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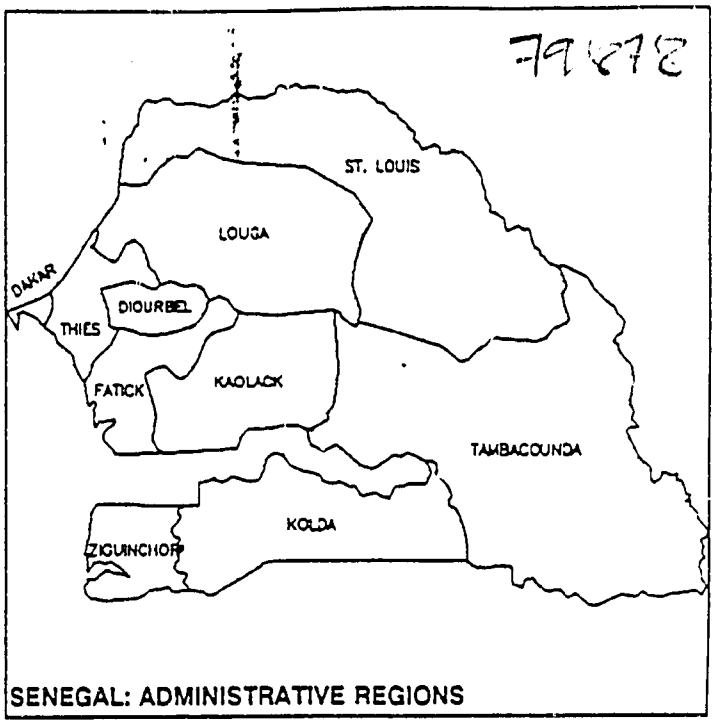
SENEGAL AGRICULTURAL SECTOR ANALYSIS



SENEGAL: ADMINISTRATIVE REGIONS

USAID/SENEGAL/ADO January 1991.

PREFACE

This report was prepared by the Agricultural Development Office, USAID/Senegal (ADO) as part of the analysis to support Mission's new development Strategy for Senegal. The principal author was Rod Kite, Chief, Agricultural Economics Division/ADO (supported by L. Thaim and M. Kieta of the Agricultural Economics Unit). Wayne Nilsestuen (ADO Office Chief), assisted by Jane Ellis, wrote Chapter V. The front office, Mission Director Julius E. Coles and Deputy Director Gary Nelson, and Mr. Nilsestuen provided guidance and council throughout the process. Several members of the Mission staff, especially Mission Program Officer Richard Greene, reviewed the report. Their support and assistance is greatly appreciated.

The Mission began this analysis in December of 1989, with the preparation of an extensive annotated bibliography. The bibliography was prepared through a USAID funded cooperative agreement between the USDA/OICD and the Department of Agricultural Economics, Michigan State University. The principal authors were Eric Crawford, R. James Bingen and Malcolm Versel. In June 1990, the Mission issued two short contracts: one to Dr. Crawford to develop a range of strategic and analytic options; and one to Dr. John Eriksen for an analysis of structural adjustment and the implications for agriculture, and the GOS/donor investment program. Finally, in August 1990, the Africa Bureau/Office of Technical Resources AID/Washington supported work by USGS/EROS to develop an analysis of land carrying capacity using population forecasts with land quality and land use information available at EROS. The Mission especially appreciates the support provided by Dick Cobb (Director/AFR/TR) and his staff and the people at USGS/EROS.

The analysis in the report focuses on crop based agriculture and forestry in Senegal; fishing and livestock are not treated in any detail. This does not reflect a judgement that these two sub-sectors are unimportant -- it reflects an early Mission decision that this analysis (and eventually the CPSP) would not deal with these two sub-sectors. The fishing sub-sector was excluded because there are already several donors with significant programs and because it was not felt that the United States had a comparative advantage in the sub-sector. Livestock was excluded because experience demonstrated that it is not an area in which USAID can operate effectively. The certainty that resources available for a new program will be limited also led the Mission to restrict the range of analysis.

This report includes several graphs and maps, all of the associated data have been collected into a separate volume "Agricultural Sector Analysis: Statistical Annex". Every attempt has been made to obtain the latest and most accurate data <u>but</u>, as often happens, different sources may have different values for the same variables, and the usual caveats about data quality and reliability apply.

Finally, this analysis and its supporting data base (the Statistical Annex) are intended to provide the basis for a "living" document, in that they will be under constant revision as new and better information becomes available.

SENEGAL AGRICULTURAL SECTOR ANALYSIS

EXECUTIVE SUMMARY

Senegal's population is rapidly approaching its resource limits. Resources are being mined in the attempt to keep up with this explosive growth. The preoccupation with providing an adequate food supply for ones family has seen a shift of land out of cash crops and into food crops to compensate for declining resource productivity and increasing population. The sixty percent of Senegalese living in rural areas have seen a decline of 4.6 percent per year in real per-capita cash income over the past 15 years. There is no modern industrial sector to absorb the surplus population, as the "modern" economy is predominantly service based, so the rural sector must take responsibility for its own future. The solutions to the rural decline in Senegal have to arise from arresting the decline in the productivity of the resource base, with efficient investment to maximize returns in the areas with the greatest potential. Yet, only 8.7 percent of planned investment in the sector is devoted to the forestry/natural resources sector and similar small amounts are targeted at investments in soil improvement and protection. Increasing the efficiency of increased investment in these areas is the challenge of an Agricultural Strategy for Senegal.

Senegal has lost control of two of its most basic and most fragile resources - land and forests. Even though the Groundnut Basin is Senegal's most intensely cultivated and most densely populated rural region, it has essentially been abandoned (at least in terms of investment). In addition, soil and forest management problems in the regions with the most agricultural potential (Tambacounda, Kaolack, Kolda and Ziguinchor) have been ignored. The soil resource has been "mined" to such a degree that it is incapable of producing enough food to feed the nation (often not enough to feed even the rural population). As the result of stagnant (at best) total production and a shift from cash to food crops, the real value of marketed agricultural output has declined by 2.5 percent per year since 1960. Cash income to purchase food to fill the production-consumption gap, to purchase health and education services, farm inputs and implements and to invest in better technology has declined. In the absence of a significant and sustained effort to improve efficiency and productivity, there is little prospect that Senegal's rural population can hope for improvement. Senegal's population already exceeds its sustainable level with respect to fuelwood (sustainable density 20 people/km^2 and an actual density of

35 people/km² -- in 1988) and it is able to produce only 55-60 percent of national cereal consumption. Given the current rate of growth in population, and the diminishing and deteriorating resource base, prospects for the future are not good. This analysis, therefore, concludes that a resource based development strategy is essential to obtain any improvement in the quality of life for the Senegalese people.

Between 1976 and 1988, the nation's population grew at 2.7 percent per year (2.1% for the rural population and 3.8% for the urban population). About 40 percent of the total population is urban; by the year 2000 the urban population will account for 44 percent of the total, which means more and more imported food, more food aid and other financial assistance. There is no expectation that Senegal can achieve food self-sufficiency, to the contrary, without serious productivity enhancing interventions, the day is rapidly approaching when Senegal's resources will not be able to support even its rural population. The increasing population has already forced a shift from cash to food crops as the expanding rural community adjusts to compensate for the population/resource imbalance to meet its own food needs; each active rural person currently cultivates one hectare per year, over one-half hectare below the 1.6 hectares each active person cultivated in 1976. The area each active person plants to food crops has remained about constant (0.6 hectares) - result has been lower cash crop areas. If the existing land base is not made more productive, the near-term result will be, first, very little cash crop production and then increasing food shortages in the rural sector.

The primary sector (crops, livestock, forestry, and fishing) represents about 20 percent of GDP in Senegal, extremely low for an economy with 60 percent rural population (clearly a structural problem). A disproportionate part of the economy is based in Dakar (55%), largely in the service sector which is in turn dependent on donor resources. It is not based on productive capacity. Yet, over 60 percent of Senegal's population (86% of the rural population) claim agriculture as their main profession. Thus, 60 percent of the population is participating in the generation of only 20 percent of national income and most of them derive their income either directly or indirectly from rainfed crops where production has, at best, been stagnant and erratic. Real prospects for growth in the both the rural and urban sectors are dim without growth in agriculture. While many of Senegal's resources must be classified as "moderate", this analysis has shown that possibilities for real growth in agriculture exist,

and that these possibilities are within reach, if appropriate measures are taken.

The cash crop sub-sectors ought to provide part of the answer for rural growth, except production is stagnating and the state owned industries are generating large deficits. The four groundnut oil mills are barely operating at 40 percent of capacity, and cotton (marginal in terms of overall contribution) is still highly subsidized. Major changes are needed before the traditional cash crops can contribute to economic growth in Senegal.

Untangling the political, social, environmental/resource and economic interdependence and ascribing cause and effect to eventually suggest solutions is not a simple task. But, in a broad context, certain facts are evident: the more the elements of a system are controlled and protected, the less controllable and more complicated the system. The policy to expand local rice production at any cost is a good example. The information presented in this report has shown that, without massive subsidies, Senegal cannot possibly produce rice competitively in the Senegal River Valley under current pricing and marketing policies. Measured according to domestic resource costs (DRC), it costs about three FCFA to replace one FCFA of imported rice. Yet, the majority of Senegal's investment in agriculture and the majority of its agricultural credit is focused on irrigated rice in the Senegal River Valley. Rice is the "wage good" in Senegal and is, thus, firmly attached to political and welfare issues. Rice represents over half of urban cereal consumption, and it already represents about 29 percent of the rural diet, moreover its importance has been increasing. Nationwide, rice is the most important cereal in the diet. Yet in 1989 (a relatively good year) Senegal produced less than 25 percent of national rice consumption. On the surface, there would seem to be three solutions to the basic problem: increased urban employment and incomes; increase production of cash crops with which to purchase more food; and increased production and consumption of local cereals.

Expanding local cereals production and consumption is an obvious part of the solution. There are potentials and there are constraints. The constraints can be eliminated (at least minimized) and the potentials can be exploited. The analysis has shown that, with appropriate policy changes, local rice can be grown and processed profitably at the village level. The analysis has shown that other cereals, especially corn, can be grown and processed by semi-industrial mills, if the distortions imposed by rice pricing and marketing policy are removed.

The analysis has also shown that in order to exploit this potential a larger market surplus must be generated and that consumption patterns must change.

The portion of the country with the majority of the rural population (Louga, Thies, Diourbel) has little room for crop land expansion and highly variable rainfall and, thus, highly variable production. Virtually all of this land is extremely susceptible to erosion, with little actual investment targeted to resource management. This, combined with the high rate of population growth, has a number of negative impacts:

- a steady decline in the area cultivated per agricultural worker;
- extension of farming to marginal land;
- a shift from cash to food crop cultivation; and
- an increasing food deficit.

Although there is some evidence that a few farmers have begun to place more land in fallow (to regain lost productivity because of low soil organic content and increasing erosion), there has been a general decline of soil productivity (3-5%/year), this is one of the root causes of stagnation in the rural sector.

That portion of the country with the greatest potential for expanded rainfed agriculture is the least populated (Fatick, Kaolack, Ziguinchor, Kolda and Tambacounda). This area possesses a wider range of development alternatives, but has, as well, some marketing/transportation and land/population management constraints. While this area contains some of the country's "best" land (Senegal has no land that would be classified as "good") a large portion of even this land is also susceptible to erosion, once the vegetative cover is removed. This region also has the largest forested area, but pressure from "mining" newly cleared land for crop production and to provide woodfuel (woodfuel provides 69% of the nation's energy) continues to place more and more land at risk. Exploitation for woodfuel alone can be expected to account for vast clearing. Because of its potential and because the soil and forest resources are at least not beyond recovery, this region is suggested as the primary geographic focus for a new USAID development strategy based on resource management and related agro-forestry programs.

In order for such a strategy to be effective, a basic change in the structure of the agricultural economy is required. Senegalese policy makers will have to demonstrate that they have the will to make the hard decisions necessary to nudge the rural economy into motion. The donors will have to help by financing appropriate programs to build and strengthen the national capacity at

both the administrative and producer level. Existing systems must be made more efficient (thus, the call for privatization in the rice and groundnut sectors and more flexible pricing systems for groundnuts and cotton) and alternative revenue sources must be exploited (edible groundnuts, cashew nuts, fruits and vegetables, agro-forestry). Existing soil resources must be improved and newly opened land must be protected: better soil and water management on existing farm land can improve productivity 30-40 percent; unless properly managed, newly cleared forest lands lose 50 percent of their organic content within two to three years. The cost in terms of lost output, and the potential in terms of added production, is large (it is reported that a one-tenth of one percent increase in soil organic matter increases millet yield by 145 kg/ha - about 10%). The impact is multiplied, a 10 percent increase in production would mean a 100 percent increase in marketable surplus (better food security for farmers, more money from marketing and a real chance to substitute local production for imported rice). Most of the income from marketing local cereals accrues to rural people (67%) while virtually all income generated from marketing imported rice accrues to urban merchants.

The incentive for farmers and processors to adopt new techniques and technologies has been one of the principal concerns of this analysis. The information available demonstrates that these "instruments" exist (the research system has already investigated many farm based techniques and technologies and food processing technologies are available). The analysis has also shown that the institutional system, while weak, has the capability of developing and delivering appropriate technologies to processors and producers.

An appropriate Agricultural Strategy for Senegal cannot be separated from a Population Strategy. The key is the balance between the population, the resource base and its productivity. In the agricultural sector, it is clear that the resources, even though marginal, can be managed more effectively and that productivity can be increased. This management for productivity requires that investments be redirected to support it; that policies be modified to encourage it; that technologies be proven to accomplish it; and that all of these be brought to the farmers of Senegal. This is not a simple agenda, but without this effort, the longterm decline in the resource base and rural incomes is assured.

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LIST OF ACRONYMS

ABP	Association Producteur de Base
ADF	African Development Fund
CCCE	French Bilateral Development Investment Agency
CDH	Horticulture research center (division of ISRA)
CEAO	Economic Community of West African States
CERP	Centre d'Expansion Rural Polyvalent
CIDA	Canadian International Development Agency
CNCAS	Senegalese Agricultural Credit Bank
CP	Cereals Policy (1986)
CPSP	Perequation and Price Stablization Commission
CRS	Catholic Relief Services
CSA	Senegalese Food Security Commission
CSS	Senegal Sugar Company
DAC	Direction de l'Action Cooperative
DERBAC	Projet de Developpemment Rural de la Casamance
DPCS	Direction de la Production et du Controle des Services
DPDA	Declaration of Agricultural Development Policy
DPV	Division of Crop Protection/MDRH
ECU	European Currency Unit
EEC(FED)	European Economic Community(European Development Fund)
ESAF	Enhanced Structural Adjustment Facility
FAC	French Bilateral Technical Assistance Agency
FAO	Food and Agriculture Organization
FCFA	CFA Francs
FED	European Development Fund of the EEC
Filieres	Commodity-based-agro-industrial networks, as in cotton or groundnut filiere
GDP	Gross Domestic Product
GIE	Economic Interest Group (Groupement d'Interet Economique)
GOS	Government of Senegal
GP	Producers Group
GTZ	West German Bilateral Technical Assistance Agency
ICOR	Incremental Capital-Output Ratio
IDA	International Development Association
IFC	International Finance Corporation
IMF	International Monetary Fund
IRA	Inspections Regionales de l'Agriculture
ISRA	Senegalese Institute for Agricultural Research
ISRA/CDH	ISRA Horticulture Development Center
KFW	West German Bilateral Development Investment Agency
MDRH	Ministry of Rural Development and Hydraulics
MEF	Ministry of Economy and Finance
MI/DAT	Ministry of Interior/Direction of Territorial Planning
MRA	Ministry of Animal Resources
NGO(ONG)	Non-Governmental Organization
NAP(NPA)	New Agricultural Policy (1984)
OMVG	Gambia River Development Authority
OMVS	Senegal River Development Authority
PAGRI	Programme Pilote d'Amelioration des Services d'Appui aux Agriculteurs
PASA	Agricultural Sector Adjustment Program

ACRONYMS (CONTINUED)

PNVA National Agricultural Extension Project (World Bank)
PRIMOCA Italian Integrated Rural Development Project in Casamance
SAED Public Enterprise for Development of Irrigation in the Senegal River Delta
SAF Structural Adjustment Facility
SAL Structural Adjustment Loan
SDA Secteur Departmental de l'Agriculture
SDR Standard Drawing Right
SECAL Sectoral Adjustment Loan
SODAGRI Societe de Developpemment Agricole Industriel
SODEFITEX Cotton Parastatal based in Southeastern Senegal
SODESP Livestock Parastatal based in the Ferlo area of Northern Senegal
SODEVA Societe de Developpemment et de Vulgarisation Agricole
SOMIVAC Regional Parastatal for Development of the Casamance
SONACOS Parastatal for Processing and Marketing of Edible Oils in Senegal
SV Section Villagois (a cooperative)
Systemes des Perequation
Systems for cross subsidization of losses in domestic agro-industries
URIC Parastatal industrial mills in the Senegal River Valley
USAID United States Agency for International Development
Verite des prix
Full-cost pricing

CHAPTER I
AGRICULTURE IN THE ECONOMY
GROWTH, INVESTMENT AND STRUCTURAL ADJUSTMENT

Between independence in 1960 and the end of 1989 Senegal's economy passed through several distinct phases. These phases are usually specified according to movements in macro-economic indicators of output, consumption and trade such as gross domestic product, final consumption, savings rates, investment and the balance of payments, and vary slightly, depending on the analytic focus. For the purposes of this Analysis major economic policy and/or program changes related to the agricultural sector have been used to separate movements in the economy into four periods.

The economy's performance has been dominated by the usual external, (generally uncontrollable) and internal factors. The external factors have been nature, world markets and external economic policy. The internal factors have been general economic and political philosophy and several specific economic policies and programs. This chapter will trace the major patterns in the economy, as influenced by major events, with the purpose of describing linkages and impacts to and from the primary sector (agriculture, livestock, fishing and forestry) and to some extent the secondary sector (manufacturing and mining). The focus is on economic growth in general, and the contribution of the primary sector in particular, to provide an overview of the macro-economy and the role and importance of the primary sector (agriculture, forestry, livestock and fishing) within the overall economy. More complete macroeconomic analyses may be found in [Berg, 1990], [Commander, 1989], and [World Bank, 1989].

Table 1

Real Gross Domestic Product by Period

Years	1960-1966	1967-1980	1981-1983	1984-1989	1960-1989
Sector	7	14	3	6	30
(Average Billion 1977 FCFA)					
Primary	91.6	113.0	117.7	125.9	111.1
Secondary	61.5	93.1	129.9	151.4	101.0
Tertiary	145.5	175.5	202.9	228.5	181.8
Salaries	47.3	54.4	79.6	86.0	61.6
Admin.	43.6	50.5	73.1	77.4	56.5
Workers	3.7	3.9	6.5	8.7	5.1
Total	345.9	436.0	530.1	591.8	455.5
Per Capita	100,951	93,684	90,269	89,357	94,173
(Percent of Total)					
Primary	26.5	25.9	22.2	21.3	24.4
Secondary	17.8	21.3	24.5	25.6	22.2
Tertiary	42.1	40.3	38.3	38.6	39.9
Salaries	13.7	12.5	15.0	14.5	13.5
Admin.	12.6	11.6	13.8	13.1	12.4
Workers	1.1	0.9	1.2	1.5	1.1
Total	100.0	100.0	100.0	100.0	100.0
(Average Percent Change Within Period)					
Primary	3.4	2.1	8.0	0.9	2.7
Secondary	4.4	3.6	7.6	3.2	4.1
Tertiary	3.9	1.4	3.6	2.3	2.4
Salaries	2.5	3.0	5.1	0.9	2.7
Admin.	2.6	3.0	5.3	0.3	2.6
Workers	1.3	4.0	2.8	7.4	3.9
Total	3.3	1.8	5.7	1.9	2.6
Per Capita	0.3	-1.0	2.9	-0.8	-0.3

Source: Calculated from Table 1 Annex 1.

