedi), and pending IDA support for Kaedi and Gouraye. But the GIRM's recent reduction of SONADER's operating budget, and related moves to restrict growth of SONADER personnel, at a time when new facilities construction is imminent, may further impair the institution's capacity to make the perimeters economically viable and financially self-supporting. This problem, along with the time lags and the low productivity that can be expected in the initial development of large scale perimeters, particularly where resettlement of farmers is required (Gorgol Noir), implies that the GIRM and donors need to balance carefully the rate of new construction with the development of the organizational, operational, and maintenance procedures required to help new and old projects produce to their designed capacity.

As the preceding sections have indicated, successful irrigation practice requires a transformation of current farming systems and, consequently, the practices of farmers. A recent World Bank study expressed the view that

"Expansion of irrigation is also limited by the speed with which farmers not accustomed to irrigation can absorb new techniques and the required cultivator discipline ... Poor water management, partly due to deficiencies of the infrastructure but also to lack of expertise and management control, gives rise to

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<sup>1/</sup> Scott, 1982, p. 7.

<sup>2/</sup> SONADER, 1981a.

irregularities in water supply which increase farmers' risks and undermine their willingness to cultivate intensively. At the same time, these factors severely limit both farmers' willingness and ability to pay the water charges required for financing maintenance." (World Bank, 1981, pp. 77-78).

Thus, a basic human constraint in terms of knowledge and skill must be addressed by field extension services. Unfortunately, while a great deal of attention has been paid to the physical problems of perimeter management, it is not at all clear that extension practice is based on the principle that the success or failure of a perimeter depends intrinsically on its ability to meet the risk reduction and crop production objectives of its individual members.

The experience of SONADER and its sister organizations in Senegal and Mali have led Mauritanian officials and foreign donors to realize that significant research of an applied nature must be undertaken to develop farming systems which will enable farmers to make the transition from dryland to irrigated agriculture. While there has been extensive rice experimentation, other crops have been neglected; on-farm trials have been carried out under highly artificial conditions, if at all; research and extension links are almost non-existent, and basic farm management data are not available. The OMVS/AID Agricultural Research project has been designed to create an institutional capacity to undertake the diversified farming systems research and extension needed to improve the performance of the irrigated perimeters.

### C. Livestock Herding

#### 1. Environment and Habitat

No matter how the ecological zones of Mauritania are defined in terms of mean annual rainfall, all are sufficiently arid to require highly flexible herd management in order to cope with extraordinary resource variability over time and space (RAMS SS 3, p. 16). Spatially constrained production zones, whether ranching schemes or grazing blocks, may appear attractive in certain locations for average rainfall years, but they would arbitrarily limit management flexibility and would probably be counterproductive. The same is true for politically constrained management alternatives which would fall into the category of range management, although there may be some scope for assisting localized pastoral clans which already have firm control of a section of grazing land. However, a centrally defined land use plan would limit flexibility and would be unenforceable, and it may increase political tensions between producer groups. Recent environmental degradation in Mauritania has occurred in regional or localized areas of human settlement, or where services and infrastructural development have been introduced. The seriousness of the degradation depends on its extent, which is unknown, but according to the Dutch research team in Mali, degraded areas generally are not in imminent danger of desertification. Much of the deterioration has occurred in agricultural areas under the combined influences of herding, farming, population pressure and below average rainfall, yet the resource use patterns in agropastoral areas will be

difficult to change since the human populations of these areas are stable and do not have the dynamism necessary to accommodate new modes of production.<sup>1/</sup>

Individual production strategies are influenced by the size, and especially the composition, of each herd. Sheep and goats require high quality forage, and sheep and cattle are principally grazers while goats and camels are browsers. (The difference between sheep and goats is recognized in RAMS SS 3, but the distinction is not made in the study because prior surveys--except the FAO survey mentioned above--combined the two species as "small ruminants".) The specific mix of animals in a herd influences the spectrum of habitats which can be exploited. Diversified herds also give herders greater economic flexibility in marketing and subsistence; for example, milk production may be extended over the year when lactation cycles of different species occur at different times (Aronson, 1982). The point of this discussion is that development activities must address all species of ruminants and numerous production strategies if the objective is to build on traditional production systems as recommended in the "Livestock Subsector Study" (RAMS SS 3, p. 8)<sup>2/</sup>.

The majority of Mauritania's livestock is reared in extensive production systems on natural rangelands and, to a lesser extent, on fallow lands. These systems are exploitative; that is, minimal effort is made to improve the primary productivity of foraging areas beyond their natural capacity. In cropping regions, there may be supplementary feeding on a seasonal or ad hoc basis, but usually in quantities which are necessary to prevent excessive production losses during periods of stress. Some extensive production is integrated with crop production systems, especially in the southeast and southwest where cattle are allowed to forage on grain stalks after the harvest (map, ibid., p. 17). Also, economic integration with crop production is achieved when farmers purchase cattle for investment purposes and entrust them to Fulani herders (ibid., pp. 25-26). A much smaller percentage of livestock is reared in semi-intensive production systems where animals are kept on or near a farm plot and are fed a combination of natural forage and crops or crop by-products, some of which may be purchased. This applies to many sheep and goats and, to a lesser extent, to cattle (RAMS AS 7-1, pp. 31-32, 56).

Something must be said at this point about nomadism, sedentarization and transhumance as they apply to systems of production. There are many ways to define these terms and even to subdivide them (ibid., pp. 27-28, quoted from Bremard, 1977), but it is difficult to formulate a consensus definition. The RAMS "Livestock Subsector Study" ducks this

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<sup>1/</sup> For a discussion of possible environmental and production benefits from, and what subsistence means when applied to, pastoral herding, see Aronson, 1982.

<sup>2/</sup> Some pastoral production systems are of recent origin, and all are subject to evolution. The term "traditional" is used here to describe base line production systems; it has no historic connotations.

issue, perhaps wisely, and only refers to mobility as an essential livestock management tactic (RAMS SS 3, pp. 4, 24). The study "Social Change, the Future of Pastoralism" (RAMS AS 8-1) supports and extends this interpretation by separating the nomadic lifestyle from the mobility which is required for herd management, thus:

"...nomadism is... a form of economic and social organization which always involves sedentary groups. And this form of economic and social organization sometimes remains operative even after the dynamic aspect of the nomadic lifestyle--its mobility--is, for one reason or another, blocked." (ibid., p. 25)

"...during the remainder of the year, especially in the rainy season and at the time of the great North-South trek, they move almost every day. These movements have one sole motive: the search for pasture." (ibid., p. 28)

It is now generally agreed that sahelian systems must remain mobile for production purposes (transhumance?) in order to cope with large and rapid changes in the vegetation which are caused by erratic seasonal rainfall. It should be clear that development efforts must deal with great herd mobility in spite of the perceived trend toward sedentarization.

Another difficulty related to mobility is how to interact with those herders who undertake seasonal migrations with their herds into Mali and Senegal (RAMS SS 3, p. 29). As indicated earlier, many herds remain out of the country longer than they do in Mauritania, especially in years of very low rainfall.

## 2. Water Point Distribution

Uneven and inadequate water point distribution in Mauritania may be an obstacle to complete utilization of the potential forage resource (RAMS SS 3, p. 3). The FAO identified 55 million hectares of pasture land in Mauritania of which 39 million is currently grazed. However, it is unclear whether the undeveloped pasturage is really unused. It may be used only during occasional years of heavy rainfall, in which case developed pasturage may be concomitantly reserved for late season foraging. To construct permanent water points, such as bore holes or multiple dug wells, may lead to inordinately large herd concentrations. For example, wells dug in a localized browse habitat which gives easy access to ground water may lead to overforaging and destruction of the browse species with a consequent decline in the productivity of goats or camels. Water development should proceed only with a knowledge of existing local herd management techniques and habitat conditions in order to ensure against negative changes in production systems.

In Mauritania, there is a tendency to "improve" wells by adding cement water troughs. But this innovation is counterproductive; settling of the earth below causes the troughs to break off and become useless appendages which limit access to the wells' edges and, perhaps worse, cement troughs cannot be adequately dried or cleaned and become foci for the dissemination of pathogens (Sollod, 1981).

### 3. Technological Measures for Improving Livestock Productivity

Experience with livestock development projects in other parts of Africa indicates that ten years or longer are needed to make a worthwhile contribution to livestock production in pastoral systems (Moris, 1981). The types of activities which should be supported include field research and small scale testing of emerging technology, a gradual accumulation of small improvements, the strengthening of Mauritania's technical manpower and institutions, and maximizing the herders' participation in development.

Some technologies generated from projects and research in other sahelian countries are appropriate for trial application in Mauritania. Innovations should be kept uncomplicated, make maximum use of indigenous inputs and place economic responsibility for sustaining the technology in the hands of the herders.

Five technical areas deserve attention, perhaps in the following order of priority. First, animal health can be improved and sustained through a veterinary sécuriste system in which herders are trained to carry out most interventions for members of their own peer group. Herd health, rather than individual animal care, should be stressed and the spectrum of diseases should be limited to those of greatest economic importance in terms of the herders' own production goals. Problems which affect the productivity of both man and animals, such as vitamin A deficiency and brucellosis, may give the greatest returns for effort. Eventually, a distinctive and appropriate animal health delivery system could be built up.

Second, water points could be developed. Rather than looking for areas where pasture can be "unlocked" by the addition of new water sources, the strategy should be to improve water quality and make the supply more reliable throughout the year. Deepening of wells and improvement of run-off collection points should be considered.

Third, range management innovations may be introduced which would allow herders to improve animal productivity<sup>1/</sup> and ensure meeting their fuel wood needs. However, no large scheme which requires significant social engineering or land tenure modifications should be attempted. Instead, one or two pastoral clans which already control a significant block of rangeland should be identified as a target. Although such a clan is likely to be economically well-off, a valuable management model may emerge for future application within the context of the Sahel Development Program.

Fourth, the science of animal reproduction, or theriogenology, includes some simple technologies that could be introduced. A good starting point would be to give Mauritians the capability to confirm pregnancy in cattle and camels and to detect a few reproductive disorders. This could be introduced to both extension agents and herders through a sécuriste system.

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<sup>1/</sup> Such as the grazing system developed by the USAID-funded Niger Range and Livestock Project.

Fifth, animal nutrition, particularly the fluctuating quality of natural forage, is a major limiting factor that is difficult to remedy. Some improvements may be made for village herds, but the changes would not have widespread impact. Hay production in pastoral areas could help immensely but there are too many technical and socioeconomic complications which should be resolved first in other sahelian countries. No thought should be given to using imported feedstuffs since this would not lead to producer self-sufficiency and would not be ecologically sound in non-confinement systems of animal production.

#### D. Economic and Social Issues

A number of key issues of a socio-economic nature have been identified by the RAMS study and other investigators, both Mauritanian and expatriate. Some of these issues--such as the labor conundrum and land tenure, problems and the role of women--are shared with other sahelian countries, and vary only in degree; others--principally the vestiges of caste stratification among certain ethnic groups--appear to be peculiar to Mauritania. There follows a brief discussion of what appear to be the main issues. Some are treated at length in the RAMS study, but unfortunately not in an interdisciplinary fashion and perhaps in some cases in a relatively non-objective frame of reference. All of them are in need of further, truly multidisciplinary research by persons who are deeply familiar with the historical and cultural context of the socio-economic phenomena and who can relate culturally and linguistically with the target groups concerned.

##### 1. Land Tenure and Labor Relations

The complex of relations between various types of rural people and the land that they exploit, and among them in the context of their relations with the land, have been identified as one of the most--if not the most--important issues that will have to be dealt with in order to implement development interventions in the Mauritanian rural sector (RAMS AS 8-2, p. 3).

Two uninspired attempts to deal with the quality of land ownership and land use that characterizes the traditional land tenure system have had little or no positive effect. In 1928 the French tried to impose a landownership act that would recognize owners only after registration of the land. This had very little impact on customary laws. However, some owners who had registered land through the colonial system are now using this law to claim ownership of land whose value has recently been increased through irrigation. And in 1960, the newly independent government enacted a new land ownership law which is considered very vague. It does not address the relationship between ownership of land and its use. Furthermore, it does not make allowance for the diversity of customary laws. (RAMS 8-2.)

Thus, although acute land tenure problems have arisen in most agriculture development interventions including barrages, oases and irrigated agriculture, the question of how to secure the accrual of benefits to all groups concerned will have to be resolved in order to ensure maximum participation (RAMS AS 8-2, pp. 23-27), as well as for reasons of social equity.

Related to the issue of land tenure is that of agricultural labor relations. A considerable portion of the agricultural work is still performed by servile groups. Hence, the availability of labor will be affected by the massive exodus of these groups to the urban areas in their search for ways to break the ancient social and economic bondage. In the rural areas themselves, a considerable amount of tension is exemplified by the cases of R'kiz where, in 1972, the Haratine actually refused to cultivate the land in opposition to the heavy land use fees (RAMS 8-2, p. 32), or of the Magta Lahjar area, where land whose value had been increased through the construction of dams by Haratine cultivators was claimed by Bidan landowners.

The lack of an appropriate land legislation has been identified as a constraint to livestock development and environmental protection, for example in the Guidimaka IRD Project:

"Interventions involving range management are not likely to be effective without a stronger national policy on access to, and control of grazing lands."

"The lack of legislation or regulations limiting pasture use between residents and nomads has dampened the motivations of people nearby to carry out major improvements such as planting trees or leguminous species." (Scott, 1982, pp. 15, 30.)

In several case studies (RAMS AS 8-2, pp. 31-36), the RAMS sociological team asserts that, beyond the problem of social equity, the land tenure issue can have negative effects on production itself. The problems encountered by SONADER in the development of irrigation in the Senegal River Basin is a good illustration of how the production results from a project involving very high investments can be much lower than expected owing to unresolved land issues (*ibid.* pp. 69-70).

An AID project is underway in that field through the technical assistance of the Land Tenure Center of the University of Wisconsin. A preliminary study made some innovative proposals (Manzardo, 1981), based on the premise that most land tenure problems in the RIM are not within groups but between groups competing for a single set of resources. The author proposes land tenure legislation similar to the hema system of Syria whereby traditional land control rights were recognized by the Government and the management of these resources was turned over to the local communities, which were organized as cooperative groups. Such measures may be quite effective in relation to livestock raising and environmental protection.<sup>1/</sup> But their application to cultivated land would probably not diminish the tensions within the different social groups for the control of the products of farming.