MAJOR PHASES

Senegal was one of the African states which opted for "African Socialism" at independence in 1960. The over-riding philosophy was that the state, and especially an enlightened bureaucracy, would manage the economy for the benefit of all its citizens. This philosophy translated into extensive price controls, subsidies and state owned and managed industry. This general philosophy was in effect from 1960 through 1983, when the first real attempts at structural adjustment began. The period following 1983 is characterized by extensive state disengagement and general economic liberalization.

The economy underwent a series of severe shocks between 1960 and 1984. Some of the shocks were created by policies and politics outside Senegal, for example the French suspension of preferential treatment for groundnut oil in 1966 and OPEC policy. Some of the shocks were created by nature - average rainfall in the peanut basin declined from 635 mm for 1960-1966 to 376 mm over the period 1981-84, and there were severe insect infestations in several years. Some of the shocks were the result of policy, program and sometimes management problems: in the agricultural sector the Programme Agricole, under ONCAD, generated 142 billion CFA in deficits; agricultural credit was forgiven four times and even suspended for four years between 1981 and 1984; the state undertook a series of nonproductive investments as part of the Senegalization process, as it purchased previously French owned businesses and began to create numerous parastatals (the number of public enterprises increased from 21 in 1962 to 83 in 1977). The result, as shown in Table 1, was an economy which was subject to substantial instability; in per capita terms growth was marginal (and often negative) with the result that on the average real per capita income declined 0.3 percent per year over the 1960-1989 period.

THE PRIMARY SECTOR: PATTERNS AND TRENDS

Growth in primary sector gross domestic product has also passed through four distinct periods. The trend in real GDP generated in the primary sector over these periods, along with an indication of the periods covered by the major policies and programs are shown in Figures 1-A and 1-B.[1]. In summary they are:

I. (1960-1966): Seven years of stable growth in a range of 2.5 to 4.5 percent per year.

This period begins with independence and is marked by good weather, the initiation of the 20 year "Programme Agricole", and preferential treatment for exports (especially peanuts) by the French.

An extensive cooperative system was created, almost exclusively concentrated on providing credit and inputs to the peanut producing regions and peanut marketing. By 1963 about 80% of the cooperatives had been established. They were controlled and managed by state agents. Even at the outset loan repayment rates were low (68%).

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[1]The data shown in the Figures are two year moving averages and are thus "smoothed" to compensate for year-to-year fluctuations. This is done to adjust for farmers' tendency to alternate between millet and groundnuts.

II. (1967-1980): Thirteen years of widely fluctuating output and building sector deficits.

This period begins with the loss the French preferential treatment for groundnut exports in 1967 and ends with the termination of the "Programme Agricole" in 1980. It encompasses the creation, growth and eventual dissolution of ONCAD, the creation of 83 regional development authorities and other state owned and operated agencies, Senegalisation of the economy, several bad weather years - including forgiveness of agricultural credit, growth and eventual discrediting of state controlled cooperatives, and the world wide commodity crisis.

The cooperatives were under the control of ONCAD, which was also responsible for the purchase and sale of agricultural commodities, determination of cooperative credit and input needs and their pass-through to cooperatives. By 1970 there were 1870 cooperatives with 1060 specific to groundnuts.

ONCAD staff increased from an initial level of about 450 to over 2900 in 1979, when personnel costs accounted for about half of the ONCAD budget. Credit repayment rates fell to 48% in 1970 (agricultural credit was forgiven three times in the 1970's and again in 1980 when ONCAD was dissolved).

ONCAD debt was estimated at 75 billion CFA by 1980 (142.4 billion by 1983).

III. (1981-1983): Transitory stage and the beginning of stabilization - crisis.

SONAR was created to replace ONCAD, all agricultural credit was suspended, deficits, partly from ONCAD and now from SONAR built to crisis levels and SONAR was dissolved.

SONAR's main function was the provision of seed and fertilizer to the groundnut sector. SONAR deficits accumulated to 27.4 billion CFA between 1981 and 1984.

The World Bank's first Structural Adjustment Loan (SAL-I) was approved in December 1980. The SAL-I program was aimed at improving parastatal efficiency, increasing producer and exporter incentives, raising productivity of investments, containing urban consumption and a wide range of institutional and policy reforms in the agricultural sector.[2] SAL-I was considered a failure because of two bad weather years (1979/80 and 1980/81); because it was based on inaccurate and incomplete information (debt and arrears were much higher than originally thought); because of excessively optimistic forecasts; and because of GOS action (or inaction). Virtually no progress was made in agricultural policy reform. High world groundnut prices led the GOS to increase the producer price by 43% in 1981 and, when world prices fell in 1982, the deficit exploded. The second

[2]The specifics of the various structural adjustment programs are discussed in detail in, The World Bank and Senegal, 1960-1987, World Bank, August 31, 1989, pg 21.

tranche of SAL-I was postponed and the outstanding balance was canceled in June, 1983).

IV. (1984-1989): Stabilization and structural adjustment period.

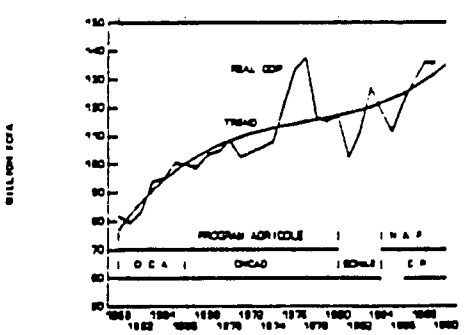
The New Agricultural Policy (NAP) was formulated and initiated in 1984; the Cereals Policy (CP) was formulated in 1986; state disengagement began; weather returned to near "normal"; an emphasis was placed on privatization and elimination of subsidies and price controls; sectoral growth began to recover. As part of the NAP fertilizer subsidies were reduced and then eliminated in 1988 and price and marketing controls on cereal grains (except rice) were eliminated.

V. Present:

In 1989 the GOS and four of the major donors began discussions which are expected to lead to a structural adjustment loan for agriculture ("Programme d'Adjutement Structurel Agricole" - PASA). The government of Senegal produced its newest statement of development policy (DPDA - "Declaration de la Politique de Developpement Agricole"). This statement, combined with the conditionality under SAL-IV, will complete the privatization/liberalization process. The DPDA and the donor/GOS dialogue will be discussed in more detail later.

Figure 1-A

Real Primary Sector Gross Domestic Product
(1977 FCFA and Quadratic Trend)

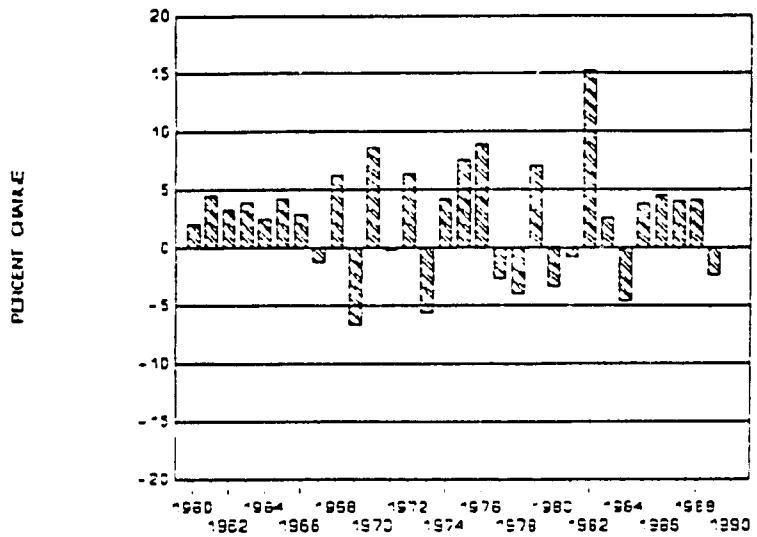


Note: CP = Cereals Policy; NAP=New Agricultural Policy;
See the list of acronyms for names of the various institutions.

In general, the primary sector is characterized by extreme output variation, especially during the 70's and 80's. The reasons have already been enumerated: bad weather, variable world prices and policy and program implementation. All of this is shown very clearly in Figures 1-A and 1-B. Information presented later in the report (Chapter II) will show that there is another and very serious factor - declining productivity, which has resulted in an apparent reduction in the "importance" of the primary sector in the general economy.

Figure 1-B

Percent Change in Primary Sector GDP
(Constant 1977 CFA)



Source: Annex I Table 1

SECTORAL SHIFTS AND THE IMPORTANCE OF THE PRIMARY SECTOR

Although the primary sector has declined in importance relative to the other sectors (from 26.5 percent of real GDP during 1960-66 to 21.3 percent over 1985-89), it continues to generate much of the variation in economic growth, a large part, but not all, of which can be attributed to rainfall variation. It is also important to remember that the groundnut oil mills contribute around 12 percent to the secondary sector (3% of the total in 1988) and that overall agriculture provides raw materials for about 30 percent of Senegal's industry [MAPS Phase II, pg 7, 1990].

Dakar and the nearby areas dominate economic activity in Senegal, largely because of the concentration of administrative, secondary and tertiary activity. Recent data are not available, but for the 1981-84 period this area accounted for 55 percent of national GDP [MDR, 1986, pg 8]. Although the primary sector only accounts for about 21 percent of total GDP, 44 percent of GDP generated outside the Dakar area is attributed to the primary sector. Given this highly skewed economy, it is not surprising that over one-third (37%) of the permanent

markets are located in Dakar, or that Dakar has over 80 percent of the registered merchants [Ministry of Plan, 1989, pg 35].[3]

A part of the development "problem" for Senegal is that, despite the dominance of the major urban center in overall economic activity, the greater portion of its people are employed in its most volatile sector - agriculture. The rural sector accounts for two-thirds of Senegal's total active population and 60 percent of Senegal's active population lists agriculture/transformation as their profession (Table 2).

Table 2

Professions of Senegal's Active Rural and Urban Population (1988)
(Thousands and Percent by Profession)

Profession	Number (000)			Percent		
	Total	Rural	Urban	Total	Rural	Urban
Management	16.0	1.3	14.7	0.7	0.1	1.8
Education	23.9	1.9	22.0	1.0	0.1	2.7
Technician	103.4	18.5	84.9	4.4	1.2	10.5
Commerce	119.7	40.2	79.5	5.1	2.6	9.8
Agriculture	1,438.3	1,346.8	91.4	60.7	86.4	11.3
Production	260.9	56.2	202.8	11.0	3.7	25.0
Labor	79.4	24.1	55.3	3.4	1.5	6.8
Sales/Servic	326.7	67.0	259.7	13.8	4.3	32.0
Total	2,368.3	1,558.0	810.3	100.0	100.0	100.0

Source: 1988 Population Census, Table 5.06

Even among the urban population, agriculture ranks relatively high (11% of the total active urban population, the fourth highest ranked profession). While the Census data with respect to women probably has some definitional problems, it still helps to establish a perspective. According to the 1988 Census, 26 percent of the active population was female and 63 percent of the active female population had "agriculture" as a profession.

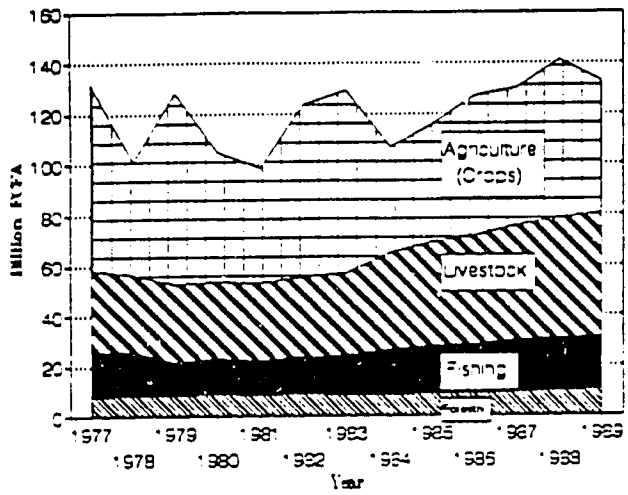
The larger part of GDP generated in the primary sector comes from crop based agriculture and livestock; the two together accounted for over 75 percent of primary sector GDP in 1989. The shares of the four sub-sectors in the primary sector (agriculture, livestock, fishing and forestry) vary considerably over time, depending on rainfall and crop production. However, as shown in Figure 2, there has been a tendency for the livestock sub-sector to gain share while

[3] The importance of Dakar and particularly the tertiary and administrative sectors in Dakar emphasize Senegal's dependence on donor financing. Although it is not appropriate to attribute all of the economic activity in Dakar to donor financing, neither is it inappropriate to suggest that a large part of that activity is generated by donor financing.

the fishing and forestry sub-sectors have remained relatively stable. Also, although there has been a slight positive trend in total primary sector output (in real terms), the total in 1989 was only a little above the total in 1977. This points to the major focus of this analysis, the potential for improving the rate of growth in the primary sector, with the emphasis on crop based agriculture. This does not mean that the other sub-sectors have less potential nor that they are unimportant. The Mission decided from the beginning that because of relative comparative advantage and other donor involvement, livestock and fishing would not constitute a part of this analysis.

Figure 2

Real GDP in the Primary Sector, by Sub-Sector
(Billion 1977 FCFA)



Agricultural exports, crop marketing in general, and food aid are discussed in some detail in Chapter IV of this report - only a brief summary will be given here. As would be expected, given price and weather variation, earnings from crop exports in the 1980's have shown a lot of variation. The value of crop exports varied from a low of about 20 billion FCFA in 1980 to a high of 65 billion in 1983 and 1984, for an average of 40 billion FCFA (21% of the value of all exports - for comparison, exports of fish and fish products acounted for almost 23% of the total, so the primary sector has averaged about 44% of export earnings). Within the crops sub-sector, groundnuts and products accounted for almost 81 percent of the crop total (17% of all export earnings), cotton for 12 percent and fruits and vegetables for 7 percent.

Food aid has effectively filled the gap between domestic production, commercial imports and national food requirements. Virtually all commercial imports are through a state agency - CPSP. Food aid imports are programmed by a joint GOS/donor committee, which meets after the first food production

estimates are available (November) and most of the currency generations are programmed by a joint institution, the Common Fund. With the exception of crisis years, food aid has amounted to around 10 percent of total food grain imports. Since considerable care is taken to limit food aid to the "gap", food aid, itself, is not a big issue in Senegal. Currency generated has, generally, been used to support local cereals marketing and processing (the Common Fund) and to assist the GOS in covering costs associated with policy reform (the PL 480 self-help measures). The role of the state in importing and distributing cereals (essentially rice) is an issue and is the subject of an active dialogue between the GOS and the various donors. This is discussed at greater length in Chapter IV.

Structural Adjustment, Investment Priorities and the Policy Dialogue [4]

The earlier discussion summarized some of the history of policy and economic adjustment activity in Senegal. Given the relative stagnation of the sector, in terms of real GDP, these interventions can be judged to have been only moderately successful. Growth has been very low and highly variable - there are still serious constraints. Current GOS policy, as defined by the 1984 "New Agricultural Policy", the four SALs and more recently by the DPDA and the donor/GOS dialogue in preparation for the Agricultural Sector Adjustment Loan (PASA), is aimed at relieving many of the constraints which have contributed to the present status of the sector.

Structural Adjustment: the Impact

Since 1983 the Government of Senegal has been implementing a package of structural and macroeconomic policies. The adjustment process is now operating under the Medium and Long-Term Structural Adjustment Program (1984/85-1992/93). During the period 1983/84 to 1989/90 the Government of Senegal has taken steps to:

- Liberalize the national economy;
- Reduce agricultural and industrial production distortions;
- Strengthen public investment programming;
- Initiate reform of the public enterprise sector;
- Reduce its overall fiscal deficit;
- Pursue an appropriate credit policy; and
- Put in place a prudent external debt management policy.

The macroeconomic policies implemented have contributed in some measure to a revitalization in the national economy; to a dampening of inflationary pressures; and to strengthening of the country's external sector position.

[4] The material in this section of the report is taken from [Eriksen, 1990]. Much of the text is verbatim, but in some cases it has been edited and/or re-arranged.

However, as has been the case since independence in 1960, Senegalese economic planning at all levels continues to be significantly affected by exogenous factors -- chiefly the spatial and temporal distributions of annual precipitation and its effects on crop and livestock production and agro-industrial activity; and, to a lesser extent, secular trends in world prices for Senegalese exports.

The adjustment period in question, therefore, can be broken down in three distinct sub-periods during which factors exogenous to the adjustment process -- i.e. annual rainfall distributions over the entire period and, more recently, locust invasions and civil disturbances -- affected the economy. From 1983/84 to 1984/85, there was a drought-related decline in economic activity which set the tone for the effective start of the current adjustment program. From 1985/86 to 1987/88, Senegal had a period of relatively good rains and, as a consequence, real gross domestic product (GDP) grew at an average annual rate of 4.2 percent, substantially exceeding a population growth rate estimated at 2.7 percent.

In 1988/89, the economy was once again adversely affected by poor rains and locust invasions causing subsequent declines in agricultural production and related agro-industrial and trade activities. This situation has been made more difficult by civil disturbances arising from difficulties between Senegal and neighboring states and from domestic interest group reactions to the strictures and uncertainties imposed by the structural adjustment process. As a consequence, 1989/90 has been a year of economic recovery with increased domestic tensions, necessitating some reformulation of the content and timing of key macroeconomic targets in the adjustment program.

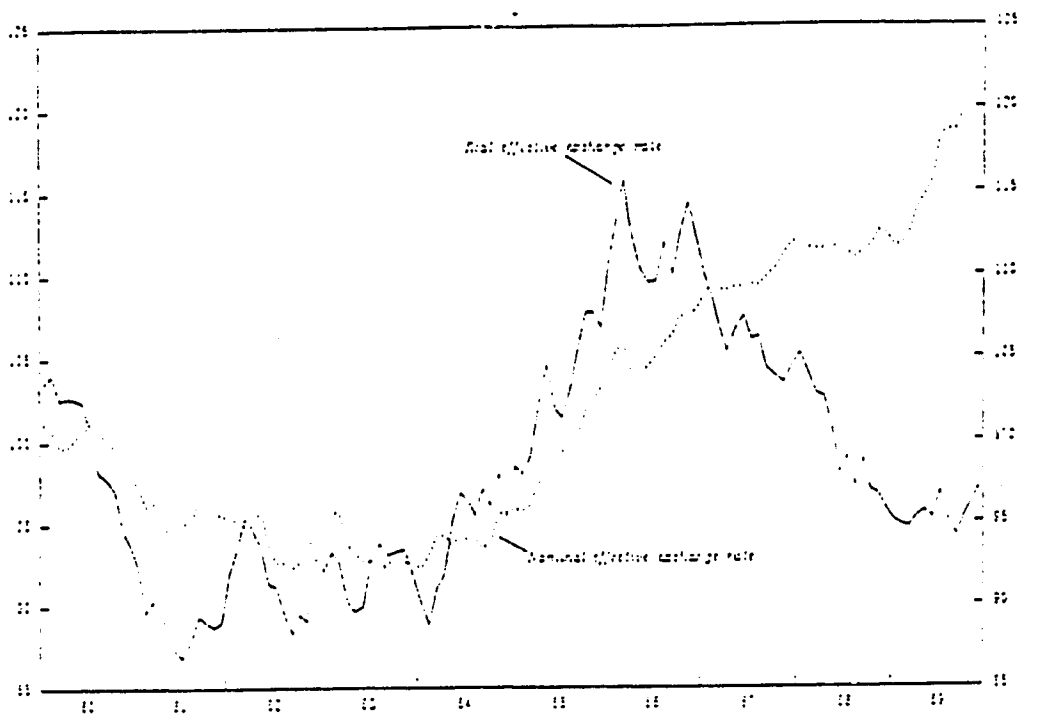
According to recent appraisals from the IMF (March 1990) and the World Bank (November 1989), the Senegalese macroeconomic structural adjustment program is "broadly on track". The government is still pursuing a two-pronged economic strategy focussed on the promotion of private sector activity and the strengthening of public resource management. This strategy continues to aim at achieving an average annual rate of growth of real GDP of 4.0 percent; containing the rate of inflation, as measured by GDP deflator, at 2.3 percent; and reducing the external current account deficit, excluding official grants, to 6.1 percent of GDP by 1991/92. Taking into account the programmed reduction in the external Treasury financing requirements from CFAF 97.9 billion in 1989/90 to CFAF 35.0 billion in 1991/92, the balance of payments would record surpluses, excluding debt relief, starting in 1990/91.

In general, the structural adjustment program has been reasonably successful in introducing a greater measure of stability into the economy in the second half of the decade. In addition, given that Senegal as a member state in the West African Monetary Union has essentially no direct control over its currency and cannot resort to direct devaluation of the CFA Franc (FCFA) as a policy instrument in its structural adjustment program, the government through resort to second best measures -- i.e., tariff protection and other controls on imports, limited export promotion, measures to dampen inflationary tendencies, and general tightening in monetary and fiscal policies -- has at least succeeded in forcing a decline in the real effective exchange rate. This decline has now

reached the point where the distortions created by overvaluation are, at least, no worse than they were at the beginning of the decade (Figure 3)[5].

Figure 3

Nominal and Real Effective Exchange Rates (1980-1989)
(1980=100)



In addition to the general macroeconomic improvements induced by the structural adjustment program, several elements bear directly on the agricultural sector:

- changes in the regulatory environment affecting commercial marketing of agricultural inputs and outputs;
- efforts to stimulate greater private sector participation in the sector;

[5]Measures necessary to adjust for the overvaluation have been a part of the dialogue associated with the development of the PASA -- especially as related to imported rice. There are those who do not agree that adjustment has "worked" and who argue that it is to early to pass judgement. See [Berg, 1990].

- reforms of and reductions in the scope of public enterprise involvement in the economy;
- price policies affecting the terms of trade and mitigating disparities in income distribution between rural and urban inhabitants; and
- greater effort by government to improve its allocation of budgetary resources to sectoral activities and eliminate or defer low priority expenditures in conformance with the strictures of the macroeconomic program.

In the agricultural sector, the most significant improvements of the decade have come in the following areas:

- Deregulation of domestic coarse grain markets (except rice);
- Elimination of subsidies on most agricultural inputs (except SODEFITEX);
- Reduction in public enterprise involvement in sector activities and greater enforcement of financial accountability through management contracts;
- Willingness to use agricultural price and trade policies to affect improvements in terms of trade and income disparities; and
- Greater restraint in and scrutiny over allocation of available budgetary resources, coupled with greater transparency in accounting procedures.

In sum, then, as a result of progress with the structural adjustment program, agricultural markets in Senegal -- with the principal exception of rice, groundnuts, and cotton -- are subject to significantly less government intervention and control than was the case before the mid-1980s.[6]

Allocative distortions in use of agricultural inputs flowing from government subsidy programs have essentially been eliminated -- with the sole exception of inputs distributed through SODEFITEX for cotton and maize -- and even these subsidies are to be eliminated in 1993. As a result, farmers' use of most purchased inputs has declined significantly but residual input use is almost certainly being allocated more efficiently.

Some of the largest and most deficient agricultural public enterprises have been disbanded and others are scheduled for privatization or elimination before the end of 1991. Management contracts, organizational and financial restructuring, reductions in force, and other cost savings have been effected in many of public enterprises remaining and the government has pledged to continue and accelerate these activities under SAL IV and its agreements with the IMF.

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[6] The problem is, according to Berg [1990], that many of the adjustment measures have not been implemented so adjustment has been delayed.

Government use of agricultural prices, monetary and fiscal restraints, and trade policies in the 1980s appear to have benefited the rural populace more than the more affluent, urban population. Increases in nominal -- if not real -- agricultural prices for major commodities probably improved rural incomes relative to urban ones, where real incomes in the formal sector were declining significantly over most of the decade. That is to say, the rural/urban terms of trade has improved - but both are worse off. And, government restraints on the importation of rice limited to some extent the negative effects of these importations on domestic cereals prices, marketing and consumption.

Some progress toward restructuring the economy has been made, but many of the more difficult adjustment decisions remain -- especially in defining and implementing explicit adjustment programs in agriculture. The World Bank's latest Structural Adjustment Loan (SAL IV) and the PASA now being discussed will help to implement some of these difficult decisions.

Policy Dialogue: Agricultural Sector Adjustment

The first three structural adjustment programs were aimed, generally, at deficit reduction and improving Senegal's balance of payment status. While all of the SAL's also included market liberalization, privatization and reorganization of para-public institutions, SAL IV and the discussions which are expected to lead to an Agricultural Sector Structural Adjustment Loan will extend the "adjustment" process with significantly more privatization and market liberalization.

The SAL IV agreement signed in February 1990 is the most complete, recent, statement of negotiated policy commitments with a detailed agenda of actions to be taken, and a timetable for their execution[7]. Annex I presents the most complete summary available of the actions negotiated and the time frames adopted for macroeconomic and structural adjustment policies for the period 1989/90 to 1991/92. The agricultural sector policy reform commitments made by the government have the objectives of:

- Expanding and diversifying production;
- Increasing net sectoral contribution to public finances; and
- Narrowing price distortions.

The government commits itself to pursuit and development of the reform process envisaged in the New Agricultural Policy, specifically including gradual

[7] The principal sources of information relevant to this objective are recent Government of Senegal statements of intent with respect to structural adjustment and the agricultural sector -- i.e., the Declaration de Politique de Developpement Agricole (Republique du Senegal, Decembre 1989) and its follow-up Plan d'Actions (Mai 1990); and the Lettre de Politique de Developpement Quatrieme Programme d'Ajustement Structurel (SAL IV) (Republique du Senegal, 29 Decembre 1989). These documents are supplemented with records of commitments made to the World Bank and the IMF in the context of the SAL IV and the Enhanced Structural Adjustment Facility - - i.e., Senegal: Policy Framework Paper, 1989/90-1991/92 (World Bank, 15 November 1989) and Senegal - Midterm Review Under the Second Annual Arrangement Under the Enhanced Structural Adjustment Facility (IMF, 16 March 1990) -- as they pertain to the agricultural sector. Finally, other information related to the on-going multi-donor/GOS negotiations over the proposed World Bank SECAL and the allied bilateral donor programs was reviewed.

elimination of price distortions and subsidies and disengagement of government from productive and commercial activities.

In the cereals sub-sector, a commitment is made to promote substitution of domestic coarse grains for imported rice. And, to move toward a less costly and more sustainable policy for irrigation. The major elements foreseen to achieve these commitments are:

- Testing suitable technologies at different scales of production;
- Setting criteria for adjusting price(s) of imported rice to provide an adequate degree of protection for local cereals;
- Rationalizing the domestic pricing of rice;
- Developing capacity within the Ministry of Rural Development to use and improve agricultural pricing models; and
- Implementing the third Lettre de Mission of SAED relating to phased disengagement from productive and commercial activities, full-cost pricing of irrigation water for farmers benefiting from double cropping, and autonomy and privatization of rice milling activities.

In the groundnut sub-sector, the overall objective is to reduce the sub-sector financial deficit. These is to be done through:

- Rationalizing the groundnut processing capacity of SONACOS -- the parastatal oil groundnut processing company;
- Adopting a flexible system for determination of producer prices for oil groundnuts in line with world market conditions;
- Executing a technical and financial study of SONACOS and instituting a system of regular independent audits;
- Revising the protocol between SONACOS and the government;
- Strengthening the guarantee fund for groundnuts to monitor the financial performance of SONACOS and associated enterprises; and
- Privatizing the commercialization of confectionery groundnuts.

In the cotton sub-sector, the overall objective is to reduce the cost to public finances. This is to be accomplished through the preparation of a recovery program for SODEFITEX -- the parastatal cotton company -- to include technical performance criteria, internal economy measures, and the progressive reduction of subsidies on inputs provided to farmers.

In the sugar sub-sector, the objectives are to reduce the cost of producing domestic sugar and reduce the cost to the CSS -- the private monopoly sugar company. These objectives are to be accomplished through:

- Preparing a plan of action to further increase productivity at the CSS;

- Renegotiating the agreement on the determination of domestic sugar prices; and

- Linking the reference price for local industrial sugar users to world market prices.

A commitment is made by government to increase the sustainability of the rural credit system. The major actions are envisaged:

- Drawing up a plan for the reform of the agricultural credit system;

- Opening the capital of the CNCAS -- the national agricultural credit bank -- to private participation and increasing its commercial autonomy; and

- Preparing a program for recovery of overdue loans and advances; setting up an analytical accounting system; and instituting annual external audits for the CNCAS.

Crop diversification and export promotion are to be pursued through development of cash crops for domestic consumption and export and stimulation of domestic and foreign investment for the development of high-yield crops. The government is to prepare a plan of action to promote crop diversification, including steps to facilitate the marketing and export of fruits and vegetables.

Improving the land tenure system and reducing administrative obstacles to the productive use of land is also an element of the sectoral program. This objective is to be forwarded by:

- Defining and introducing an initial series of studies, consultations, and specific measures designed to improve the land tenure system;

- Reviewing regulations and administrative systems governing the allocation of irrigated land in the Senegal River valley to foster more intensive land use; and

- Preparing and introducing a new rural code.

Supplementing the commitments made in land tenure reform, the government is to develop national and region-specific approaches to the productive management and conservation of natural resources. It is to set up an administrative framework for implementing and evaluating pilot natural resource conservation and management activities.

Finally, the SAL program aims at strengthening the policy-making capacity of the Ministry of Rural Development by establishing a small strategy unit within the Ministry to program and implement agricultural policies.

In addition to commitments made by government to agricultural sector reforms, proposed reforms in two other areas -- i.e. parapublic sector reform and investment programming -- will have significant impacts on the sector if implemented.

Under the parapublic sector reform, the government is committed to privatize 35 parapublic enterprises and to liquidate an additional 10 enterprises

by the end of 1991. In line with this commitment, a list of target enterprises to be privatized -- or, in the event of non-sale, liquidated by the end of 1991 -- has been drawn up. Agricultural enterprises included on the list include: SENPRIM, the Projet Fruitier de M'Boro, CNCAS, SEPFA and SONACOS. In addition, SOMIVAC and SEIB (the groundnut mill in Diourbel) were scheduled for outright liquidation by 30 June 1990.

Other parapublic enterprises not subject to privatization and/or liquidation are to be the subjects of cost reviews, reductions in force, regular external audits and stricter management contracts with the government.

Finally, the investment programming is to be tightened considerably under the structural adjustment program. Actions to be taken in this regard include:

- Adopting an annual public investment program in the context of a three-year rolling public investment program;
- Rationalizing budget preparation and ensuring close coordination of the ministries involved;
- Transferring responsibilities for project identification and preparation to certain technical ministries;
- Adopting and periodically reviewing sector investment strategies;
- Adopting a uniform approach to project preparation and appraisal;
- Consolidating the investment outlays financed by foreign grants and loans with the regular budget monitoring and expenditure control processes; and
- Improving the monitoring of projects.

Current Dialogue

Current dialogue relative to agricultural policy revolves around development of an Agricultural Sector Adjustment Loan (PASA after the French title). This dialogue is being pursued jointly by the World Bank, The French (CCCE and FAC), the European Development Fund (FED), USAID, and the Germans (KFW). While the discussions have progressed slowly the process has led to an unusually high degree of donor coordination and a common stand on most basic issues. The exact amount involved is not know at this time, but it will probably total around $100 million. The PASA extends and supports SAL IV and the agricultural portions of the various USAID-ESF programs. The formal dialogue was initiated December of 1989, following development of the Declaration de Politique de Developpement Agricole (DPDA), (actual discussions have been underway since 1988).

As with most statements of policy intent, the Senegalese policy declarations with respect to the agricultural sector in the DPDA were stated in broad and often ambiguous terms. They lacked critical information as to the operational details of policy changes and projected implementation schedules for the timing of such changes. The DPDA preamble essentially reiterated the goals of the 1984 NPA:

- A better distribution of income with respect to rural areas;
- A reduction in rural/urban migration;
- Balanced regional growth;
- Improved food security through increased production and consumption of local cereals; and
- Better management of resources -- particularly soils --coupled with better integration of agricultural, forestry and livestock.

The DPDA was followed (May, 1990) by a supporting "Action Plan" which was developed following joint discussions of the DPDA. This document oriented the "adjustment" actions toward a large number of studies and "measures to be determined". Following extensive donor consultation and further discussion, the GOS agreed to produce another action plan. The donors also prepared and submitted several statements of what they considered necessary engagements (including engagements necessary before additional discussions could take place). The GOS responded with a second action plan (November, 1990).

As of the writing of this report, the most recent "Action Plan" had not been subjected to a complete review by the donor community, so no joint reaction is available. The document is a considerable advance over the first action plan, and it does include more specific engagements. It can be said that the document does not extend "adjustment" to the limits expected by the donors, either because the engagements are still vague or because they are delayed.[8] It is too early to conclude just what adjustment measures the final PASA will contain (or even that it will be successfully concluded). However, given commitments made under SAL IV and some firmly held donor convictions, the final version will need to contain a reasonable program for the following:

- Reduced state intervention
  - Privatization of SEPFA (edible groundnut parastatal) agreed to by the GOS and formally announced.
  - Privatization of SONACOS (groundnut oil mills).
  - Privatization of SAED rice mills.
  - Privatize local rice marketing.
  - Reduce the role and function of CPSP including: eventual transfer of rice import to the private sector; immediate liberalization of private sector whole and intermediate quality rice imports; and restriction of CPSP activities to the cereals sector.
  - Reduce the role of the GOS in CNCAS (not to exceed 25% ownership).
  - Elimination of SODEFITEX subsidies on agricultural inputs.

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[8] The DPDA preamble concludes by reemphasizing that actions taken under the sectoral adjustment program must not conflict with those of the NPA and must not be brutal or rash in their execution or consequences.

- More flexible pricing system
    - Establish a groundnut and cotton farm pricing system which is more closely linked to world prices.
    - Eliminate transport subsidy on imported rice (Dakar to the various regions).
    - Establish a rice pricing system which does not require subsidies at the farm, processing and marketing levels (some combination of import duty, higher retail prices and/or lower farm costs).
- Improved resource management
    - Increased local control over local resources.
    - Passage and implementation of a new forestry code.

Since a large part of existing policy and of the current dialogue focuses on import substitution and increased local cereals production, and since this will continue to be important, it is worthwhile to look at some price ratios which show, at least partially, how the policy has been implemented. Table 3 shows nominal, real and relative real producer price indexes for food crops, cash crops and all crops, along with the consumer price index and urban wage rates. Several relationships are apparent:

- the relative prices of cash crops and food grains have remained favorable to cash crops - the cash/food crop price ratios (column 7) are generally greater than one, which is consistent with a goal to maintain farm cash incomes but not with import substitution;
- the urban/rural terms of trade has been favorable to the rural community - the ratio of crop prices to urban wages (column 9) is substantially greater than one, as is the ratio of crop prices to civil servant wages (column 10);
- real farm prices have remained about constant since 1980 - which is consistent with the information in Figure 2 which shows that real gross GDP from crops has been constant, which means steady <u>per capita</u> declines in rural income - approximately equal to population growth rates (2.1% per year);
- real urban wage rates have declined substantially, especially over the 1980's; and
- real civil servant wages have declined faster than unskilled urban wages (last column), except for 1988 and 1989.

Thus, in real terms both farm incomes and urban wages have declined (it is just that the decline was greater in the urban sector than in the rural sector so the rural terms of trade has improved relative the the urban sector). Does the decline in per capita farm income conflict with the information in Table 3 which shows that there has been a relative cash crop price advantage over food crops? No, what the price ratios show is the <u>intent</u> on the part of the GOS to influence the economy.

Table 3

Producer Price Indexes, Consumer Price Index, SMIG and Civil Servant Wages 1970-1989

Year	Basic Data						Ratios					
	Producer Price Index			CPI 1980=100	SMIG (CFA/hr)	Monthly Civil Servant (000/CFA)	Cash to Food Crops	All Crops to CPI	All Crops to SMIG	All Crops to Civil Servant	Civil Servant to SMIG	SMIG to CPI
	Food Crops 1980=100	Cash Crops 1980=100	All Crops 1980=100									
1970	51	41	45	37	51	46.0	0.807	1.227	1.192	1.101	1.083	1.029
1971	45	43	44	38	51	46.8	0.963	1.159	1.157	1.050	1.102	1.002
1972	45	51	48	41	51	48.9	1.136	1.177	1.268	1.101	1.151	0.928
1973	47	51	49	45	51	52.3	1.068	1.095	1.294	1.051	1.231	0.846
1974	62	65	64	53	98	62.5	1.039	1.199	0.869	1.134	0.766	1.380
1975	80	91	86	69	107	67.2	1.131	1.249	1.079	1.431	0.754	1.157
1976	80	91	86	70	107	66.7	1.133	1.230	1.078	1.442	0.748	1.141
1977	90	91	91	78	107	66.1	1.013	1.161	1.134	1.529	0.742	1.024
1978	90	91	91	81	107	77.9	1.008	1.121	1.137	1.301	0.874	0.986
1979	100	91	95	89	107	100.3	0.911	1.069	1.192	1.059	1.126	0.897
1980	100	100	100	100	134	111.6	1.000	1.000	1.000	1.000	1.000	1.000
1981	100	97	99	102	137	110.2	0.971	0.967	0.965	0.999	0.966	1.002
1982	125	132	129	120	146	116.5	1.049	1.073	1.182	1.233	0.958	0.908
1983	125	111	118	134	152	123.6	0.884	0.877	1.036	1.061	0.976	0.847
1984	139	111	124	148	175	132.6	0.801	0.834	0.946	1.039	0.910	0.882
1985	153	132	142	172	184	135.4	0.861	0.823	1.031	1.167	0.884	0.798
1986	182	197	190	183	184	146.6	1.085	1.038	1.383	1.446	0.957	0.750
1987	182	197	190	175	184	151.9	1.085	1.085	1.383	1.395	0.991	0.785
1988	182	197	190	172	184	156.9	1.085	1.104	1.383	1.351	1.024	0.798
1989	193	155	173	169	184	156	0.803	1.021	1.257	1.235	1.018	0.813

Source: Wage rates, consumer price index from (Berg, 1990); producer price indexes calculated from data in Annex II (Lasperes) is 1979/80=100 to be consistant with the Berg data). Food crops are millet, maize, paddy, cowpeas and cash crops are cotton edible and oil groundnuts. SMIG is the minimum unskilled urban wage rate.

The fact that farm incomes have not increased reflects constraints which cannot be manupliated by commodity pricing policies alone. Chapters II, III IV and V will investigate the issues in considerable detail. The basis of the problem is that increasing population and a relatively fixed supply of land is reflected in a shift from cash crops (groundnuts) to food crops as farmers attempt to produce enough food to maintain their own food security. What the data show is that if farmers could respond, they would most likely do so by producing more cash crops.

It is especially true that price policy has not been consistent with an import substitution goal so far as local cereals and imported rice are concerned - especially after 1988 when the retail rice price in Dakar was dropped from 160 FCFA/kg to 130 FCFA/kg. The analysis in Chapter IV will pursue this question in detail. The point is that local processing of local cereals is problematic at current rice prices - especially when confronted by the CPSP subsidy on rice transport to the various regions.

- The GOS has agreed to eliminate the transport subsidy by March 1991 (as a result of the discussions under the PASA) and has announce a new set of wholesale prices which have already partially eliminated the subsidy (in September, 1990). These data are shown in Table 4.