Although the land tenure issue is politically very sensitive, Planning Ministry officials have publicly recognized it as a "principal" problem (MPAT, 1982, p. 10):

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<sup>1/</sup>A World Bank Project in livestock is getting under way in the southwest in which the traditional rights of communities on rangelands will be recognized and herders will be organized in associations with legal status.

"Aucune solution n'est encore en vue pour trancher les problèmes fonciers qui freinent la mise en valeur agricole et nuisent à la poursuite de l'objectif d'auto-suffisance alimentaire. De ce fait, les terres cultivables ne peuvent être aménagées et livrées aux activités de production intensive. La gestion des parcours est rendue difficilement organisable, ce qui nuit à l'amélioration de l'élevage. Dans la mesure où ils ne jouissent pas de l'usufruit de leur travail, les paysans et éleveurs n'ont pas la motivation nécessaire pour leur libération économique. L'absence de solution au problème foncier est l'élément principal de stagnation du secteur rural.

Several national commissions were created in recent years to study the land tenure issue and come up with solutions, but they have had little success. The Ministry of Interior presides over the latest of those commissions, which has been given the task of elaborating a new land tenure legislation.

## 2. Participation

Farmer or herder participation in development interventions is very difficult to stimulate in a very hierarchical society where most producers are isolated, dependent on government initiatives, and not accustomed nor trained to deal with the technical and organizational problems that arise with the implementation of rural development projects.

In the livestock sector, the creation of herders' associations has been identified as the most effective way to deliver services to the herders and to serve as a vehicle for interaction between the government and the herders in Sahelian countries (Aronson, 1982). Two livestock projects which are about to start in the southwest (World Bank) and southeast (FED) regions of Mauritania are aiming at organizing herders' associations and improving range management practices through the recognition of traditional territorial rights of those groups.

However, the land tenure and caste relations issue is a powerful impediment. In Mauritania only the most powerful Moor factions have undisputed territorial rights over areas that are large enough to make range management viable, as well as sufficient internal homogeneity to guarantee some success to herders' associations. Without drastic changes in legal access rights, this would effectively exclude the Fulani, for example, despite their important role in cattle raising, because they have no traditional territorial rights over the areas which they occupy.

In the crop production sector, the question becomes how to promote manageable cooperative groups when dealing with small independent farmers, absentee owners and sharecroppers. Although the need for cooperative groups for the provision of inputs and for the management of credit and communal infrastructures is felt, difficulties have arisen over the choice between supporting traditional forms of authority--with the risk of non-participation of the lower status groups (see the case of the

Gorgol Noir Project), or of setting up artificial structures that do not automatically ensure maximum participation. The Guidimaka Project was faced with this type of problem:

"The former (Peulh) seem often incapable of organizing themselves for permanent cooperative ventures. In the latter (the Soninke), the extended family is already a de facto cooperative, whose established patterns and power structures are threatened by new cross-family cooperative action." (Scott, 1982, p. 32)

Furthermore, the cooperatives which have been created up to now were often artificial structures whose raison d'être was tied to the construction of a perimeter in the river valley, or to the hope of obtaining some kind of assistance from the government in other areas. The statutes imposed by the cooperative service of the Ministry of Rural Development were unadapted to their situation, and the extension training which farmers received was limited to new agronomic techniques. Hence, these groups are, by-and-large, incapable of dealing with their management and organizational problems.

The Ministry of Rural Development is currently "reorganizing" the cooperative movement by eliminating fictitious cooperatives, creating regional unions of cooperatives, and holding training sessions for farmers in cooperative management in a school which just opened in Boghé.

The RAMS case study, "Agro-Pastoral Group of Boumdaid", indicates the potential for rural development through dedicated and enlightened local leadership. In this case, a traditional community ("brotherhood"), headed by a religious leader, managed to introduce simple and appropriate innovations to develop farming and stock raising in the area under its control. The village became self-sufficient in food and was subsequently able to produce substantial quantities for the market in several cities, including Nouakchott. The spiritual leader of this community knew how to motivate his followers by integrating the positive aspects of traditional and modern values. He built on "istinbate", the traditional principle of work and continuity in action, to encourage his people to increase production and productivity. By invoking the dictate of the Cheikh that success in agriculture depends on a rational attitude toward trees, the brotherhood was also successful in forbidding the cutting of trees on its land and delimiting a protected forest. (RAMS AE 4-1, pp. 48-51).

This case seems to demonstrate that many of the social problems encountered by development projects--disputes over land ownership, deteriorating project dams and wells, failure of the cooperative systems--could be solved by working through the leadership of a well integrated group that controls a territory through traditional customs and usages. In the Boumdaid case, the formal cooperative system, based on imported values, seems to work well because it is supported by an informal, traditional community headed by a revered leader. No land tenure issues

are raised. Project works are well operated and maintained, and recurrent costs are taken care of by the community.

### 3. The Role of Women

The role of women in agriculture has undergone considerable change in the past few decades. With the increasing migration of the men to the urban centers, an important part of the agricultural work, including "management", has fallen to the women; yet, they have not been integrated in their role of producers into the development programs that have been initiated up to now (RAMS AS 8-2, pp. 51-52; Smale, 1980).<sup>1/</sup> Nevertheless, official demographic data, including the census and RAMS demographic projections (AS 3), continue to ignore the role of women in the labor force.

Smale observes that (at least until 1980) "projects addressing women as income earners and producers have received meager support". Her study also shows that specific approaches to involvement of women in development activities must be tailored to the socio-cultural peculiarities of each ethnic group and sub-group with regard to traditional sex roles and to how the drought and the concomitant accelerated migration and sedentarization have influenced these roles (*ibid.*, pp. 77-78 and 93-94). However, the following general points can be made:

- most rural women do not have access to non-agricultural employment;
- women tend to have less tenure security than most men; this inhibits their investments in production: for example, irrigation projects to date have attempted to reduce land tenure insecurity by registering plots only to male heads of households;
- crop production projects have failed to address the needs of women to produce a diversity of crops to meet traditional needs for sauce ingredients, dye and fiber, and to reduce exposure to the swings in fresh vegetable prices;
- women play important roles in small ruminant production, but this segment of the livestock sector receives little attention from donors and government;
- women are responsible for collection of tertiary products from natural vegetation, but the plants concerned are not incorporated into development projects, nor are women involved directly in forestry projects;
- because of their restricted mobility women are at a competitive disadvantage when they market production because they must often depend on intermediaries, and

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<sup>1/</sup> These comments do not apply to Bidan women. However, while they have valued idleness traditionally as a sign of nobility, the exodus of servile labor is forcing some Bidan women to play a more active role.

- women do not have access to the rural food processing and transformation technologies that would enable them to invest in greater production of perishables. (Ibid., pp. 98-103).

Clearly, if the GIRM's objective of stabilizing the rural population is to be met through improvement in rural living conditions, projects and government services must reorient some of their operations to meet the needs of such an important component of the rural labor force.

#### E. Manpower Constraints and the Capacity of Public Institutions

Chapter IV summarizes the overriding dependence of Mauritania on external financial aid to meet its basic food needs and its capital investment budget and even its current public expenditures. This section examines briefly the development constraints inherent in the deficiencies of the public administration apparatus as a result of the combined effects of the fiscal problems and the level of education and training of the population from which the bureaucracy can be selected. The political reasons that underlie many of the inefficiencies of the public administration are left largely implicit.

The weaknesses of the education and training system have been analyzed by the RAMS study: the excessive emphasis on general education; the neglect of primary and technical/vocational education; the exaggerated granting of scholarships, which usually consume two-thirds of the institutions' budgets; the slow progress in Mauritanization of the teaching staff; the low quality of training, especially in the countryside where primary school students are mostly taught by "monitors" (those who failed the graduating exams of the elementary teachers training school); the irrelevance of training to the job market; the complete lack of education for adults (RAMS, op. cit., especially pp. 223-243). RAMS also suggests radical and large-scale reforms which require the mobilization, involvement and coordination of all public agencies concerned, the creation of many new organizations and coordinating committees involving the President, many ministers, agency heads, and government representatives at all levels. In short, the RAMS study recommends, not only for education but also for all other fields related to the development of the rural sector, a sweeping, even grandiose planning and implementation scheme that is quite unrealistic in the Mauritanian context.

The general degree of manpower skills in Mauritania is much lower than in most LDCs. This shortage has been remedied to some extent through expatriates who are supposed to transfer skills to local counterparts, and by in-country or overseas training. While substantial resources and effort have been devoted to both, progress has been slow. The question can be asked whether the gap between the supply and demand of manpower is widening rather than diminishing with time.

The deficiencies identified by RAMS are not surprising: the loss to the modern sector (SNIM) of people trained for the rural sector; frequent reorganization of the government to reflect policy changes; highly centralized structure; lack of adaptability to meet the critical needs of the rural population; absence of an effective planning mechanism and

coordination between planning, budgeting and implementation, and multiplication of institutions (RAMS, AE 4-2). But these weaknesses are merely the symptoms of the need to maintain political stability. Hence, administrative reforms based solely on technical and economic considerations would be difficult to achieve.

All of the civil service agencies (services administratifs), including those of the Ministry of Rural Development (MDR), follow the same personnel and finance rules, along the French bureaucratic model. These rules are enforced by the ministries of Civil Service and Finance. As a result of successive austerity measures and inflationary pressures, salaries and operating funds have been gradually but drastically reduced in real terms. At the end of 1982, the per diem for all civil service employees at all levels for in-country travel, for example, was a total of 600 UM (US\$12) for ten accumulated days, and even this was paid only in cases where host authorities cannot provide food and lodging from budgets which contain very little representational funds.

There are now some 30 autonomous organizations (EP's) under the supervision (tutelle) of the Ministries. The reasons for their creation are many: to overcome the rigidity of the Civil Service rules which do not fit the requirements of development; to satisfy the requirements of external donors and lenders that do not want to see their resources dispersed in the general budget; to provide the operational flexibility required by the industrial or commercial nature of the responsibilities of certain institutions; because the private sector is too weak and too small to handle big enterprises or to take over foreign enterprises which have been nationalized.

Civil servants can be seconded to EPs and enjoy all their perquisites, while still maintaining their rights to seniority, advancement and retirement in the Civil Service. Law 67.169 establishing the Civil Service Statute (art. 69-86) allows for a détachement of up to 5 years, renewable each year thereafter. While the law prescribes that the total number of seconded personnel cannot exceed 20% of the total corps of civil servants concerned, it excludes from this percentage cases of détachement d'office (an automatic mechanism in case of appointment to policy-making offices). Finally, because of the shortage of staff, the Directorate of Civil Service is in no position to enforce this provision, and socio-political realities do not seem to encourage enforcement.

The law also authorizes a civil servant to be mis hors cadre to serve in autonomous organizations and later be reinstated in his original service at his old level. After exhausting all these devices, he may have recourse to the mise en disponibilité which allows him to interrupt his career service for a few years with the possibility of rejoining it later. The Ministry of Civil Service has issued memoranda reminding other ministries correctly to observe civil service regulations in these matters. Ordinance No. 79.313, issued in 1979, provided for the leveling of personnel compensation (base salary and allowances) in para-public and public sector organizations, but it has not been enforced to date because the implementation decree has not been issued.

Almost all autonomous organizations are run by Civil Servants or military personnel. Their boards of directors comprise directors of the ministries concerned, and their management consists of civil servants seconded from the ministries. The bureaucrats tend to run all public corporations as though they were administrative agencies whose purpose is to render a public service free of charge, but not to generate revenues.<sup>1/</sup>

Naturally, the central government structure and personnel are very heavy at the top in Nouakchott and very light at the arrondissement level. Administrative units at the level of the village and nomadic encampment, called for by legislation first enacted in 1968 in Public Law No. 68.242, and later, in 1980, in Public Law No. 80.144, have not materialized because of the delay in the issuance of an implementing decree (ibid., pp. 73-74).

Three major issues can be raised here: (1) ministries are supposed to provide coordination to parastatal organizations under their supervision to achieve the goals of their sectors, but how can they fulfill this role when they are in such an unfavorable situation in terms of human and financial resources relative to the organizations under their tutelage? (2) how could the state budget, with its meager revenues, handle all the counterpart funding and recurrent costs generated by the parastatals-run development projects that are supported by external resources? (3) how, with such a low capacity of government at the local level, can the bureaucratic machinery hope to penetrate and develop the rural areas in accordance with the decentralized and participatory policies of the planning rhetoric?

Given the overwhelming constraints, the possibility for developing the capacity of public sector institutions appears to be very limited. The professionalization of the bureaucratic work force that would allow for a rational allocation of manpower and an increase in institutional effectiveness will be difficult to achieve without a stabilization of the socio-political system. An expansion of the bureaucratic machinery at the local level to develop the rural areas is not possible because of financial constraints. The remaining options may consist of the reallocation of existing government resources among the different government sectors and the involvement of the non-government sector in development projects. The following suggestions might be considered in implementing such an approach, which may help relieve some of the existing constraints.

#### Reduce the Role of the Civil Service Bureaucracy

The efficiency of civil service agencies, seriously undermined by the fiscal constraints, might be enhanced if their roles were reduced and concentrated on keeping law and order, collecting taxes, providing justice and basic education, building public networks, and fulfilling the country's international obligations. In the sphere of economic

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<sup>1/</sup> For an analysis of parastatal performance in the agricultural sector, see RAMS AE 4-1, pages 16-28.

development, their role could be confined to providing economic infrastructure and orienting and regulating the economy. Direct actions and interventions could be left to parastatals and projects funded from external sources. The Ministry of Rural Development's administrative services could reduce their role to planning, coordinating and controlling, and let parastatals and projects handle the operational tasks. The operating personnel of the former could be reassigned to the latter.

Such a division of labor is also congruent with the different management structures of public and para-public sector institutions. The French civil service model, with its rigid and centralized structure and operating rules, is good for bureaucratic organizations whose job is to provide services of well-defined and routine character within a stable environment. The structure and operating rules of parastatals and "projects" are much more adapted to the requirements of development activities.

#### Improve the Economic Efficiency of Parastatal Organizations

With proper supervision, guidance, and support from ministries, parastatals could be made responsible for their performance. To this effect, the existing detailed a priori control of management processes, which tends to delay the parastatals' operations and to consume a lot of ministries' time and energy, could be replaced by an a posteriori evaluation of performance and results. This type of control can be achieved by having the parastatals submit to the ministries work plans and financial plans against which performance could be measured within the framework of the Government's sectorial policies. The system of program-contract (contrats de programme) contemplated by the GIRM Fourth Plan is an application of this new approach to control. These contracts determine the objectives of production and productivity increase, funding, management and financial results in return for certain government commitments. With such a system of control, a balance can be achieved between the privileges enjoyed by the parastatals' employees and their responsibility to account for results. Among other objectives, this might lead to greater economic efficiency by lowering costs and--where applicable--increasing revenues, in order to minimize the financial strain on the State budget.