Table 4

Official Wholesale and Retail Rice Prices and Transport Subsidy, by Region
(Prices Established September, 1990)

Region	Wholesale Price (FCFA/kg)			Total Subsidy Eliminated (FCFA/kg)	Retail Price (FCFA/kg)			
	May 1988	September 1990	March 1991		May 1988	September 1990	March 1991	Change 91-88
Dakar	120.2	122.4	122.4	2.2	130.0	133.0	133.0	3
Ziguinchor	124.5	126.7	135.2	10.7	135.0	138.0	146.0	11
Diourbel	121.6	123.8	123.8	2.2	132.0	135.0	135.0	3
St. Louis	122.6	124.8	125.1	2.5	133.0	136.0	136.0	3
Tambacounda	125.2	127.4	129.7	4.5	135.0	138.0	138.0	3
Kaolack	122.0	123.8	124.3	2.3	132.0	135.0	135.0	3
Louga	122.0	123.8	123.9	1.9	132.0	135.0	135.0	3
Thies	120.2	123.2	123.2	3.0	131.0	135.0	135.0	4
Kolda	124.5	126.7	133.6	9.1	136.0	139.0	146.0	10

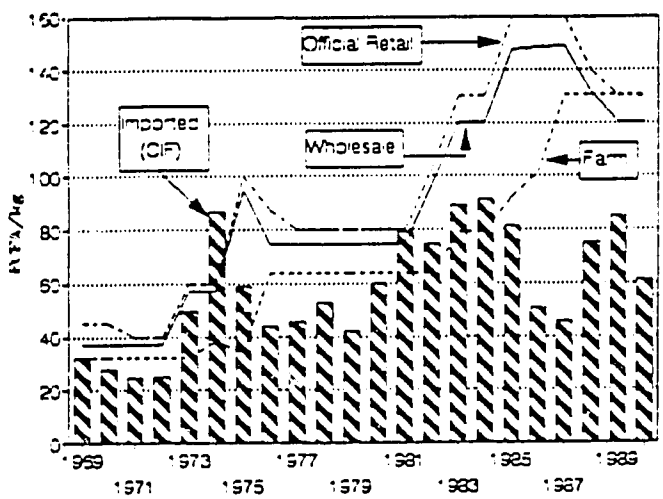
Source: MEFP/CPSP

Elimination of the rice transport subsidy is a step toward encouraging local cereals processing. However, a retail rice price of 138 FCFA/kg leaves very little margin for marketing locally produced and processed cereals in Tambacounda. This will be covered in greater detail in Chapter IV, but what it means is that grain millers have absolutely no incentive to pay the cost of storing grain so they can operate on a year-round basis. These are all part of the reason why the PASA discussions have called for additional adjustment in rice pricing policy.

It is unfortunate that the discussion about rice pricing policy has addressed the issue in terms of "protection" for local cereals. In fact, the discussions have only been about adjusting for the overvalued FCFA. The actual amount of the overvalue has been accepted by most participants as 40-45 percent. What the discussions to date have not fully appreciated is that since the mid-1980's, rice prices have been set at levels at or above this level. This is demonstrated by Figure 4, which shows imported rice costs (CIF), official wholesale and retail rice prices and the official paddy price converted to a rice equivalent price (Annex VII, Table 1 contains the data used to create the figure).

Figure 4

Farm, Wholesale, Retail and Imported (CIF) Rice Prices: 1969-1990
(FCFA/kg)

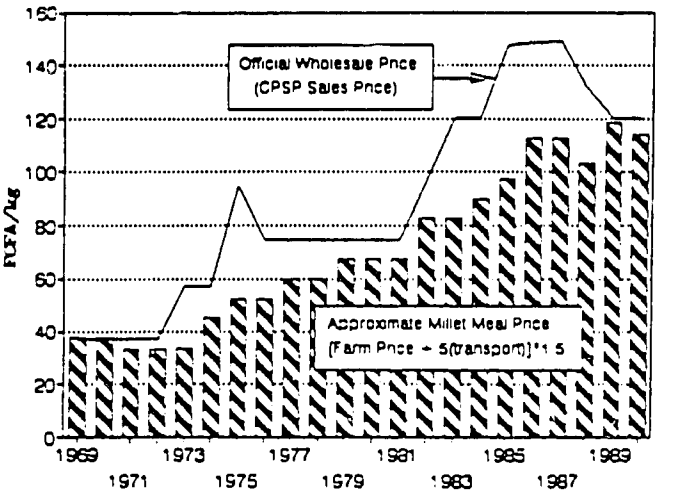


Official rice prices followed world prices fairly closely throughout the 1970's and into the early 1980's (with the exception of lags in adjusting for world price changes). However, beginning about 1982 and especially after 1984 official prices were set at levels well above world prices and the difference (perequation) became an important source of revenue for the state. Farm prices were raised for the 1984, 1985 and 1986 crops and have remained at 85 FCFA since. Meanwhile, retail prices were increased to 160 FCFA in 1985 then dropped to 130 FCFA in May of 1988. Since the farm price was maintained at 85 FCFA/kg, the rice equivalent paddy price (not counting transformation and marketing costs) now exceeds the official wholesale price and is about equal to the official retail price. There can be no complaint about the level of protection for locally produced rice. The problem is that Senegal has a comparative disadvantage in rice production (DRC of 3-5, depending on the technology used - see Table 17, Chapter III). Thus, while there has been a production incentive, it has been at a very high cost in terms of domestic resources (it costs three to five FCFA to replace one FCFA of imported rice).

Has rice and other cereals pricing policy protected local cereals in a similar way? Yes and no. Official prices were established for cereal grains up to 1988 when they were liberalized. As Figure 5 shows, until liberalization, these prices were set at levels which were consistent with the rice price policy; until 1988, converted to an approximate millet meal price, they were generally at levels which could be considered competitive with rice.

Figure 5

Wholesale Rice Prices vs Approximate Millet Meal Prices



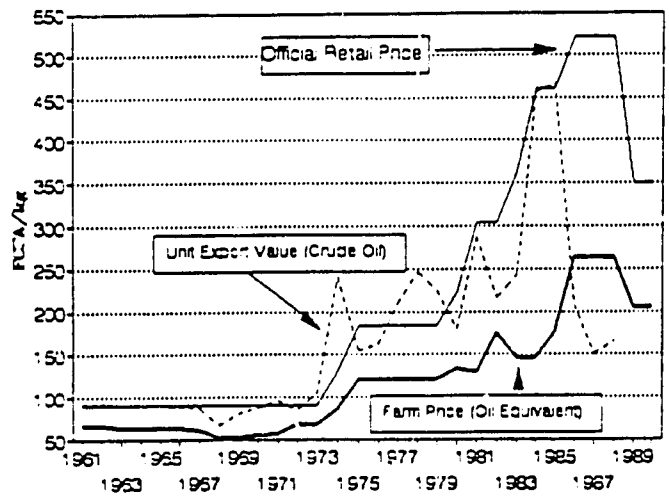
Although Figure 5 contains data for only two years of liberalized cereals prices, it suggests that millet prices have adjusted so that they are consistent with a millet meal - wholesale price equilibrium (i.e the wholesale rice price sets a limit on millet prices - as would be expected).

The history of groundnut pricing has been similar to the history for rice pricing, in that until about 1985 domestic prices followed world prices fairly closely (with minor adjustment lags - Figure 6). The margin between the oil equivalent farm price (farm price/oil yield of 34%) and the unit export value grew fairly large during the mid-1970' and the mid-1980's. But, in 1986 the unit export value of crude oil fell well below the farm equivalent price - which is why the PASA discussions are calling for a groundnut price which is more closely tied to world prices (Annex VII, Table 2 shows the related data). The recent margin is even more negative than is shown on the figure because SONACOS processing costs are extremely high (nearly 67 FCFA/kg of crude oil in 1989 and because capacity utilization is so low, about 80% of that is fixed cost [SOFRECO, 1990, pg 129]. Also, beginning 1986 a considerable tax was imposed on local consumers, even considering the high processing costs (17 FCFA per kg of crude oil refined plus 24 FCFA per kg bottled). There can be little doubt that

something must be done if Senegal is to derive any benefit from its major export crop.

Figure 6

Groundnut Oil Prices: Oil Equivalent Farm Price, Official Retail and Unit Export Value



SAL IV and the provisions being discussed under the PASA call for privatization of the oil mills. At issue is whether or not the GOS has the will to carry through with this "adjustment" and, if so, at what speed, and, if so, whether or not the private sector would be willing to participate. The elimination of input subsidies, the transfer of seed storage responsibility to the farmers and the re-liberalization of groundnut marketing are all steps toward establishing a more efficient and responsive system. But, as the data have shown, despite a high level of "protection" and reasonable incentives, production has not responded - there is still a serious constraint to be addressed. Irrespective of the efficiency of the marketing and processing system, or of how "correct" the policies may be, unless the farming system becomes more productive there is little prospect that Senegalese farmers will be able to respond to either cash or food crop production incentives, or hope for a significant improvement in their incomes. It is also clear that a much more comprehensive analysis than simple price ratios is needed in order to sort out the relationships between policy, the economy, the resource base and crop production.

The PASA dialogue has become an important element in donor investment and support policy in Senegal and has already led to considerable readjustment in several investment programs, because the major donors (with a few exceptions) have tied new investment programs to completion and implementation of a meaningful agricultural adjustment program. The following section provides a summary of the existing program. Because of the discussion process, a number of positive measures have already been taken the GOS:

- Agreement to eliminate the transport subsidy on internal rice distribution;
- Eliminate CPSP operations in the cotton and groundnut sectors (includes creation of a separate perequation system for groundnut oil);
- Announcement of privatization of the edible groundnut sector (process, etc. still to be discussed);
- Agreement to privatize the local rice marketing and processing system (specifics to determined and discussed);
- Agreement to close the groundnut oil mill at Diourbel; and
- Established a schedule for the final elimination of SODEFITEX input subsidies (to be included in the next "Lettre de Mission").

Since delays in preparing and implementing several "Lettre de Mission" which are tied to the PASA (SODEFITEX and SAED) and recent termination of several projects have introduced a degree of uncertainty into Senegal's agricultural investment program, the data are not complete. However, since the investment plan is really expectations about donor support, the plan does provide an indication of GOS (and the supporting donors) investment priorities.

Investment Priorities

In the first of the four three year investment programs (1987/88-1990/91), the agricultural sector was broken down into six categories: agriculture, livestock, forestry and natural resources, fisheries, agricultural water development, and rural water development. In succeeding investment programs, all water development was grouped as a single category and two new categories were added -- agricultural research/studies and institutional support/agricultural extension. A summary of the programmed funding for the agricultural sector in the four successive three year investment programs 1987/88-1990/91 to 1990/91-1992/93 is shown in [Eriksen, 1990, Annex B Table 1][9].

Over the four programs, aggregate investment in the agricultural sector was projected to grow from FCFA 280,309 million to FCFA 337,709 million -- or at an interprogram rate of 5.1 percent in nominal terms. At the same time, the agricultural sector's share of the total government investment programs was projected to fall from 38 percent of the first three year program to 30.2 percent of the fourth program.

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[9] Information with respect to the programming of Government of Senegal funding for the agricultural sector was derived from the data presented in the four successive government investment budgets -- i.e., Programmes Triennal d'Investissements Publics -- dated 1987-1990 to 1990-1993. Although these budgets provide a rolling three year picture of government intents with regard to agricultural development activities, there were no government documents available on the actual execution of investment programming -- i.e., Bulletin d'Execution du Programme d'Investissements Publics -- beyond budget year 1987/88. One other analysis of government's second three year public investment program 1988/89-1990/91 was also available but this was an a priori analysis and contained no information on actual plan implementation. [World Bank, 3 June 1988]. Finally, the inclusion of a project investment activity in a Three Year Plan is not always an accurate reflection of the actual state of donor commitments to the activity; nor are the investment figures cited by project activity always accurate.

Each investment program presents the total investment projected, the level of funding committed, the level of funding still to be negotiated, and the level of unsecured funding by sub-sector and project. In addition, each investment program presents a breakdown of investment in sub-sector and projects in three categories: investment disbursed prior to the program period; projected investment over the three year program period; and projected funding in the investment pipeline after the program period.

Over the four investment programs, changes in these three variables are as follows:

- The percent of investment disbursed prior to the program period rises from 23.6 percent to total investment in the first program to 31 percent in the fourth program;
- The projected investment during the successive three year periods as a percent of total investment remains essentially constant at between 47.3 and 51.2 percent; and
- The projected pipeline carryover at the end of each investment program as a percent of total investment declines from 29.1 percent in the first program to 18.6 percent in the fourth program.

Due to the modifications in sub-sector investment categories between the first and second three year programs, changes in investment allocations between sub-sectors can only be done for the period from 1988 to 1990. In general, these changes appear to have been rather minor. Agriculture sub-sector investment remained relatively constant around an average 51.4 percent of total sector investment. Livestock investment continued to be low at about 2 percent of total investment. And, forestry and natural resources and fisheries investments also remain constant at about 9 and 6 percent of total investment, respectively.

The three investment categories showing the greater variation were water development, agricultural research/studies, and institutional support/agricultural extension. Funding for water development --as distinguished from development of irrigated perimeters -- was 14 percent of investment in 1988; jumped to 22.3 percent in 1989; and dropped off again to 18 percent in 1990. Agricultural research/studies showed the reverse pattern starting at 10 percent in 1988; falling to 2.5 percent in 1989; and rising again to 6.3 percent in 1990. Only the institutional development/agricultural extension category showed a consistent upward trend in investment from 4.3 percent of total sectoral investment in 1988 to 7.7 percent in 1989 to 9.3 percent in 1990.

<u>Sub-Sector Investment Allocations in the Fourth Three Year Investment Program (1990/1993)</u>

In the context of the USAID agricultural sector analysis, the Fourth Three Year Investment Program is of greatest relevance since it covers the period 1990/91 to 1992/93. As has been the pattern throughout the 1980s, investment flows are heavily skewed toward the agriculture sub-sector -- and within it toward irrigated agriculture in the Senegal River basin and, to a lesser degree, in the Casamance (50% of primary sector investment). The water development sub-sector -- where projects are often in support of development in irrigated agriculture areas --is the second most important investment category (18% of the primary sector total). (See Table 5).

Table 5

Senegal's 1990/93 Investment Plan for the Primary Sector
(Distribution by Sub-Sector and Source)

Primary Sector Investment (million FCFA by Sub-Sector)	Total Investment	Bilateral Donors	Multilateral Donors	External Development Banks	Local Funding (b)	Unsecured
Agriculture	168,181	88,556	46,338	11,045	20,318	1,924
Water Development	60,888	33,903	2,460	9,722	2,713	12,090
Institutional Support(a)	31,452	15,247	9,804	749	5,652	-
Forestry/Nat. Resources	29,548	15,353	10,240	520	3,435	-
Ag. Research/Studies	21,311	5,473	6,156	267	9,415	-
Fisheries	20,570	14,476	3,210	-	2,884	-
Livestock	5,759	2,288	807	-	2,314	350
Total Primary Sector	337,709	175,296	79,015	22,303	46,731	14,364
Other Sectors	782,316					
Total Investment	1,120,025					
Percent of Sub-Sector Total by Source	(%)	(%)	(%)	(%)	(%)	(%)
Agriculture	100.0	52.7	27.6	6.6	12.1	1.1
Water Development	100.0	55.7	4.0	16.0	4.5	19.9
Institutional Support	100.0	48.5	31.2	2.4	18.0	-
Forestry/Nat. Resources	100.0	52.0	34.7	1.8	11.6	-
Ag. Research/Studies	100.0	25.7	28.9	1.3	44.2	-
Fisheries	100.0	70.4	15.6	-	14.0	-
Livestock	100.0	39.7	14.0	-	40.2	6.1
Total	100.0	51.9	23.4	6.6	13.8	4.3
Percent of Source Total by Sub-Sector	(%)	(%)	(%)	(%)	(%)	(%)
Agriculture	49.8	50.5	58.6	49.5	43.5	13.4
Water Development	18.0	19.3	3.1	43.6	5.8	84.2
Institutional Support	9.3	8.7	12.4	3.4	12.1	-
Forestry/Nat. Resources	8.7	8.8	13.0	2.3	7.4	-
Ag. Research/Studies	6.3	3.1	7.8	1.2	20.1	-
Fisheries	6.1	8.3	4.1	-	6.2	-
Livestock	1.7	1.3	1.0	-	5.0	2.4
Total	100.0	100.0	100.0	100.0	100.0	100.0
Primary Sector % Total	30.2					
Other Sectors % Total	69.8					

Source: [Eriksen, 1990, Annex B]

(a) Funding primarily from the USAID Agricultural Production Support project (APS) and the new World Bank agricultural services project. The APS project is scheduled for termination at the end of December, 1990. The funds remaining will be transferred to the USAID Agricultural Sector Grant.

(b) Local funding represents participant contribution and GOS support. GOS support includes salaries, etc.

Projected Investment by Sub-Sector and Source of Funding

Projected funding by bilateral donor agencies dominates Senegal's agriculture sector investment program for the early 1990s. Bilateral donors are expected to contribute 51.9 percent of total sectoral investment and will also be the major funding source for project activities in all sub-sectors except livestock and agricultural research/studies. All together, donors are expected to provide about 82 percent of the total investment budget (Table 5).

In the livestock sub-sector, investment from local sources (the government and project participants) will be the only significant source of funding because French participation in the SODESP livestock project had been cancelled.

In the agricultural research/studies sub-sector, primary funding is projected to come from local sources, followed by multilateral and bilateral donors. External donor participation in this sub-sector largely involved with the new World Bank agricultural research project, which has co-financing from several bilateral donors.

Italy is projected to be the largest individual investor in Senegalese agriculture with 13.8 percent of total sector investment -- i.e., FCFA 46,605 million. French investment -- i.e., CCCE and FAC -- is projected at FCFA 26,760 million -- or 7.9 percent of the total. The United States is the third ranking bilateral donor (6 percent); followed by West Germany (4.5 percent), Canada (4.4 percent), and Japan (4.1 percent). Ten other bilateral donors are expected to fund 11.2 percent of the total sectoral program.

World Bank funding is projected to be 45.7 percent of total multilateral donor investment -- or FCFA 35,744 million. EEC investment is next most important with funding of FCFA 22,763 million (28.6 percent). And, the African Development Fund and United Nations agencies -- i.e., FAO and UNDP -- are, respectively, the third and fourth most important multilateral investment sources.

Funding from external development banks is expected to make up 6.6 percent of the total investment program. The most important investment source is the West African Development Bank; followed by the Arab Development Bank and the Islamic Development Bank. The African Development Bank has token representation in the investment program. [Eriksen, 1990, Annex B Tables 4 and 5].

Orientations of Individual Donors by Sub-Sector Investment

The Fourth Three Year Program presents a picture of Senegalese evaluations of individual donor commitments to the development of the agricultural sector. These evaluations appear to be based on a donor's previous track record of projectized assistance; firm commitment documents and budgets for on-going projects; and government expectations of further involvement.

Within the agriculture sub-sector, the current Three Year Program lists nineteen separate donor agencies and twenty-two separate external funding sources. If separate sources of investment from the same donor are combined (CCCE and FAC for France and GTZ and KFW for West Germany) the ranking of the major donors by projected sub-sector investment is as follows:

1. Italy (FCFA 27,135 million -- and 16.1 percent of sub-sector investment);

2. World Bank (FCFA 20.272 million -- 12.1 percent);
3. European Economic Community (FCFA 17,633 million -- 10.5 percent);

4. France (FCFA 16,030 million -- 9.5 percent); and

5. West Germany (FCFA 11,774 million -- 7 percent).

In the livestock sub-sector, external donor investment is insignificant relative to the projected sectoral program. In reality, it is virtually non-existent since French involvement in the SODESP has either been cancelled (CCCE) or already spent (FAC). If one takes the changes into account and the fact that approximately 77 percent of EEC investments are shown as having been disbursed prior to 1990, then the United States (the USAID water buffalo project) remains as the only significant external donor still funding specific livestock activities.