Two Mauritanian sector institutions would appear to deserve priority support: one, the Kaedi Agricultural School, because of its proven track record as the only institution of its kind in the country, and the other, the National Development Fund, because it promises to function effectively as the missing link between external capital (official and private) and existing and future national institutions and enterprises.

The Kaedi National School for Agricultural Training and Extension (ENFVA) was created, and nurtured for 20 years, by FAO /UNDP. The school's faculty is now 100% Mauritanian and its student body exceeds 150. But its plant and equipment have deteriorated and have become inadequate; its faculty needs upgrading, and its curricula need to be reviewed in the light of the country's current needs.

The school has been seeking additional help from external sources to increase its capacity to produce more effective rural development workers, and has obtained a grant of \$2,000,000 from the Saudi Fund to develop and expand its facilities. But ENFVA needs additional sources of funding and other assistance to upgrade its teaching staff and curriculum. To date, the school has trained 300 middle and lower level rural development workers. It enjoys relative autonomy as an "établissement public á caractère administratif" under the supervision of the Ministry of Rural Development. As such, it does not have to follow all the rigid civil service rules. Its Board of Directors has some freedom to determine the appropriate allowances for the staff and to approve the design the of various tracks and curricula. The financial procedures it has to follow are relatively uncomplicated. Funding for operating expenditures appear to be adequate at present.

The Fonds National de Developpement (FND) is a small, competently staffed development finance institution that, according to its mandate, is called upon to assist in the creation of economically viable public, private and mixed enterprises through loans and equity capital and planning and management aid. The FND is looking for help in setting up the already approved mixed-capital National Corporation for Rural Credit and Supply, and it has plans for financing and supplying the artisanal fishery sector, as well as for commercial fisheries. The FND could function as an intermediate credit institution on a pilot basis, in connection with the corporation for rural supply, in artisanal fisheries cooperative credit, or in industrial fisheries support.

#### F. Grain Prices and Price Policies

Mauritania is no exception to the pattern of negative grain price policies that are typical of sub-Saharan Africa (see World Bank, 1981; Eicher, 1982). In most other countries of this area price policies are perceived to distort consumption patterns at the same time that they prevent domestic production from rising to meet demand. Perhaps the most disturbing aspect of Mauritanian grain pricing is the uniformity of the prices for imported sorghum, maize and wheat. On the other hand, because there is no evidence to the contrary, it is contended here that, under present conditions, price policies tend to have little or no short or medium term effect on output in Mauritania, except perhaps on the small irrigated acreage.

##### 1. Official Pricing Versus the Market

A little more rationality has recently been introduced into the largely government-managed grains market, above all with the fusion of the Cereals Office (OMC) and the Food Aid Commission (CAA) into the new Food Security Commission (CSA), and with the assumption by the latter of all domestic grain buying, including rice which had previously been purchased by the irrigation development agency, SONADER. Also, official sale prices of grains from government stocks (which, of course, are almost entirely imported) have begun to increase; in principle they are to be allowed to rise to levels equivalent to CIF-plus distribution costs over the next few years.

The present differential of one UM per kg (about seven percent) between the price of sorghum and wheat sold in the capital and the price charged in the provinces (in favor of the latter)--as well as the previous 25% spread when both prices were lower--are ostensibly designed to help stem city-ward migration during the drought years. That the differential has been ineffective should not have surprised anyone because, during times of scarcity, ample availability surely outweighs small price differences in people's minds; besides, once the grain has been sold government stocks, market prices tend to be higher in the countryside than in the capital precisely because there is always an assured supply at the official price in the city.

The price of rice--both domestic and imported--to the trade is also subsidized.<sup>1/</sup> From a fiscal point of view there had not been any explicit loss to the treasury until 1980 because the public agency that deals in milled rice--SONIMEX--compensated its losses on rice accounts with profits on "luxury" imports such as sugar, tea and cloth.

In a not uncommon attempt to please both producers and consumers, the GIRM has devised a comparatively complex, largely official, marketing system for rice. Market surpluses of domestic rice are purchased by the CSA, at a fixed support price of 12.5 UM per kg (24 cents per pound) of paddy and resold milled to the official distribution agency, SONIMEX, at 24 UM per kg regardless of quality, after milling at one of two government owned mills (at a low average milling rate of 60%). SONIMEX resells the milled rice to merchants at 25 UM per kg; this represents a net loss of 5 UM per kg, including the milling charge of 3 UM. Small wonder that during the 1980-81 crop year, the public agencies bought no more than 1,000 tons of rice from local producers, against an estimated total production of about 6,600 tons including about 1,800 tons produced by the state farm at M'Pourié. The small balance of 3,800 tons can be assumed to have been home-consumed, with negligible quantities available for the private domestic trade or for illicit sale across the borders to Senegal and Mali. At present price relationships, the incentive for such illicit trade is substantial. In 1981, "rice prices in Mali and Senegal (were) 70-100% higher than the SONIMEX sales price in Nouakchott. SONIMEX believes rice is leaving the country in substantial quantities as a result." (USAID/Mauritania, 1981, p. 51).

It should be noted that, as in Senegal, the Mauritanian rice market is conditioned by the fact that the population was originally introduced to rice in the form of imports of cheap (100%) broken grain from Asia which, inter alia, resembles couscous in its cooking quality. Even today the typical African consumer continues to demand broken rice (which domestic milling practices find it easy to supply).

The long-term economic implication for Mauritania's rice production from substantially expanded irrigation would seem to be a need for its rice to be produced at a cost competitive with imports of the same quality. The outlook for such competitiveness, as well as the effect of

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<sup>1/</sup>Martin (1982, pp. 192 and 193) estimates the subsidy on domestic rice at 5.8 UM per kg, and on imported rice at 4 UM at Nouakchott and 6.5 UM in the provinces.

government price policies on the relative profitability of irrigated rice, maize and sorghum production, will depend on the rationality and uniformity of grain price policies to be adopted by the three OMVS nations.

There had not been any increase in the highly subsidized consumer prices for dryland grains until the last two years; there was also a substantial adjustment in producer prices in 1982. As of the end of September, 1982, all imported wheat, sorghum and maize (except, of course, free relief distributions) was sold at a uniform 13 UM per kg in the provinces and 14 UM in Nouakchott. The FOB quotations per metric ton for US origin grains for August, 1982 reported by USAID/Nouakchott were as follow:

Wheat	178 dollars
Maize	134 dollars
Sorghum	126 dollars

This is a spread of 41 percent between sorghum and wheat. (Besides, in the case of wheat, the GIRM slae price was estimated to be only two-thirds of the full CIF price plus local handling, storage and transportation.) If Mauritanian consumers were in fact beginning to have a preference for wheat over the imported, red sorghum (a question that no one seems to deem worht investigating), the GIRM's uniform pricing policy is doubtless producing a permanent dependency on wheat--and cheap wheat at that--which could cost the government dearly one day in either financial or political terms. Moreover, the relatively unplanned, and not necessarily equitable, free food distributions reportedly tend to disrupt rural markets.

## 2. Are producer prices relevant to aggregate output targets?

The lack of a positive supply response to higher grain prices at the farmgate does not necessarily imply a negative response from farmers to government price policy. Neither does it rule out the existence of other constraining factors in the production process. However, given the low quality of the land resource base and the limited framework for economic activity in the rural areas one should expect a highly inelastic supply response for farm products. Unless there is evidence to the contrary, this seems to be the case in the agricultural sector of Mauritania.

Present technology on the family farms relies mostly on labor, with little or no capital inputs. Thus, any increase in aggregate production would have to come from expansions in the planted area. But such an expansion would not take place unless the supply of rural labor increased substantially. Given the large out-migration of labor from the rural areas that has been taking place, this is an unlikely scenario. Without more capital intensive technology the marginal productivity of farm labor, and hence returns to family labor and farm wages, will not rise and labor will continue to prefer the relatively greater stability and certainty offered elsewhere.

Indeed, in view of widespread reports of seasonal and permanent rural labor shortages--partly confirmed by informal observation--due to emigration, the labor shortage factor should not be eliminated as a

partial explanation for the purported decline in output over the last decade or more. The traditional technology employed in dryland grain farming (and to some extent, in irrigated rice farming) is almost entirely dependent on human labor handling primitive tools during the critical planting time. It is thus entirely possible that a sudden massive withdrawal of laborers at critical times may leave potentially cultivable dryland or irrigated land idle. It is true, of course, that the basic cause for the scarcity of labor has been the succession of droughts that expelled the labor in the first place. But the lack of price incentives in the past may also have had something to do with encouraging the labor force to continue to stay away.

In cases where there is access to labor substituting inputs the problem may be one of the opportunity cost of capital. Given the high risk of Mauritanian agriculture it would not be surprising to find that the nominal cost of capital in the informal market, plus the transaction costs and the high risk of failure due to drought, make the use of capital intensive inputs an unattractive proposition.

In the short run, we assume that the planted--and, of course, the harvested--area is determined solely by the specific year's rainfall pattern within the constraints of the producer's capacity to marshal family (and perhaps some paid) labor. Thus, output and, hence, market surplus, is determined entirely by the weather, at least in the short run. However, in the long run producers in the higher rainfall areas who have access to additional land might be induced by moderately higher prices to invest in labor-expanding capital such as oxen and ox-drawn equipment.

For a country whose per capita GNP is estimated to be around 400 dollars and declining in real terms. Mauritanian wage rates appear to be relatively high. (Eicher (1982) observes that the high wage rates of West African countries are partly responsible for making the costs of producing rice non-competitive with the prices of imports.) The official minimum wage of 150 UM per day has been generally used in recent years to indicate the opportunity cost of rural labor in Mauritania. (During a field visit to Selibaby in November, 1982, the team was told that it costs 250 to 300 UM plus meals to hire an agricultural laborer). This state of affairs is believed to stem from the above-mentioned large-scale labor emigration and from the low real value of the nominal wage in ouguiyas when compared with the cost of everything but subsidized food-grains and with the black market exchange rate of the officially over-valued and inconvertible ouguiya.

It is entirely possible that substantial areas of rainfed land are not cultivated because of the absolute labor constraint and/or because they are economically sub-marginal for hand labor cultivation at present peak season labor costs. If this hypothesis could be empirically verified it might lead to renewed efforts to introduce--or reintroduce--animal powered technology in specific areas, supplemented by such ancillary services as would be required to assure economic viability and sustainability, such as storage and marketing, credit and above all, availability of equipment and trained animals.

In any case, this highly controversial subject requires thorough field-level research and insight into current and potential land use and the dynamics of peasant household decisions, as well as careful economic and social analysis of the phenomena. Two important facts must be taken into consideration: the support price for domestic sorghum is now twice as high as the landed price of imported red sorghum (13 versus 6.5 UM), and towards the end of the consumption year the market price of domestic sorghum tends to rise sharply. Any further increases in producer prices might have a socially regressive effect at the consumer level or might encourage the GIRM to continue subsidizing consumer prices.

## VII. CONCLUSIONS

To recapitulate briefly: Mauritania's development is severely handicapped by several sets of basic constraints: the hostile natural environment which has worsened during the second decade of the nation's independent history while population pressure has increased; certain deep-rooted, development-negative, socio-cultural traditions and a very low index of formal and vocational education; a quantitatively excessive and qualitatively deficient bureaucracy; the virtual absence of an indigenous entrepreneurial class and of a private industrial sector; and, finally, increasing reliance on external donations not only for basic food supplies and development capital but also for financing recurrent government expenditures.

Against this background, which has resulted, inter alia, in almost two decades of squandering of much external assistance on white elephants, the rhetoric of the Fourth Development Plan Outline (March, 1982 version) calls for a long-term (20 years) strategy that aims at greater economic independence--especially in food and education--and emphasizes the development of "our first resource, the human resource".

Within this long-term framework, the intermediate rhetorical goals for the five-year plan (which was to have begun in 1981) were fiscal austerity, consolidation and (where necessary) replacement of prior investments, and a "re-structuring" of the economic base, including reform or abolition of public enterprises as and where appropriate, etc. The "principal practical recommendations" for implementation of the plan are:

- investment policy favoring low capital intensity and high employment generation, and the "productive sectors" in general;
- limitation of foreign indebtedness in relation to export earnings;
- limits on the relative growth of the tertiary sector;
- "growth through decentralization of the people's and the private sector's participation in order to orient private savings towards productive activities";

- rehabilitation of the para-public sector by "reinforcing its management".

The major objectives for the rural sector are as follows:

- long-term development of irrigated farming and reconstitution of the livestock herd, as well as specific actions such as poultry development and promotion of fish consumption;
- environmental rehabilitation measures such as village reforestation and protection of infrastructure against sand invasion;
- improvement of rural living conditions and increased peasant incomes.

Priority, it is specified, will be given to participatory projects entailing the smallest possible outlay for recurrent costs. And, the draft asserts, while water and land resources are not the limiting factors, a number of juridical problems such as land, forest and water legislation, must be resolved.

In the domain of marine fisheries, the draft plan proposes to remedy the failure to date of the 1979 policies through "integrated development of a purely national, artisanal and modern fishery," on the basis of the same policies, i.e., abandonment of licensing of foreign fleets in favor of "the creation of mixed enterprises that market from Mauritania".

Except for the continued lack of realism with respect to fisheries,<sup>1/</sup> there seems to be little that an external donor or lender could object to regarding the ostensible development strategy, policies and proposed measures in the draft five-year plan. The real question--assuming such a plan were formally adopted--is to what extent the GIRM can be expected to implement them, or even at what level there is a real--as distinct from a rhetorical--political commitment to them.

Mauritanian policy makers are caught in a highly equivocal position: the rhetoric calls for political and economic "independence"; in reality, self-support for the Mauritanian economy is probably decades away. Economic and institutional efficiency are not improving, while economic dependence is increasing. Foreign donors, multi- as well as bilateral, carry their share of guilt for this situation: the game for each is to maximize the number and/or nominal value of "projects". Economic, financial and institutional analyses tend to be fictionalized. Separate Mauritanian bureaucratic structures are called for that cannot be adequately staffed or (without budget support) funded and that disappear overnight when the "project" is "completed". The GIRM's administrative agencies are so overloaded keeping track of project implementation in accordance with GIRM regulations, multiplied by those of the donor, that the few technically qualified civil servants have very little opportunity to practice their skills.

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<sup>1/</sup> See Fisheries Assessment.