The forestry and natural resources sub-sector shows the best balanced distribution of projected investments between donors. While Canada is projected to be the largest single sub-sector investor -- FCFA 5,000 million and 16.9 percent of the sub-sector program -- three other donors are expected to fund programs at levels of FCFA 3,000 to 3,500 million -- i.e., the World Bank, West Germany and the United States. In addition, six other donors have projected investment levels of between FCFA 1,000 and 2,000 million.

Projected investment in the fisheries sub-sector is expected to come from three principal sources: Canada (FCFA 6,711 million); Japan (FCFA 5,150 million); and the African Development Fund (FCFA 2,666 million).

The water development sub-sector -- i.e., borehole and shallow well development and maintenance of pumping equipment -- has by far the highest level of investment in the unsecured category (19.9 percent). It also may be a sub-sector with the greatest potential instability in projected investment since almost 25 percent of the total investment is ascribed to Italy which has indicated that only about one-third of its total program will actually be funded. After Italy, the next largest investor is projected to be the United States (9.9 percent) but this is largely the Bakel project which has been terminated; followed by nine other donors with projected programs between FCFA 2,000 and 4,000 million.

The agricultural research/studies sub-sector is dominated by one large project -- i.e. Recherche Agricole II -- with major external financing from the World Bank and local government resources (71.6 percent of total sub-sector investment). The remainder of projected investment is split between a USAID-sponsored hydrological study (7 percent); an Italian-sponsored research project for irrigation water management using alternative energy sources (14.6 percent); and a whole range of small and diverse technical studies (6.8 percent).

The principal investment activities in the institutional development sub-sector are expected to be the World Bank-sponsored Agricultural Services Project (23 percent); the USAID-sponsored Agricultural Production Support Project (21 percent), due for termination at the end of 1990; and the French-sponsored Three Year Seed Plan (18.6 percent). The balance of the sub-sector investment program

is projected to be small grants to specialized government agencies for soils and fertilizer work, environmental activities, and regional agricultural planning.

Complete details of projected sub-sectoral investment by donor is presented in [Eriksen, 1990, Annex B Tables 6 and 7].

Regional Orientation of Projected Investment in the Fourth Three Year Program

The Government of Senegal's current investment program projects an allocation of 27 percent of sectoral investment to national projects. The rest of investment program is allocated by regions in close conformity with the stated objectives and biases of the NPA of 1984 and the DPDA of 1989. (Table 6).

Investment is concentrated on irrigation projects -- i.e., large public and small private perimeters -- for rice production in the Senegal River basin, coupled with complementary support efforts in rehabilitation of infrastructure, water development, farmer organization, and resource conservation. Projected investment amounts to 26 percent of total sectoral investment and involves all of the major donors and many of the minor ones.

Table 6

SENEGAL'S 1990/93 INVESTMENT PROGRAM - TOTAL PROGRAM
(PERCENT OF SECTOR BY REGION)

REGION	AGRIC. RESEARCH	AGRIC-ULTURE	FISHERIES	FORESTRY/ RESOURCES	INST. DEVELOP	LIVE-STOCK	WATER DEVELOP	TOTAL
DAKAR	-	-	15.2	1.1	0.1	-	-	1.0
ST LOUIS	3.8	43.9	8.7	13.0	6.0	-	12.0	26.5
LOUGA	15.3	3.6	-	12.2	5.0	44.3	-	5.1
DIOURBEL	-		-	17.4	-	-	-	1.5
FATICK	-	1.6	-	5.7	-	-	-	1.3
THIES	-		15.3	6.8	-	-	-	1.5
G'NUT BASIN	-			4.2	-	-	-	0.4
SINE SAL	-				-	27.9	18.9	3.9
KOLDA		25.7	-	13.0	-	-	-	13.9
ZIGUINCHOR	0.3	14.5	28.7	-	-	-	28.1	14.0
TAMBACOUNDA	2.7	5.4	-	7.5	-	-	-	3.5
SOUTH/SE	-	-	-	-	-	-	0.6	0.1
ZIGUINCHOR/ TAMBACOUNDA	-	-	-	-	-	-	1.1	0.2
NATIONAL	78.0	5.2	32.1	12.1	89.0	27.8	39.3	26.4
ALL	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
PERCENT	6%	50%	6%	9%	9%	2%	18%	100%

Source: [Eriksen, 1990, Annex B Table 9]

Projected investments in the South and Southeast of Senegal -- formerly the regions of Casamance and Senegal Oriental -- are centered on the maize and cotton filieres and on water development and rehabilitation of perimeters to prevent salinization and to permit continued irrigation in Casamance. Investment is projected at 31 percent of the sectoral program. The projected funding for the area, however, is heavily influenced by the huge Italian PRIMOCA integrated rural development effort planned for the Moyenne Casamance around Kolda. And, to a lesser extent, by continued French support for SODEFITEX programs based in Tambacounda. USAID support for improved water management in Casamance and West German efforts with maize and rural development constitute the other major development efforts.

Since there is considerable doubt about the directions and actual funding level for the PRIMOCA project, realized investment in this region may be considerably lower than anticipated in the investment program.

Investment projections indicate a relative donor neglect of the central groundnut basin (Diourbel, Fatick and Kaolack) and its northern extension in Louga. Project funding in these areas is anticipated to constitute only 13 percent of total sectoral investment. The orientation in committed projects is toward forestry and natural resources (27 percent) and water development (26.7 percent). And, most efforts seem to be directed at slowing down the rate of deterioration and conserving what remains of natural resource base in the groundnut basin. Little emphasis is placed on projects to directly increase agricultural productivity in the area and virtually no external funding is expected with livestock activities.

Little direct investment attention given to the Dakar area and the coastal strip in the current program. Only 3 percent of sectoral funding is anticipated for this area with investment concentrated almost entirely on forestry and natural resources efforts and small projects to assist the coastal fisheries.

The USAID Agricultural Development Program

The USAID program consists of 18 project and program activities, with an annual funding level of about $40 million. The current USAID agricultural development program was developed in support of the New Agricultural Policy and the National Cereals Policy. The program shares the goals of the NAP, namely state disengagement, liberalized markets and prices, and improved resource management. The program is operated under two broad types of intervention: project assistance, aimed at specific issues and non-project assistance, aimed at sectoral issues. The program in now being reviewed and consolidated, in preparation for the Mission's 1992-96 development strategy.

Non-Project Assistance

USAID has two non-project assistance programs with an agricultural sector focus. At their planned completion dates, these programs will have provided the GOS with $61 million (Table 7).

The agricultural components of the non-project assistance programs have been used to assist the GOS in implementing structural adjustment and agricultural policy. These programs have supported cereals and input marketing privatization and free pricing system for local cereals (except local rice).

The Agricultural Sector Grant, now under discussion, will help to complete the privatization of the cereals sector through privatization of rice milling and marketing.

Table 7

USAID Non-Project Assistance to Senegal, 1985-1991

Program Title	Date of Original Agreement	Planned Completion Date	Initial Obligation (dollars)	Note
Economic Support Fund Programs	December 1985	September 1991	26,500,000 (ESF IV, V and VI)	Programs designed to assist the GOS meet the costs of structural and economic reform. These programs have supported privatization of SAED operations in land preparation, input distribution and equip. repair. The set the stage for eventual privatization of rice milling.
PL 480 Title I (Rice imports to help fill the national food deficit)	1986	1990	34,500,000	This is an annual program. The local currency generated has been used to phase out fertilizer subsidies, eliminate price support operations for local cereals and for liquidation of sector debts.

Source: [USAID/Senegal, March 1990]

Project Assistance

USAID's project assistance portfolio has been oriented toward support of the NAP. Since the NAP stressed irrigation development, a large part of the program has been to support that goal. Specific projects exist for OMVS, OMVG, an irrigation development in Bakel (will be terminated this year), a project to test the viability of water buffalo in the river valley, and a project to strengthen ISRA's research in the River Valley. An additional project, Southern Zone Water Management, will help farmers in the Casamance reclaim saline soil and improve water management techniques (Table 8).

The Mission also has three nationwide projects: the Agricultural Production Support project, scheduled for termination in December 1990; the Senegal Reforestation Project; and the Price Policy Project (ISRA/IFPRI) which will collect and analyze farm consumption/expenditure data.

There are also some centrally funded (CRSP) activities. CRSP's exist for groundnuts, sorghum and cowpeas and another supports INSORMIL work at ITA (the Food Technology Institute). The Mission also funds several, small, projects under the Technology Transfer Project - this includes the Price Policy Study and the Water Buffalo Project.

The termination dates for most of these projects is at about the time that the new Mission development strategy will begin, so the Mission is well situated for the development of new projects and programs to support the strategy, which is to be finalized in early 1991

Table 8

USAID Project Assistance to the Agricultural Sector

Project Title	Date of Original Agreement	Planned Completion Date	Initial Obligation (million $)	Note
Agricultural Production Support	February 1987	December 1991	20,000,000	Project has three components: privatize input marketing and seed multiplication, credit for input distributors, and some support for the Agricultural Statistics. Following evaluation, it was decided to terminate this project December 1990.
Reforestation	August 1986	July 1993	10,000,000	A nationwide project to encourage farmers, local communities and businessmen to plant and care for trees. Has six components: media to convey the message; training for forest service staff; matching grants (50/50) to help cover individual and community tree planting costs; private sector promotion; roadside planting; and policy dialogue. The recent mid-term evaluation found the project to be highly sucessful.
Senegal Agric. Research II	August 1984	June 1992	5,093,000	Purpose is to strengthen agricultural cereals based research (ISRA) in the River Basin by strengthening research capacity, improving adaptive and farming systems research.
Irrigation and Water Management	August 1985	September 1992	9,500,000	Assist SAED to improve and expand village irrigation systems in the Bakel Department Following evaluation, it was determined to terminate the project (December 1990).
Southern Zone Water Management	August 1988	June 1993	18,000,000	Improve farmer recovery of land (saline) and water management.
OMVS Planning and policy Development	July 1985	June 1992	6,500,000	Strengthen institutional capacity of OMVS to plan and coordinate agricultural investments in the Senegal River Basin
OMVS Groundwater	August 1983	June 1990	6,501,000	Establish a system to monitor groundwater developments generated by the new dams
Gambia River Basin Development	June 1981	May 1991	16,894,000	Develop capability in OMVG to conduct multi-objective water resource planning
Technology Transfer	July 1985	September 1993	10,000,000	This project supports a number of small, and/or experimental projects. There are two sector specific projects: the Water Buffalo II project - to test the viability of the animals in the River Valley; and Price Policy Study (at ISRA) - to collect and analyse farm consumption/expenditure data with emphasis on local cereals and rice.

Source: [USAID/Senegal, March 1990]

Conclusion

The primary sector, while diminishing in overall importance in the macro statistics, remains one of the main generators of national income and remains the main source of employment. This is especially true for the portion of GDP originating outside Dakar (Dakar accounts for about 55% of total real GDP, and which is particularly dominated by the services sector and government administration and, thus, donor financing).

GDP, especially GDP originating in the primary sector, is highly variable largely (but not totally) because of weather variation. Real growth in the primary sector has been positive, but the growth rate has also tended to decline over time. Part of the reduction in the rate of growth can be attributed to world prices and weather, but part can also be attributed to declining productivity. This is especially evident when the sector is divided into the agriculture (crops), livestock, fisheries, and forestry sub-sectors.

The agriculture sub-sector has essentially stagnated. In 1989, real GDP in this sub-sector was only slightly above the level in 1977, and this has been accompanied by a shift in relative importance from crops to livestock and fisheries. Yet, two-thirds of Senegal's active population is rural and 60 percent of them list agriculture (in the broad sense) as their profession. Clearly, the sector has some basic constraints yet to be resolved.

An investment program aimed at eliminating the major constraints has been targeted to support policies established by the 1984 New Agricultural Policy, the 1986 Cereals Policy and four World Bank Structural Adjustment Loans. Since existing policy is shewed toward irrigated agriculture, the investment program is similarly skewed:

- In the primary sector investment plan "agriculture" (essentially irrigation system development) accounts for almost 50% of the total.
- Nearly 40% of the "agriculture" sub-sector investment plan is aimed at the St. Louis Region, which, with 26% of total primary sector investment, has the largest regional share of investment.
- Donors supply 82 percent of expected investment in the primary sector, and as a group their programs are all at least 50 percent in the agricultural (essentially irrigation) sub-sector
- Given the above, it is not surprising that a small portion of the planned investment is aimed at improving and protecting the soil. Only 8.7 percent of the total is in the forestry/natural resources sub-sector and only 8.6 percent of all primary sector investment is expected to be in the groundnut basin, where soil problems are the worst.

The most recent policy statements (SAL IV) and the ongoing Agricultural Sector Adjustment dialogue will reorient the investment program to some degree. These programs are aimed at extending the disengagement begun by the NAP, particularly the privatization of SONACOS, SEPFA, and SAED rice mills. They are also aimed at a more liberal and more flexible pricing system (completely

liberalized local rice pricing system, and more flexible cotton and groundnut prices) and at completing the elimination of input subsidies (SODEFITEX). All of these programs also push for better resource management with more local and personal control over resources. All of these measures, some already negotiated (SAL IV) and some still under discussion (PASA), are aimed at reorienting the investment program toward where the rural population lives and toward its most serious problems.

CHAPTER II
POPULATION, LAND AND WATER RESOURCES

Senegal covers 196,722 square kilometers (19,672,200 hectares) with maximum dimensions of 700 km east/west and 500 km north/south. Senegal has 700 km of Atlantic coastline, 2/3 of its land mass is below 50 meters and 90 percent is below 100 meters. The highest point (in the south-east of the country) is 500 meters.

The national territory is divided into ten administrative regions, each with three departments - which are in turn divided into arrondissements. The population is further organized into urban communes and rural communities; there are 314 rural communities and 33 urban communes. The 1988 Census of the Population counted 6.9 million people, 39 percent of whom live in urban areas.

LAND CLASSIFICATION: USE AND POTENTIAL

A classification of Senegal's 19.7 million hectares according to use and/or potential use (Table 1) puts almost 81 percent of the land in parks, reserves, classified and unclassified forests, and other, non-agricultural, uses. Only about 19 percent (3.8 million hectares) of the total land mass is classified as arable. About 62 percent of the arable area is cultivated each year. The use or potential use of the arable land is largely for rainfed agriculture (91% of the total) with about 8 percent suitable for irrigation.[1] About 30,000 hectares of the 300,000 hectares classified as suitable for irrigation have been developed and about 23,000 hectares are actually used (in the Senegal River Valley) and about 62 percent of the total rainfed potential is planted. In fact, counting fallow land as active use, 79 percent of the total rainfed potential is being used. Data on the use of recessional land are not collected, but a rough estimate, used by the National Food Needs Committee, is 25,000 hectares.[2]

Discussions of Senegal's land use and land potential usually divide the national territory into either agro-ecological or climatic zones. There are six standard agro-ecological zones and four climatic zones. The agro-ecological zones are fairly standard but the climatic zones vary depending on the historical period used to define the rainfall boundaries (isohyets). Maps 1 and 2 show the two types of partitioning and some related information.

The two maps show one of the problems associated with land and land use classification in Senegal, particularly those related to rainfall zones; most notable is the location of the 500 mm zone on the two maps (just north of Dakar

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[1] Estimates of arable land, especially land potentially irrigable, vary considerably. These data, for the larger part, depend on 1976 FAO estimates. A recent estimate of potential irrigation in the River Valley [GERSAR, 1990] estimates irrigable land in the River Valley at 642,000 hectares. Practically, and in the light of experience in developing irrigation systems in the Valley, 250,000 hectares seems more realistic. The remaining 50,000 hectares are potential developments on the Gambia and Kayanga Rivers and the Cayor Canal - all extremely long-term prospects.

[2] The National Food Needs Committee is composed of GOS and donor representatives who meet to develop Senegal's food needs and food aid requirements. The potential for recessional agriculture depends on the annual flood in the Senegal River Valley. The Manantali Dam has introduced the possibility for controlling the flood, which has been accorded low priority (there was no flood in 1990 and low flood levels in several other years).

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on Map 1 and just south of St. Louis on Map 2). Map 1 is from [MDR, May, 1986, page 6] and is based on 1951-1980 rainfall data. Map 2 is from the Natural Resources Assessment [USAID/Senegal, July, 1990, page 11] with no source or time period indicated. The associated problem in attributing land potential is apparent, especially since most of the data necessary to evaluate population/production issues are reported for administrative zones.

Table 1

Senegal: Land Classification by Use and Potential

Land Classification	Total Area (Mil. ha.)	Percent Total
Arable	3.8	19.3%
National Parks and reserves	1.3	6.6%
Other (Shrub-limited use)	4.9	24.9%
Forest unclassified	7.0	35.5%
Other	2.7	13.7%
Total	19.7	100.0%
Arable	3.800	100.0%
Suitable for irrigation	0.300	7.9%
Rainfed	3.460	91.1%
Recessional	.040	1.0%
Total Cultivated Area *	3.009	79.3%
Rainfed (cultivated)	2.146	62.0%
(fallow reserve)	.840	24.3%
Irrigated	.023	7.7%

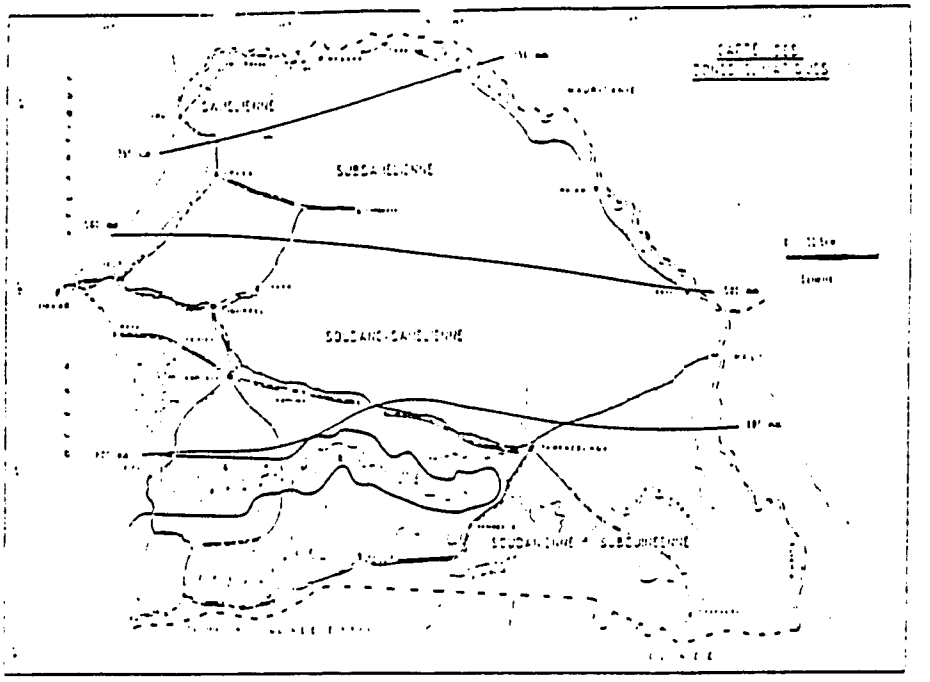
Source: National Cereals Plan, 1986, page 16.
*1985-89 average in major crops. The percentages are percent of potential for this type of land.

Fallow reserve is calculated according to information in the 1986 National Cereals Plan (1.4 million hectares, including marginal lands with 560,000 hectares of "good" fallow). Area planted has increased and fallow has decreased.

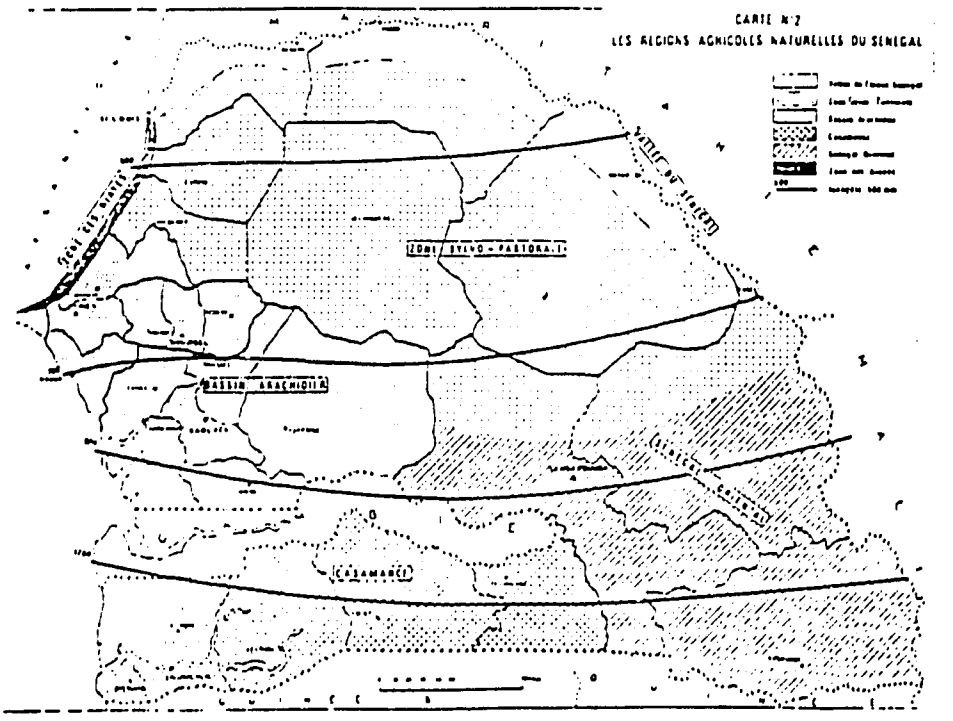
Rainfall, both its level and distribution over the growing period, is a well appreciated constraint and it will be treated in some detail later in the chapter. Map 3 is included here to show the magnitude of the problem and how it has changed over time. Most notable is the southward shift in the 400 mm rainfall zone, to the point where over the 1980-1987 period, nearly one-half of the country would have been considered unsuitable for rainfed agriculture (400 mm is considered the minimum for rainfed crops and the 500 mm isohyet corresponds to an 80% probability of 400 mm of usable rainfall)[3]. The variability of this critical rainfall zone has important implications for crop types, crop mixes and the farming system (crop/livestock choices and farm technology) and related development strategies.

[3]The 80% probability means four crops in each five years. Useable rainfall is a more meaningful criteria than just the annual average because it includes distribution as well as amount.

Map 1

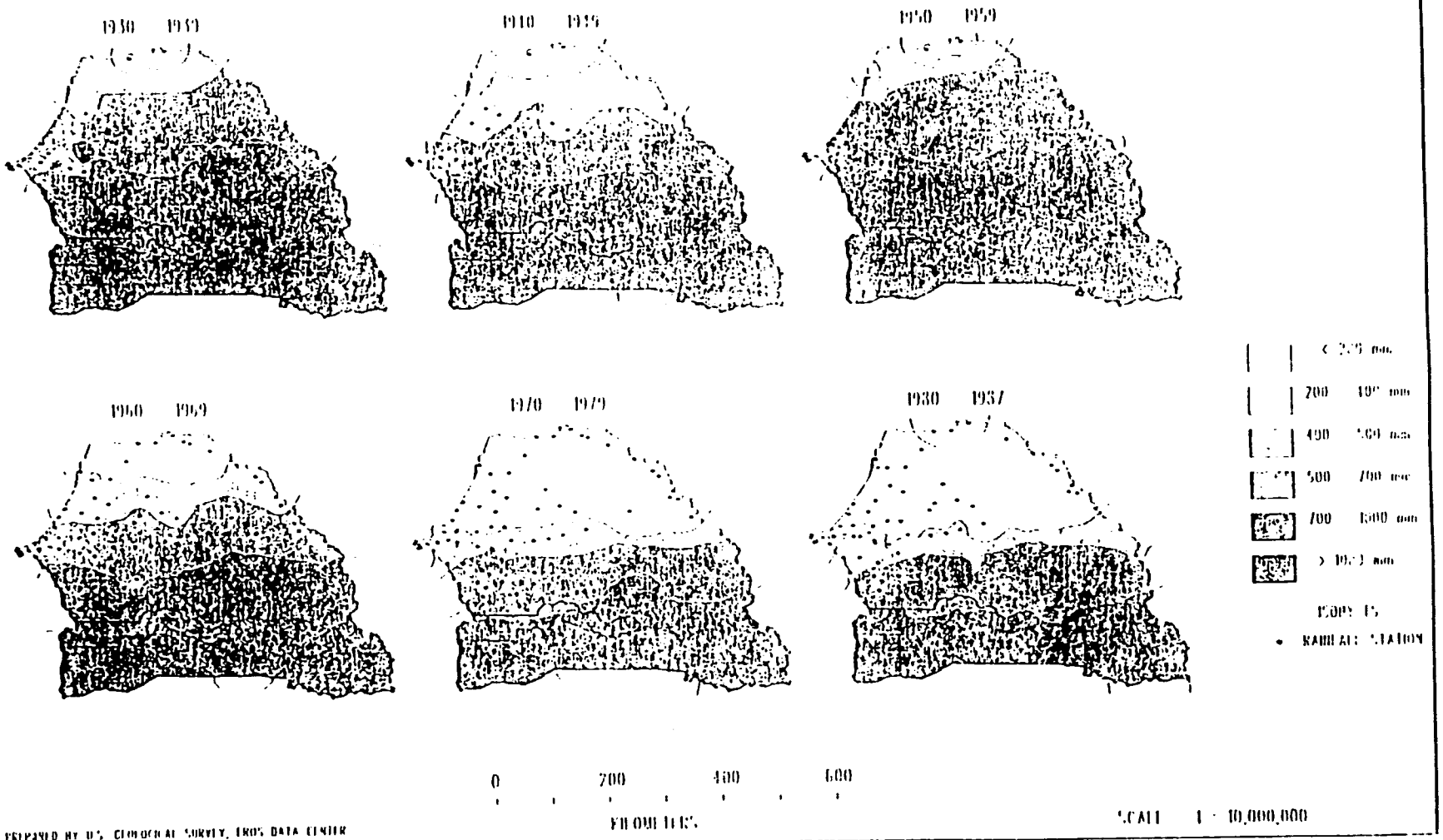


Map 2



SENEGAL AVERAGE ANNUAL RAINFALL, 1930 1987

MAP 3



PREPARED BY U.S. GEOLOGICAL SURVEY, EROS DATA CENTER

FORESTRY, FOREST AND LAND RESERVES

Domestic fuelwood demand constitutes the major use of Senegal's forest resources. While Senegal does export some wood, its overall importance is small, and in total, forestry contributes about 1.5 percent of GDP (7% of total primary sector GDP). However, despite its relatively small "weight" in the macro statistics, forestry, as defined by fuelwood, contributes about 63 percent of Senegal's total energy (the remainder is imported). It provides virtually 100 percent of all energy used by rural households and 89 percent of all energy used by urban households, which use over 50 percent of all wood consumed in Senegal. Given the high rate of growth in the urban population, and the urban population's importance as a wood consumer, growth in fuelwood consumption is expected to equal the urban population growth rate of 3.8%/year. [Natural Resources Assessment, page 93]. It is clear that considerable demands are and will continue to be made on Senegal's forestry resources.

Table 2

Forest Lands, by Type 1978 and 2000
(000 hectares)

Forest Land Type	1978	2000	Percent Change
Forests	226	220	-2.7
Dense Gallery	58	58	0.0
Mangrove	168	162	-3.7
Forest Grasslands	10,906	9,626	-13.3
Forest Dominated	2,850	2,210	-29.0
Grass Dominated	8,056	7,416	-8.6
Bush (Shrub) Forests	2,630	1,835	-43.3
Total	13,762	11,681	-17.8

Source: Natural Resources Assessment, USAID/Senegal, July, 1990, page 89, 90.

Table 2 shows the estimated areas in various types of forest land in 1978 and a projection for the year 2000.[4] An overall reduction of 17.8 percent in available forest land is expected by the year 2000, with the majority of the reduction in the fragile shrub dominated lands. Projections of wood use to the year 2016 indicate that Senegal will be deficit in nearly all categories of wood products; deficit to the degree that it will have to import, for fuelwood alone, ...3 billion m^3 of wood.[5] Forest wood output varies by climatic zone and forest type, but an average of between one-half and one m^3 per hectare indicates a deficit equivalent to the output from between 2.5 and 5 million hectares. This

[4] The data on forests and forest land is old but is currently being updated. Indications are that the new data will show a situation which is even more critical.

[5] Senegal Natural Resources Management Assessment, page 92

helps to explain the importance which the donors attach to the forestry sector and the 27 different forestry projects now operating in Senegal -- because the deficit will be covered by clear cutting, not imports. On the other hand, an indication of the priority given to the woodlands is reflected by its relatively small share (9%) in the primary sector portion of the 1990/93 investment budget.[6]

The reduction in forest area, since it is primarily from grassland sources, cannot be expected to contribute to the amount of land available for crop based agriculture, nor does it portend any benefit for grazing. For livestock in particular the removal of shrubs and trees also removes a source of fodder during the long dry season. An additional, and significant, burden is also placed on rural families (especially women and children) because of the increasing amount of time needed to search for firewood. It is reported that women and children now spend up to 3 hours/day collecting firewood. Increasing pressure from human and animal populations, especially in the Groundnut Basin, suggests that the problem will only increase. It should also be noted that a system which allocates woodcutting permits (for charcoal) and administered pricing without counting the value of the trees can also lead to serious resource abuse. This will be discussed in Chapter IV.

From the point of view of wood supply (fuel and home construction), land carrying capacity varies, depending on rainfall and the portion of the land taken out of wood production[7]. According to Gorse and Steeds [World Bank, 1987], sustainable population in terms of fuelwood and by rainfall level is as follows:

Rainfall (mm/year)	Persons/km^2 (sustainable)
350	1
600	10
800	20
800+	20

Current, national, population density is about 35 persons/km^2 so the sustainable level is already far exceeded. In fact, on the basis of the data above and regional densities, only Tambacounda would be classified as below its sustainable level. (See Table 5 for population densities by administrative region. Maps 1-3 show approximate rainfall zones.)

From a strategic point of view, the "problem" also suggests certain opportunities for the rural community. Increasing demand and diminishing supplies of wood for fuel and other uses argues that agro-forestry should be an important element in a national rural development strategy. While the need to generate wood for home use is critical in much of rural Senegal, and while the potential for income generation is high, appropriately managed agro-forestry can also make a considerable contribution in other ways. The pods from the much appreciated Acacia Albida, for example, are a high protein animal feed (on a par with barley), through nitrogen fixation and its contribution to soil organic matter it helps improve soil productivity, and it produces significant quantities of animal fodder and firewood. On the other hand, and it should be emphasized,

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[6] See Chapter I for more information of donor programs and investment priorities.

[7] Some wood is produced on cultivated land but yields are much lower than on forest or shrub lands.

the loss of forest land, and soil degradation in general, has occurred over long periods of time and corrective measures are also a long-term process. For example, overgrazed grassland can require as much as 30 years to regenerate and Seyler (1990) estimates that it will take 10 years before the benefits from a program to integrate Acacia Albida into the farming system will start to appear.

Thus, while forestry and agro-forestry are clearly important considerations for long-term development, shorter term strategies are necessary. The remainder of this chapter concentrates on identifying some of the major resource related constraints and potentials which will have to be considered in developing an intermediate-term agricultural sector strategy. The analysis concentrates on the relationships between cropland, population and water.

AGRICULTURAL POTENTIAL

Because it is important to confront land capability with population and production data, this report will use a classification which follows, as closely as possible, administrative boundaries. This will also facilitate subsequent impact monitoring, as required by the DFA legislation. The one exception is the area identified as Dakar/Niayes, which includes parts of the Regions of Thies, Louga, and St. Louis. This region is treated separately because of its importance as a horticultural zone. Table 3 and the Map 4 on the following page show basic data for land types and land use.

Table 3

Senegal: Total Land Area, Land Zoned Non-Agricultural, and Arable Land
(Thousand Hectares)

Region	Total Land Area	Zoned for non-Agric. Uses	Total Other Area	Arable Land *				Rural Population (000's)
				Cropped	Fallow	Available	Total	
Dakar	55	6	41	2	0	6	8	53
St. Louis	4,412	1,769	2,389	40	0	214	254	472
Louga	2,919	1,084	1,335	264	147	89	500	417
Thies	660	98	193	233	90	47	370	618
Diourbel	436	0	86	247	96	7	350	483
Sine Saloum	2,395	341	904	848	300	2	1,150	1079
Casamance	2,835	477	1,608	326	126	297	750	780
Tambacounda	5,960	2,331	3,229	208	80	112	400	322
Total	19,671	6,105	9,786	2,169	840	773	3,782	4,224
Dakar/Niayes	280	179	65	23		13	36	
Irrigable				6		7	13	
Rainfed				17		6	23	

Source: Senegal Agricultural Policy, 1985, page 179 with areas corrected, the 1986 Cereals Plan, pages 16 and 17 and [MDR, 1986, page 60].

* Area cropped is 1985-1989 average in major crops (peanuts, sorghum/millet, maize, cowpeas and cotton) - except Dakar/Niayes area planted is 1984 and includes horticulture.

CURRENT AND POTENTIAL AGRICULTURE OF SENEGAL

MAP 4

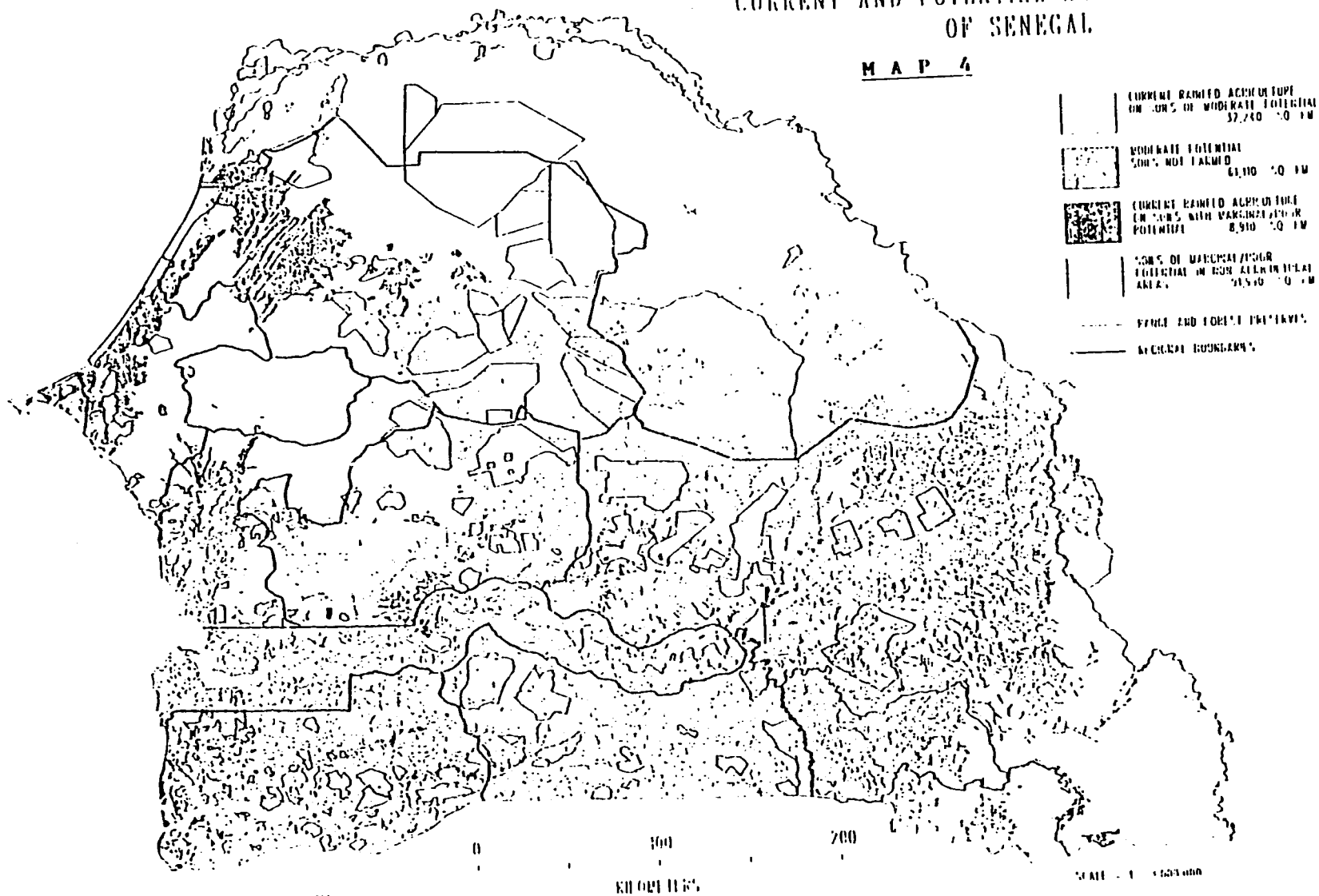
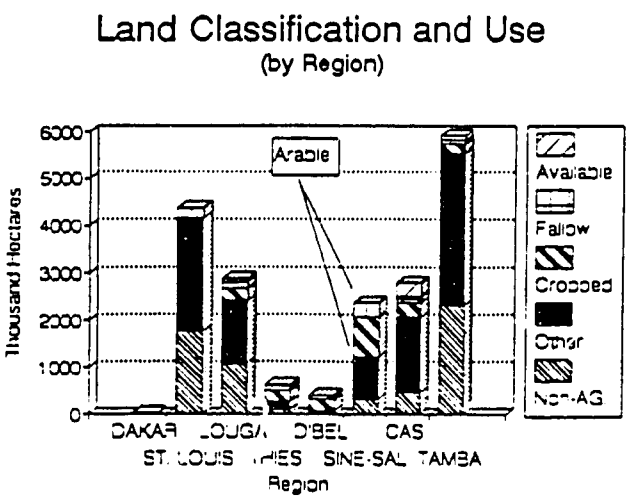


Figure 1 and Map 4 show the distribution of land by region and by broad land type. These two sets of information emphasize, particularly, the relatively small supply of arable land in each region and the even smaller amount of unused arable land, especially in the main part of the groundnut basin (Thies, Diourbel and Sine-Saloum - Kaolack and Fatick). Note also from Map 4 that there is a large and broadly distributed amount of land presently farmed which, on the basis of soil characteristics (i.e. not considering rainfall levels), is classified as "poor potential". Map 4 also shows that a large part of the unused potential is in forest or grassland reserves. This is important to the formulation of a development strategy because 42 percent of the total and 52 percent of the rural population lives in these regions. (Including Louga, this area accounts for 49% of the total and 62% of the rural population.) Another factor, not shown so clearly in Figure 1, is that the majority of the land available for expansion is in the River Valley, Casamance and Tambacounda Regions. This and some of the implications is discussed in greater detail below.