Aside from the real white elephants--which, it is hoped, are a thing of the past at least as regards the creation of new ones--the majority of development projects seem not to make any impact or, what is worse, have the potential for a net negative effect. Expatriate advisers seem to be unanimous on this. Thus, a vicious circle is created where the gainers are the host country and donor bureaucrats and an occasional politician on both sides, and the losers are the disillusioned people of Mauritania and the taxpayers in the donor countries.

What are the implications for the future approach to rural sector development in Mauritania?

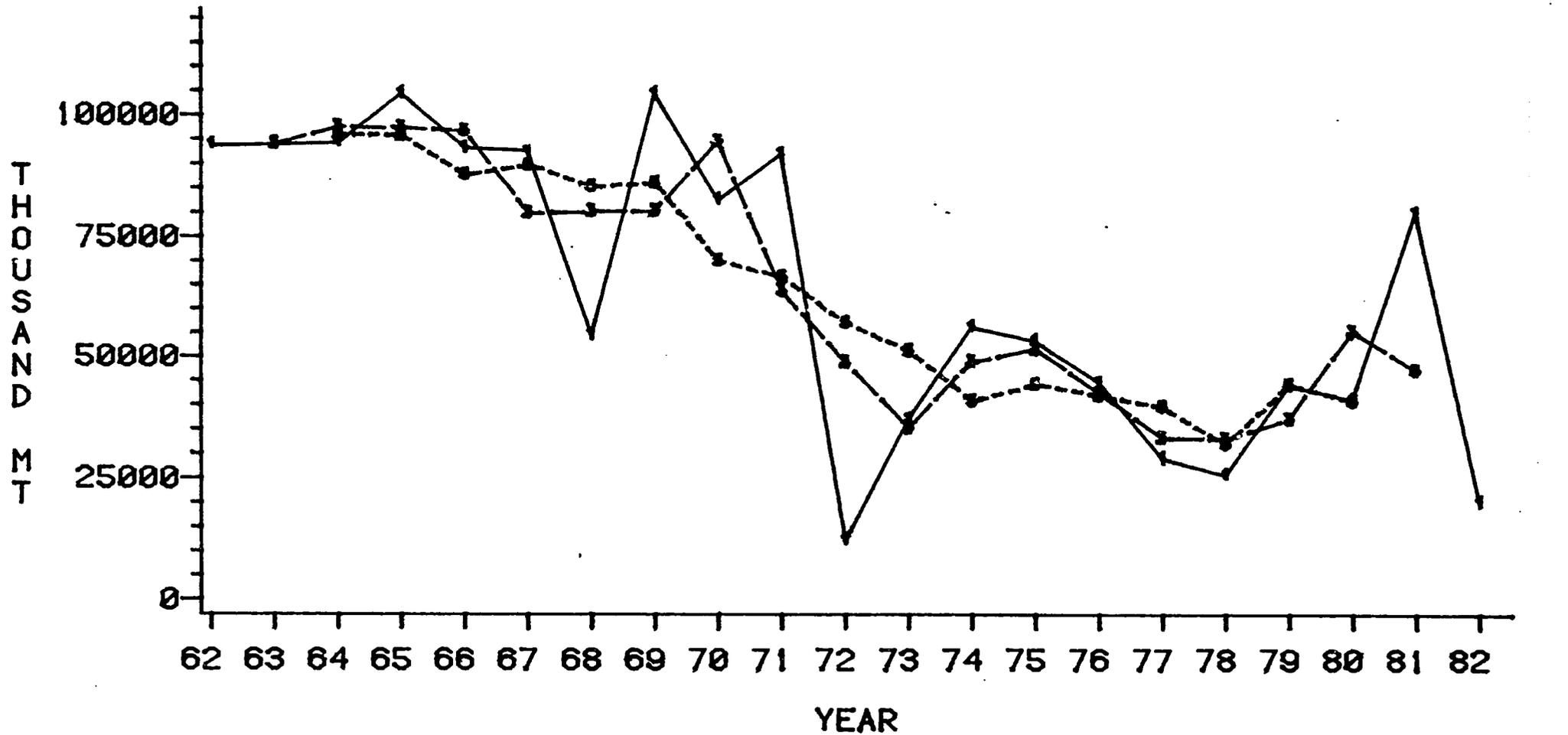
Above all, all concerned must face the probability that, for the foreseeable future, virtually all aid "projects" will show a low, or even negative, economic rate of return if they are conventionally--and honestly--appraised. From a national accounting point of view this can probably be justified in view of the fact that virtually all external financial inputs are grants or long-term soft loans, i.e., the average rate of interest of the imported capital is virtually zero. From the point of view of the external donor, the question, in purely financial terms, is whether the investment will, in the very long run, make it unnecessary for the donor to continue to grant food aid and budget support to Mauritania.

Adoption of an investment strategy in the rural sector implies some hard choices, not so much because of financial constraints but rather because the Mauritanian institutional resources should be concentrated on a small number of what promise to be the most rewarding--or the least disappointing--approaches. If the speed of the payoff were to be the overriding criterion, well-chosen investments in dryland area and yield increases would probably lead the list, provided enough idle or under-utilized land could be identified. However, such projects have a high built-in risk of not being viable economically; policymakers must therefore be prepared to subsidize such projects indefinitely in one way or another. Rehabilitation and completion of existing irrigation perimeters would come next; implementation is more complex because more sophisticated technologies and socio-economic mechanisms are involved, but the payoff is likely to be positive in a foreseeable future if the courage can be mustered to make all required investments and, if necessary, to subsidize producers for a previously specified number of years. A limited range of interventions in the livestock field probably come next, and reforestation and environmental protection are last because of the long gestation period, the low survival rates of plantings and the continuing uncertainties about the effectiveness--and even the need for--some of the techniques.

Additional investments in expansion of irrigation fall somewhere between investments in livestock and in forestry on the scale of payoff velocity, but they are doubtless the most cost effective investments in Mauritania in the long run. The risks to which they are exposed are principally man-made and their environmental risks are in principle correctible through human action. Moreover, small holder irrigated farming combines low environmental risk with high returns to land and high labor intensity.

Although experience to date in many public irrigation perimeters has been rather negative from a benefit/cost point of view, the problems can be overcome through better management and the application of human ingenuity.