Figure 1

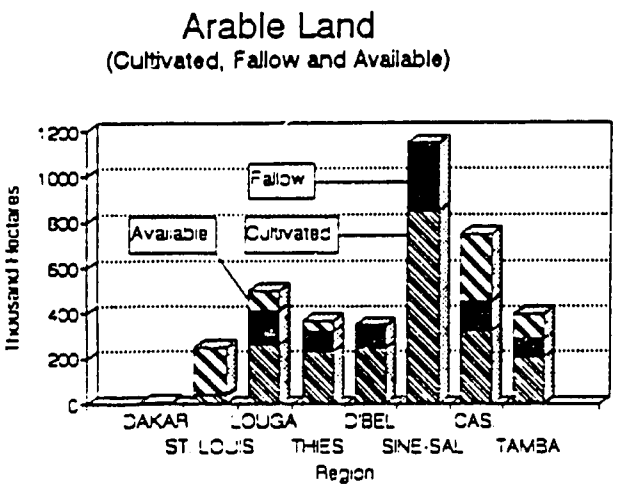


One of the central issues which must be addressed in a national rural development strategy is demonstrated in Figure 2, which shows arable land by region and by its use (cropped, fallow reserve and available). As mentioned above, the Groundnut Basin (Louga, Thies, Diourbel, Fatick and Kaolack) has very little land available for expansion and a large and growing rural population. Any expansion would mean use of the fallow reserve, which under any circumstances should not (and in the intermediate-term probably cannot) be brought into production.[8] The rural community of Kaymor is an example of the growing use of marginal land, with less fallow. In 1970, 28 percent of all land available to the community was farmed, 10 percent was fallow and 62 percent was in forest.

[8] The Senegal Natural Resources Management Assessment (USAID/Senegal, July, 1990, page 78) lists soil management problems in the Groundnut Basin (acidification - upland soils, salinization - Sine-Saloum, soil degradation - general) which suggest that most of the fallow is marginal land. Seyler (1990) has also observed that farmers are placing more land into fallow in an attempt to recapture lost fertility.

In 1983, 64 percent of the land was farmed, 2 percent was in fallow and 30 percent was forest (15% of the farmed land was classified as "bad") [Lhoste, 1987, pg 82]. As Map 4 shows, considerable marginal land is now under production, and the prospects are that this will increase with time.

Figure 2



Of the four regions which do have some land available, Louga should be discounted because of rainfall shortages and sub-soil water salinization problems, and the land available in the St. Louis Region is irrigation potential - highly expensive to develop and unlikely to be realized in the near future.

Another issue, in addition to the amount of arable land, is land quality. Senegal, in fact, has no "high" quality land and, if the vegetative cover is removed, much of the "good" land is susceptible to erosion. As shown on Map 5 on the following page, soils in all of the ferlo (north central Senegal), all of the Casamance, and virtually all of the groundnut basin are extremely susceptible to wind erosion. Soil scientists would argue that none of these soils should be cultivated without intensive erosion control measures. With the exception of a small strip along the Senegal River Valley, virtually all of the land with low and moderate susceptibility to erosion is found in eastern Kaolack and in Tambacounda and, even in there, large areas are at risk.

An example of how vegetative cover influences water retention levels and erosion is provided by research in the Casamance during the 1950's and 60's (Table 4). Once the vegetative cover is removed, land in the region loses almost 40 percent of the rainfall to runoff and over 21 tons/year of soil to erosion. The consequences for soil productivity from expanding land under production without appropriate anti-erosion measures is quite clear.

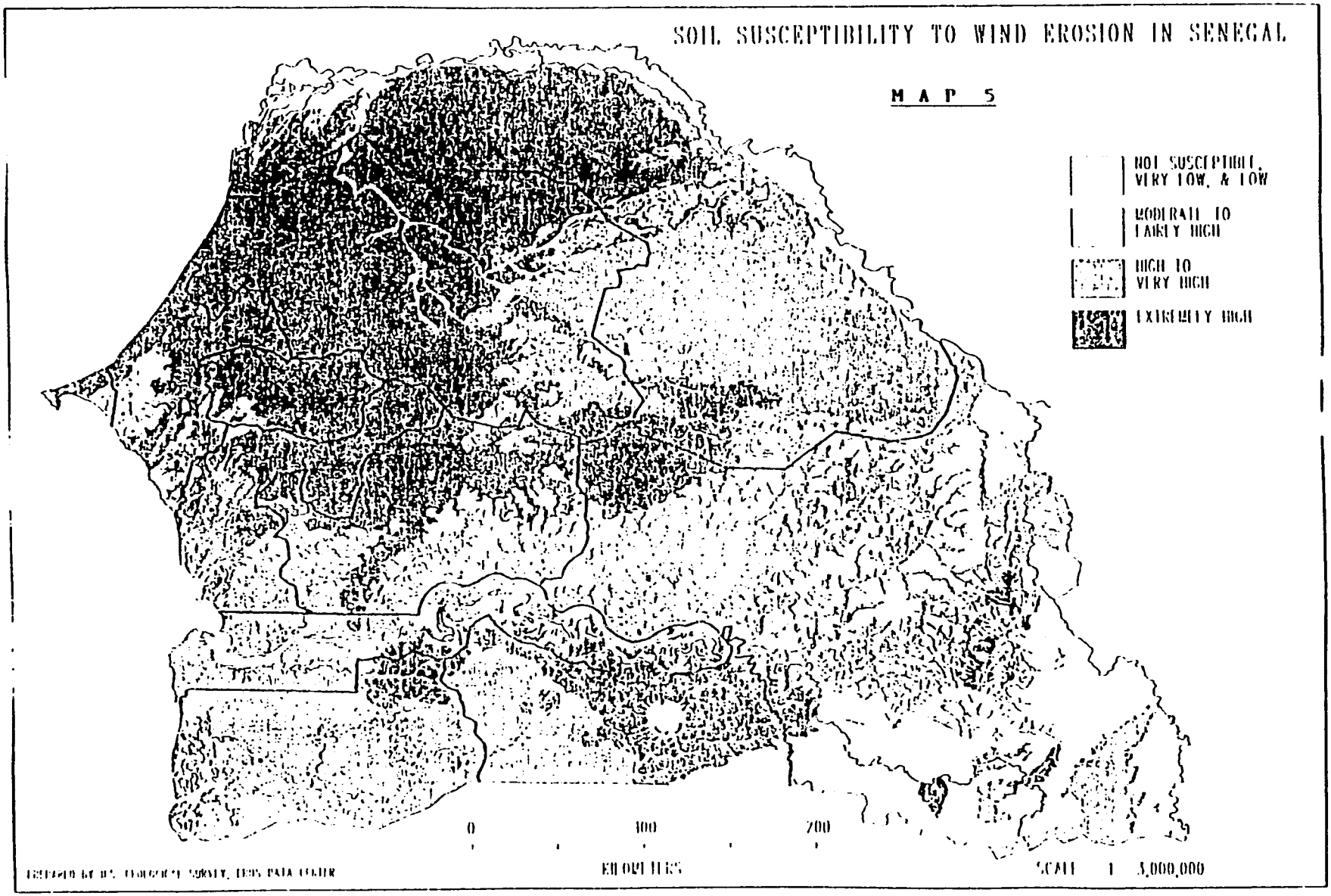

SOIL SUSCEPTIBILITY TO WIND EROSION IN SENEGAL
MAP 5
NOT SUSCEPTIBLE, VERY LOW, & LOW
MODERATE TO FAIRLY HIGH
HIGH TO VERY HIGH
EXTREMELY HIGH
0
100
200
KILOMETERS
SCALE 1 3,000,000

Table 4

Land Cover, Water Runoff and Erosion
(Village of Séfa, Casamance)

Vegetative Cover	Rainfall Runoff (% rain)	Erosion (Ton/ha) (annual)
Forest	1.0	0.18
Fallow	16.6	4.88
Crop	21.2	7.31
Bare Soil	39.5	21.28

Source: [Pieri, 1989, pg 177]

Soil quality, as measured by organic matter and cation exchange capacity, is also degraded by the cropping systems used in Senegal. In the Casamance, 12 years after the forest is cut, 30 percent of soil organic matter is lost (66% in 46 years); this is accompanied by severe changes in the chemical characteristics of the soil and reduced water retention capacity [Pieri, 1989, pg 108]. The result is reduced productivity. For example, rainfed rice in the Casamance (even with 10 tons of manure and 50 kg of nitrogen per hectare) yielded 2,021 kg/ha three years after the forest was cut and 1,195 kg/ha 46 years later. Without fertilizer the yields were 1,020 three years after clearing and 310 kg/ha 46 years after clearing [Pieri, 1989, pg 112]. Thus, in the Casamance, in addition to problems with providing sufficient fuelwood, there is a tendency to mine the soil by clearing more and more land (when "higher" technology is not employed), which means more and more erosion, less efficient use of available water and an increasing land-population-production crisis.

Continuous cultivation (which includes removal of all crop material) in the more limited rainfall zones of the Groundnut Basin and generally anyplace where groundnuts are grown (because the straw has a substantial value as livestock feed), has led to a significant decline in groundnut yields. Yields (with and without fertilizer) over time (1957-73) did not only declined, but have began to converge -- i.e. yields with fertilizer declined faster than yields without fertilizer [Pieri, 1987, pg 213]. According to Pieri, returns to fertilizer (kg groundnuts/kg fertilizer) in Darou fell from 25.7-26.7 kg for 1957-64 to 8.5-9.5 kg in 1969-73 (the first number is for a 2 year fallow and the second is for a 6 year fallow) [Pieri, pg 217]. Part of this can be explained by increasing rainfall through the mid-1960's and decreasing rainfall through the 1970's, and part of it by generally degraded soil. Overall, Pieri estimates that soil productivity has declined at between three and five percent per year [Pieri, pg 415].

In the absence of a serious program to improve soil management on existing land and protect newly opened land, growth in the rural sector is not just questionable, declining food and cash crop production is a certainty. In order to establish some parameters within which to measure the severity of the existing "problem", to outline the impacts of contributing factors, and to point to the resource/population factors which may contribute to articulation of an agricultural development strategy for Senegal, the remainder of this chapter will develop a more detailed analysis of the resource/population issues. This discussion is intended to establish the "outer" boundaries of the "problem". The other chapters of the report will deal with specific alternatives and options.

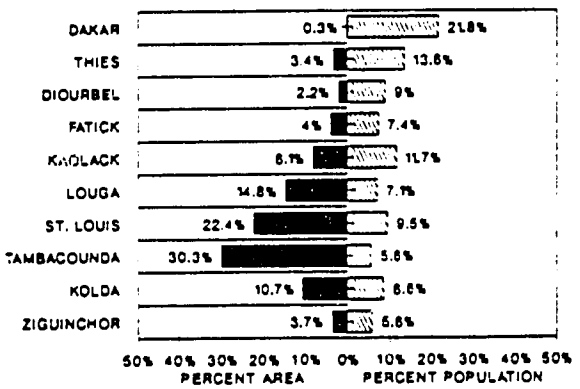
POPULATION DISTRIBUTION AND LAND USE

Like many developing nations, Senegal has experienced high population growth accompanied by increasing urbanization. In 1976 about 34 percent of the national population lived in urban areas and by 1988 (the last population census) 39 percent of the population lived in urban centers. The urban population is concentrated in a few major cities. About 22 percent of the Senegal's people live in Dakar, which had a population density of 2,728 people/km2 in 1988. In 1988 the Dakar area (Dakar proper, Pikine, Rufisque) accounted for 54 percent of the total urban population.

Considered together, the Thies and Dakar regions account for 66 percent of all urban and 35 percent of the total population. Outside these regions (which also dominate the trade and industrial sectors) the population is unevenly distributed, varying between 142 persons/km^2 in Diourbel (9% of the population and 2.2% of land area) and 6 persons/km^2 in Tambacounda (30% of the land area and 5.6% of the population). Overall, including Dakar, Senegal has 35 persons per Km^2 (Figure 3 and Table 5).

Figure 3

LAND AND POPULATION DISTRIBUTION
(1988)



A better perspective on land/population pressure is provided by the population density relative to arable land (last column, Table 5). To be meaningful both of these measures need to be related to a standard to determine whether or not they indicate a development constraint or potential. That is, a density of 182 persons per square kilometer of arable land (or inversely 0.55 ha/person) becomes meaningful only when combined with actual and potential production. To establish a broad perspective: since Senegal imports between 50 and 60% of its cereal grain needs, its <u>apparent</u> demands on the land are more than

double its present productive ability.[9] It is clear, given population growth and increasing urbanization, that any development strategy must address these issues.

Table 5

SENEGAL: POPULATION AND SURFACE AREA DISTRIBUTION - 1988

REGION	PERCENT OF AREA		% POPULATION BY REGION			% POPULATION IN REGION			DENSITY/Km2	
	TOTAL	ARABLE	RURAL	URBAN	TOTAL	RURAL	URBAN	TOTAL	TOTAL	ARABLE
DAKAR	0.3	0.2	1.1	53.5	18.8	3.5	96.5	100.0	2,728	18,756
THIES	3.4	9.8	14.5	11.6	13.5	65.9	34.1	100.0	142	253
DIOURBEL	2.2	9.3	10.1	5.2	8.5	78.3	21.7	100.0	141	176
SINE-SALOUM	12.2	30.4	25.6	9.5	20.1	82.2	17.8	100.0	55	114
FATICK	4.0		11.3	2.2	8.2	89.6	10.4	100.0	64	
KAOLACK	8.1		14.3	7.3	12.0	77.6	22.4	100.0	50	
LOUGA	14.8	13.2	11.1	3.1	8.4	85.2	14.8	100.0	17	98
ST. LOUIS	22.4	[illegible]	11.8	7.4	10.3	72.5	27.5	100.0	15	256
TAMBACOUNDA	30.3	[illegible]	7.5	2.4	5.7	84.1	15.9	100.0	6	96
CASAMANCE	14.4	19.8	18.4	7.3	14.6	78.6	21.4	100.0	35	132
KOLDA	10.7		12.2	2.2	8.8	89.6	10.4	100.0	28	
ZIGUINCHOR	3.7		6.2	5.1	5.8	62.2	37.8	100.0	54	
SENEGAL	100	100	100	100	100	61.4	38.6	100.0	35	182

SOURCE: ENDERS (1976 AND 1988 CENSUS)

Senegal's population increased at 2.7 percent per year between 1976 and 1988 (rural growth was 2.07% and urban growth was 3.83%). At this race of growth Senegal's population will total 9.6 million by the year 2000 with nearly 44 percent of the population living in urban areas (25% in Dakar). The pressure which this has, and will continue to exert, on Senegal's land and water resources is enormous. For example, Senegalese farmers use over 62 percent of the nation's total arable land each year. Compared with FAO norms, which specify a 5:1 fallow/cultivation cycle for 'traditional' agriculture (about 17% of cultivable land per year), the Senegalese numbers amount to an extremely intense cultivation schedule. To provide a perspective, at current technology, land under cultivation would have to increase 30 percent in the next ten years to provide food and income to Senegal's population. Since Senegal presently cultivates 62 percent of its arable land, farmers would have to bring all possible land into use, just to maintain the status quo.

In view of the increasing population pressure one would expect a continuous expansion in cropped area. However, much of this expected expansion has not occurred because the land/water population distribution pattern in Senegal limits the country's ability to meet near and intermediate-term food and cash crop needs

[9] This is a highly gross, and extremely limited, measure of carrying capacity. This measure, and many existing measures of carrying capacity are focused on food self-sufficiency as opposed to food security because they concentrate on food crops only. In the later part of this report, when alternative strategies are proposed and analyzed, a much broader view of carrying capacity will be employed.

by simply expanding area planted. If anything, one of Senegal's major constraints is that the major portion of its rural population is separated from the available exploitable land and water resources. This helps to explain why, in the aggregate, the area planted to major crops has remained relatively stable over the past 30 years, and why, especially for the last 20 years, there has been a general shift from cash crop (groundnuts) to food crop production (Table 6).

The average area planted over the ten years between 1980 and 1989 was 3.6 percent below the 1970-79 average, with cash crop areas down 16.3 percent and food crop areas up by 8.7 percent (an average increase of about 0.8% per year). Since the rural population has been increasing at about 2.1 percent per year, the consequences are clear - the food crop area planted per rural person will have decreased by about 1.2 percent per year, with, in the absence of increases in productivity, an attendant decline in food production and income generation. Although there are a number of interrelated factors which have contributed to the shift in the commodity mix (notably relative prices, credit, access to certain inputs such as peanut seed, and policy in general) one of the major factors behind this change must be the relative distribution of the rural population and the land/water balance.[10]

Table 6

Area Planted to Major Crops (000 ha)
(Ten Year Averages 1970, 1980, 1990)

Crop	Average Over Crop Years			Change 70/79-80/89	
	1960-69	1970-79	1980-89	Hectares	Percent
Cash Crops	1,073.2	1,154.6	966.5	-188.0	-16.3
Groundnut	1,070.1	1,122.0	932.6	-189.4	-16.9
Cotton	3.1	32.6	34.0	1.4	4.3
Food Crops	1,165.9	1,191.6	1,295.2	103.6	8.7
Millet/Sgm	977.1	999.9	1,063.6	63.7	6.4
Rice	82.4	79.2	70.8	-8.4	-10.6
Maize	44.6	49.6	89.4	39.8	80.2
Cowpeas	61.9	62.9	71.5	8.6	13.7
Total	2,239.1	2,346.2	2,261.8	-84.4	-3.6

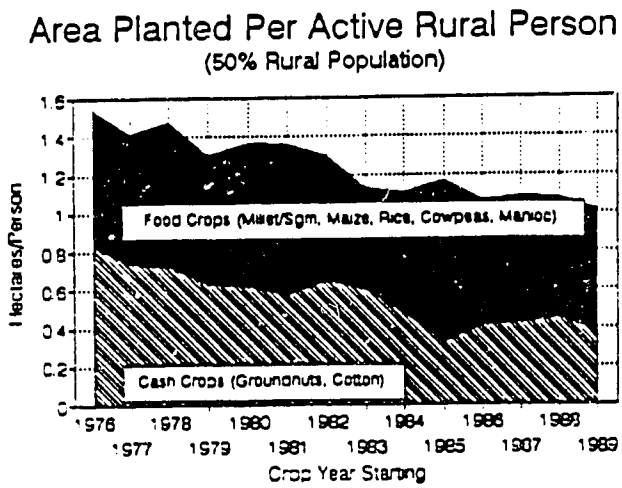
Source: Derived from data in Annex II.

Figure 3 demonstrated that there is a wide dispersion in population density, and showed, in broad terms, the population/land relationship. A more specific relationship between the land and the rural population was presented in Figure 2, which showed that the majority of the rural population had little space for expansion. Figure 4 shows the land use consequences - generally

[10] The other factors will be discussed in a later section of the report.

diminishing areas planted per person, as more and more people attempt to farm a relatively fixed quantity of land.

Figure 4



Thus, while on an aggregate basis (as was shown in Table 6) there has been a substitution from land in cash producing crops to food crops, on a per capita basis (i.e. per active agricultural person) there has been a decline in areas planted to both types of crops. And, this is true of all of the regions under discussion, except Tambacounda. As Figure 4 shows, since 1976 the area in food crops has diminished from about 0.8 ha/active to 0.6 ha/active and the area in cash crops has declined by 50%. The only circumstance under which such a situation can be considered desirable is if there have been compensating increases in productivity for food crops and real price increases for cash crops. In the aggregate, neither is true.

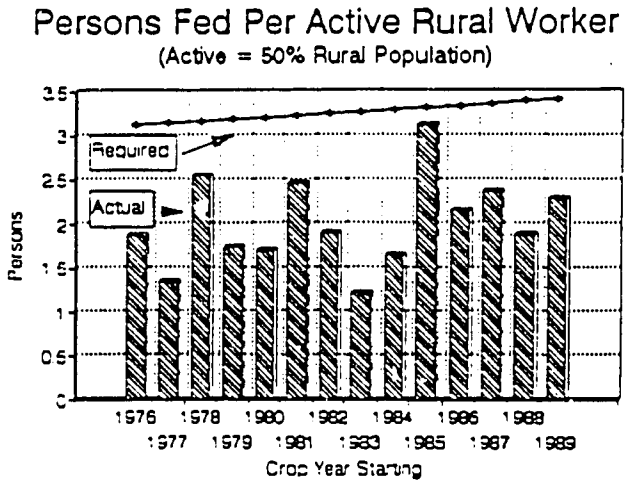
A measure of the carrying capacity of the existing system is shown in Figure 5. The data shown in the figure combine population growth and the shift between cash and food crop production to show the number of people fed per active rural worker (the height of the bars).[11] The solid line in the graph indicates the number of persons each active worker would have to feed to achieve full food security for the nation. The horizontal line at two persons per active worker would be complete satisfaction of the rural population cereal needs.