**FIGURE 1**  
**CEREAL CROP PRODUCTION IN MAURITANIA**  
**1962-1982**

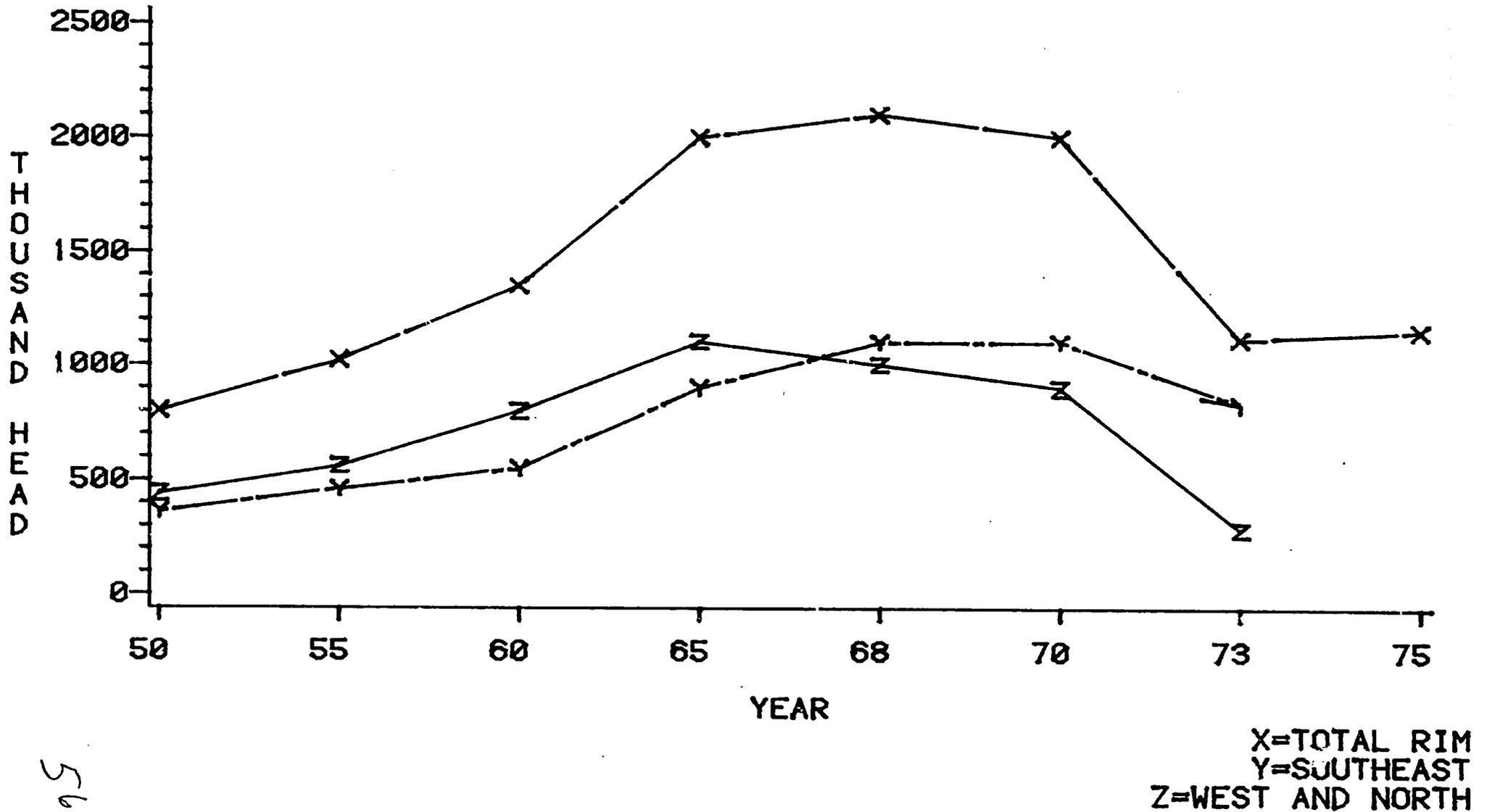


1=ANNUAL PRODUCTION  
 3=3YR MOVING AVERAGES  
 5=5YR MOVING AVERAGE

SOURCES: RAMS AS 1, PAGE 147, RAMS AS 4, PAGE 39  
 USAID 1981, 1982, CARR, 1982.

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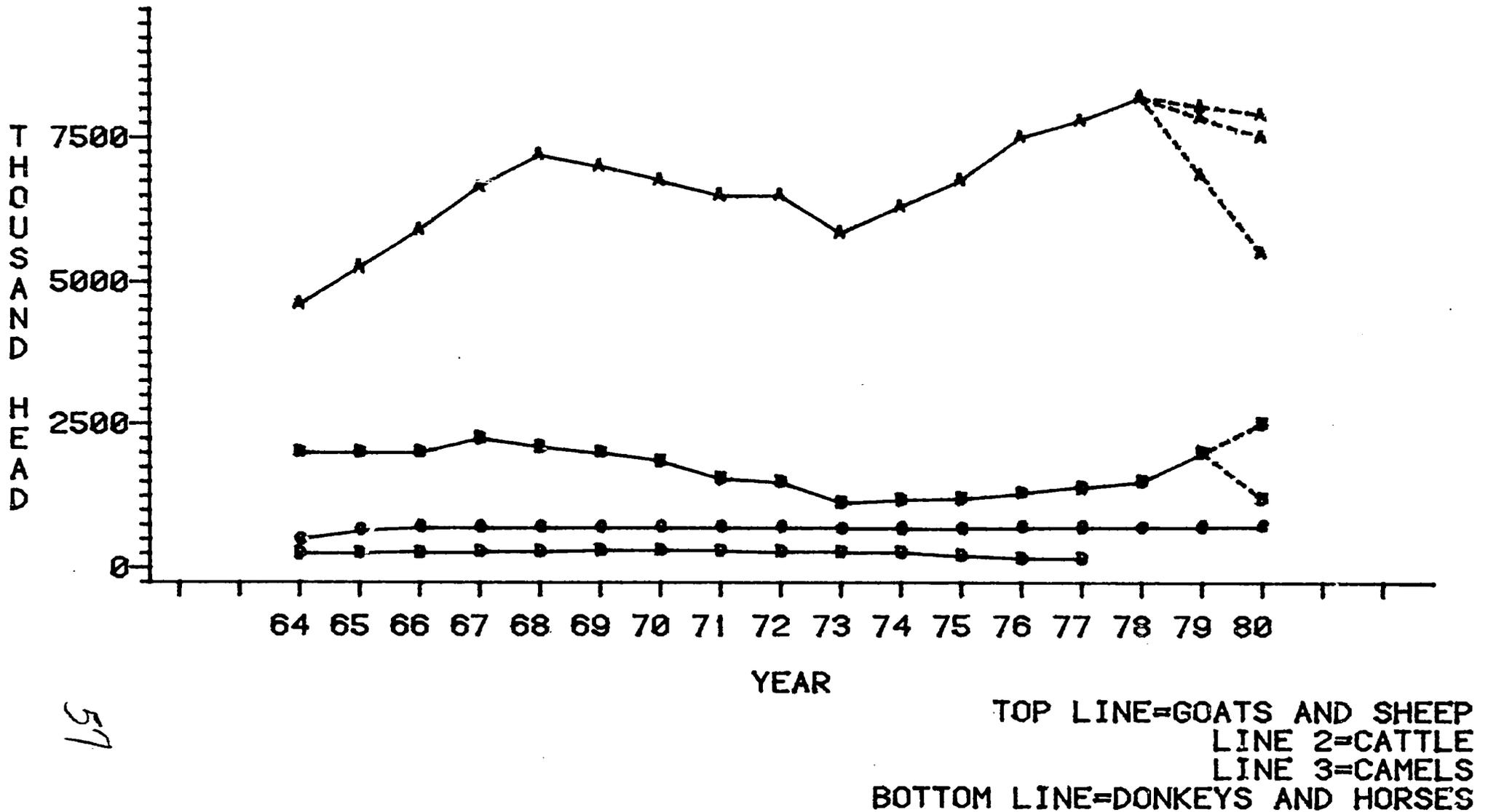
**FIGURE 2**  
**ESTIMATION OF CATTLE POPULATION:**  
**1950-1980**



SOURCES: RAMS

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**FIGURE 3**  
**ESTIMATION OF LIVESTOCK POPULATIONS:**  
**1964-1980**



SOURCES: P.AMS AS 1, PP.128,129. RAMS OP 5, P.78.

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