The figure shows a number of trends: inability to produce enough food crops to feed the population (all of the bars are below the "required" line); a widening of the gap between number of persons who can be fed and the number who must be fed (because of population growth and declining areas, output for the last four years has not been far from the level required to feed just the rural population); and there has been extreme variation in output of both food and cash

[11] Production (millet/sorghum, maize, paddy, cowpeas) was converted to millet equivalent per active worker then divided by 200 kg (estimated per capita grain consumption).

crops, with considerably more variation in food crop output than in cash crop output.

Figure 5



The graph presents an extreme view of the demands placed on crop based agriculture because it shows crop output relative to total coarse grain requirements. Even so, it indicates an increasing need either to improve crop production and productivity for the traditional crops, as well as for that part of agriculture outside the major food and cash crops. It is clearly not reasonable that crop based agriculture should be expected to generate enough output to support the entire nation. But, the "gap" raises questions about the ability of the remainder of the economy to meet Senegal's food (and revenue) needs. Knowledgeable observers say that growth in general is dependent on solid growth in agriculture and especially crop based agriculture.[12] Therefore, with the potential for expansion in land area limited, there is an apparent need for better natural resource management, and intensification where appropriate, to improve productivity (feasibility issues are addressed in the next chapter).

WATER RESOURCES AND DEVELOPMENT POTENTIAL

In the Sahel, questions of land capacity, capacity limits and exploitation of available capacity lead inevitably to water. Some areas in Senegal, especially those areas north of Dakar and a large part of the area north of

[12] See [Lele, 1990] and [Renison, 1990, pg 57].

Gambia, face a highly variable climate which places serious restrictions on the kinds of crops which can be grown. There are three sources of water: the Senegal River, sub-surface and surface. According to the Ministry of Rural Development and Hydrology these waters are distributed as follows [MDRH, 1986, page 4]:

75% Senegal River Valley,
10% sub-surface, and
15% surface.

River Systems

There are six primary surface water systems in Senegal, each with its own potentials and problems.

- Senegal River and Falsme River. Jointly, with partial control (46% of the Basin) by the Manantali Dam, these two rivers produce a potential average annual exploitable volume of 400 billion m^3 per year, sufficient to irrigate 300,000-400,000 hectares. The development of this potential has proven expensive, because of high development, maintenance, and operations costs. To date only about 30,000 hectares of the total potential has been developed.

- Gambia River. Limited agricultural potential.

- Casamance River. Extends for 300 kilometers. Because it has a low gradient, salinization caused by salt water intrusion during low-flow periods is a problem. This is being addressed by the USAID Southern Zone Water Management Project and other donors (Italy - PRIMORCA).

- Anambe River. 1420 hectares of irrigated land are under development, 395 completed and 16,000 proposed.

- Lac de Guiers. A natural lake, connected to the Senegal River. About 30-40 million m^3/year and one of the water sources for Dakar (28,000 m^3/day).

Sub-Surface Water

Senegal possesses a number of potentially exploitable aquifers (See the Natural Resources Assessment [USAID/Senegal, 1990, pages 21-31]). Explicit information on the exploitable, agricultural, potential of many of these aquifers is not available. The MDR has estimated that these water sources can provide a renewable supply of 176 million m^3/year. Senegal has established priority uses for this water as 1) human, 2) animal, and 3) irrigation.

Some of this potential is being exploited, particularly in the Niayes for irrigation, and for water in the Dakar and Louga areas. There are already some problems with lowering water tables and saltwater intrusion in the Niayes area, which raises some question about further expansion in this area. In addition, the Kebemer/Kelle aquifers (22,000 m^3/day) and the Thies and Cap Vert aquifers (115,000 m^3/day) are exploited for Dakar water, further restricting agricultural potential as well as introducing water quality concerns.

The exploitation of the deeper aquifers (some 60 meters or more) raises cost and management questions. The first concern is, and ought to be, better water supplies for rural household use. Thus, consideration of sub-surface water for agriculture is to be discounted.

Rainfall

Rainfall and its distribution during the growing season remains the primary determining factor in Senegalese agriculture. It establishes the limits to cultivation as well as defining the potentials. Earlier in this chapter Figure 2 demonstrated that there are essentially three land potential zones: the Senegal River Valley with considerable potential for irrigation; the groundnut basin with very little potential for expansion; and South and Eastern Senegal, with considerable potential for expanded rainfed agriculture. Rainfall and its distribution further emphasizes these constraints and potentials.

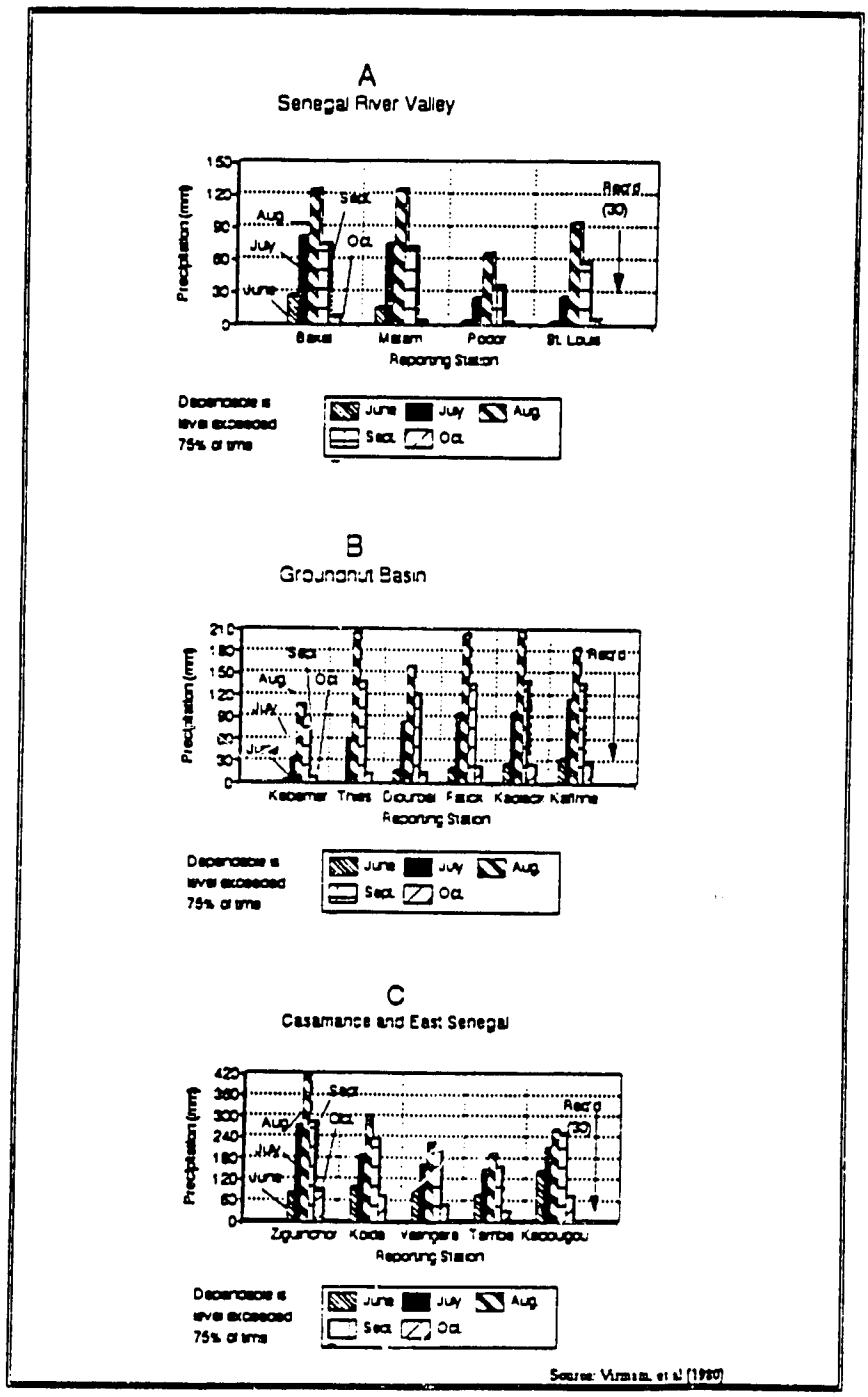
Figure 6 shows the level of dependable rainfall at reporting stations in each of the major regions. In the figure, dependable rainfall is defined as the level exceeded at least 75% of the time over successive 10 day periods; a minimum of 30 mm of dependable rainfall (over the 10 day period) is considered necessary for rainfed crops. The data establish the outer limits on what crops and crop systems can be applied during the growing season. Part A show data for the River Valley, part B for the groundnut basin, and part C for the Casamance and Tambacounda. Three facts emerge from the figure:

- in Louga (Kebemer in the graph) 60 day crops are required;
- 90 day crops are required in the Groundnut Basin; and
- in the south, 120-150 day crops are possible.

The length of the reliable rainfall period (level and distribution), climatic conditions and soil quality combine to determine which crops can be produced in a given region. But, <u>even under marginal conditions, soil moisture retention capabilities can make an enormous difference in the level of "required" rainfall</u>. Early maturing maize, for example, needs 400 mm in a three month period if water retention is low and only 200 if water retention is maximum (Table 7). The strategic implications are discussed further in the next chapter.

Figure 6

Dependable Precipitation, River Valley, Groundnut Basin, Casamance and East Senegal



Source: Virmani, et al (1980)

Table 7. Rainfall Requirements during Particular Growth Stages of Annual Crops

Crops	Number of Days from Sowing to 50 Percent Flowering		Number of Days from Sowing to Harvesting		Rainfall Required after Sowing (mm)				Rainfall Required in Month of Flowering (mm)		Rainfall at Harvest (mm)
					early maturing		late maturing		20 days before 50% flowering; 10 days after 50% flowering		
	early maturing	late maturing	early maturing	late maturing	no moisture storage	max. moisture storage	no moisture storage	max. moisture storage	no moisture storage	max. moisture storage	
Wetland rice	85-110	110-140	110-140	140-180	500 in 3 months	-	750 in 4 months	-	-	-	80 in a 10 day period
Upland rice	85-110	110-140	110-140	140-180	600 in 3 months	-	900 in 4 months	-	-	-	80 in a 10 day period
Maize	50-65	65-90	90-110	110-140	400 in 3 months	200 in 3 months	500 in 4 months	300 in 4 months	40 each 10 day period	25 each 10 day period	70 in a 10 day period
Sorghum	50-65	65-90	90-110	110-140	200 in 2 months	100 in 2 months	400 in 3 months	200 in 3 months	30 each 10 day period	15 each 10 day period	50 in a 10 day period
Common millet	35	60	60	90	125 in 1 month	50 in 1 month	200 in 2 months	200 in 2 months	30 each 10 day period	15 each 10 day period	50 in a 10 day period
Groundnut	60	90	95-110	110-140	300 in 3 months	125 in 3 months	500 in 4 months	300 in 4 months	60 each 10 day period	60 each 10 day period	30 in a 10 day period
Cowpea	-	-	60-90	90-150	400 in 3 months	200 in 3 months	450 in 4 months	250 in 4 months	-	-	50 in a 10 day period
Cotton	60-90	-	150-180	210-270	450-800 in 4 months	250 in 4 months	300 in 12 months	300 in 12 months	100-300/month (15 rainy days)	50 months	30/month 5 rainy days
Safflower	90	-	120	-	300-400 in 4 months	100 in 4 months	-	-	30 each 10 day period	30 each 10 day period	25 in a 10 day period
Sunflower	-	-	70-110	110-150	300-450 in 3 months	100 in 3 months	500-700 in 4 months	300 in 4 months	-	-	40 in a 10 day period
Sesame	-	-	40-70	100-140	225-0 in 2 months	60 in 2 months	500-700 in 4 months	300 in 4 months	-	-	40 in a 10 day period
Potato	-	-	100-150	-	450-600 in 4 months	250 in 4 months	-	-	-	-	40 in a 10 day period
Sweet potato	-	-	100	180	350 in 3 months	150 in 4 months	800 in 6 months	600 in 6 months	-	-	20 in a 10 day period
Cassava	-	-	180-450	700	900 in 12 months	-	1500 in 12 months	-	-	-	40 in a 10 day period
Sugar-cane	-	-	270-420	660-720	1.200-1.800 in 12 month 70-120 in 4 driest months of the year	-	1.500-2.500 in 12 months 18 rain days per month 50-80 in 2 driest mo.	-	-	-	40 in a 10 day period
Tomato	-	-	90-120	-	400-600 in 3 months	200 in 3 months	-	-	-	-	40 in a 10 day period

Source: [ILACO, 1981]

CONCLUSION

The information presented in this chapter suggests certain elements which have to be considered when developing a sector strategy. This chapter has shown that there has been a general decline in productivity in both food and cash crops and that increasing demands have and will continue to be made on limited natural resources and a land base which does not permit area expansion as "solution" in large parts of the nation. Soil productivity is a major issue.

Between 1976 and 1988, the nation's population grew at 2.7 percent per year (2.1% for the rural population and 3.8% for the urban population). About 40 percent of the total population is urban and by the year 2000 the urban population will account for 44 percent of the total. There is no expectation that Senegal can achieve food self-sufficiency, to the contrary, the day is rapidly approaching when Senegal's resources will not be able to support its rural population, even in good years.

The portion of the country with the majority of the rural population (the Groundnut Basin) has little room for crop land expansion and highly variable rainfall and, thus, highly variable production. Virtually all of this land is extremely susceptible to erosion, with little actual investment targeted to resource management. This, combined with the high rate of population growth, has a number of negative impacts:

- a steady decline in the area cultivated per agricultural worker;
- extension of farming to marginal land;
- a shift from cash to food crop cultivation; and
- an increasing production deficit.

Although there is some evidence that a few farmers have begun to place more land in fallow (to regain lost productivity because of low soil organic content and increasing erosion), there has been a general decline of soil productivity (3-5%/year) which has also contributed to stagnation in the rural sector. A strategy aimed at this region would have to concentrate on farm level natural resource management to stabilize, then improve production.

That portion of the country with the greatest potential for expanded rainfed agriculture is the least populated (Casamance and Tambacounda). This area possesses a wider range of development alternatives, but has, as well, some marketing/transportation and land/population management constraints. While this area contains some of the "best" land (Senegal has no land that would be classified as "good") . large portion of even this land is also susceptible to erosion, once the vegetative cover is removed. This region also has the largest forested area, but pressure from "mining" newly cleared land for crop production and to provide woodfuel (woodfuel provides 69% of the nation's energy) continues to place more and more land at risk. Exploitation for woodfuel alone can be expected to account for vast clearing (Senegal's national fuelwood sustainable density is well below 20 people/km^2 but the population density is already 35/km^2).

The next chapter deals with these questions as related to productivity, production and crop mix potentials and regional comparative advantage. The chapter will investigate, in particular, existing and potential farming systems (technology) and alternative crops on a more detailed geographic basis so that both physical and institutional constraints and opportunities can be identified.

CHAPTER III
FARM TECHNOLOGY: TECHNOLOGY CHOICES, CROP PRODUCTION AND PRODUCTION POTENTIAL

Chapter II outlined some basic environmental factors which act to limi (or expand) crop production potentials in Senegal. This chapter extends tha discussion to include human intervention to investigate the degree to whic restrictions have been, or may be, overcome and/or potentials exploited. It i clear at the outset that land quality and water supply are the two dominan physical factors in Senegalese agriculture and that these two factors severel restrict crop alternatives for much of the rural population. It is the blen of the physical and human factors which determines the degree to which th physical factors will be limiting, given the crop alternatives available. Ther are two principal issues: the availability of appropriate technology and it eventual implementation.[1] The remainder of this chapter will deal with thes issues as follows: first, a brief discussion of the locations and the importanc of various crops in national production; second, a discussion of availabl technology and incentives for or against adoption; third, a discussion of th implications for national production and food and export balances; and fourth a brief discussion of comparative advantage for existing crops and the potentia for introducing new and/or alternative crops.

Crop Production: Location and Importance

In terms of area planted and gross production, millet/sorghum an groundnuts are the most important crops produced in Senegal; over the last fiv years these crops accounted for 85% of total area planted (Table 1 and Figur 1). Millet is by far the most important in terms of area planted (50%), followe by groundnuts for oil (35%). Among the food crops, after millet, maize account for 4.5% of planted area, followed by cowpeas (4.1%) and paddy (3.5%). Cotto accounts for 1.4% of area planted and manioc and confectionery groundnuts eac account for 0.7% of area.

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[1]Much of the discussion in this chapter is from the USAID/ADO Technology Inventory (Annex VI) and dat in Annex III, most of which is based the crop budgets in [Martin, 1988], with revisions to reflect changes i prices and practices. Martin developed crop budgets for major crops in each of 12 regions. The budgets reflec a combination of station and on farm research and the judgment of researchers and experienced field staff. Th detailed budgets are included in the Annex so they will be available for evaluation and revision as bette information is available; they are about the only source of internally consistent, nationwide, budgets fo Senegal. The specific technologies are generally defined as high, medium, and low, with additional informatio for late planting and fields located near the farm residence. In each case, the yield information represent an "average" year. The late planting and "home fields" reflect the lowest available technology, with th exception that the small "home fields" receive substantial amounts of organic fertilizer. A comparison of th costs and output from these fields with the others is useful because they represent the potentially mos productive land and an indication of what might be attained from better soil management. There is considerable regional difference in what constitutes high and medium technology. For example, most technologie in the Senegal River delta represent highly mechanized (tractor) land preparation, whereas high technology i the other areas, especially in the Groundnut Basin and the cotton producing regions, may be mechanized, but i usually animal traction. In general, the medium technology is the same as the high technology but with reduce purchased inputs (fertilizer). The low technology and "home field" information is most often based on manua operations. The reader should be careful when comparing technologies across regions.

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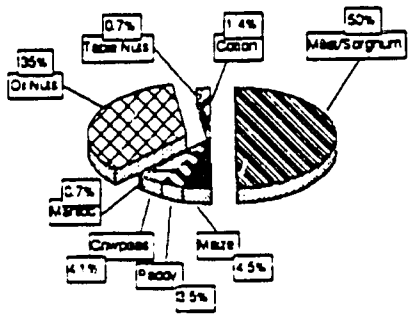
Regionally, Kaolack accounts for the largest portion of area planted (almost 28%), Fatick, Diourbel, Thies, Louga and Kolda each account for between 11 and 12 percent, farmers in Tambacounda plant 9.5% of the national total and the St. Louis region accounts for the smallest portion (2%).

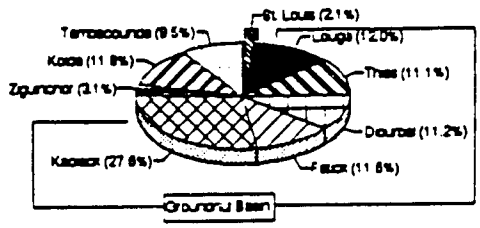
Figure 1

Area Planted to Major Crops (Percent of 1985/89 average)

Percent by Crop



Percent by Region



Source: Derived from Table 1.

The previous chapter pointed out that the regions which now account for 75 percent of the cultivated area (the Groundnut Basin) have little potential for expansion. In addition, because of rainfall patterns, crop choices in these regions are restricted to short season, drought tolerant varieties. It is apparent that growth in crop based agriculture in these regions is dependent on relieving basic soil and water constraints. It is also apparent that, in absolute terms and at present consumption patterns, increased productivity in millet (ie, improved input/output ratios through different technologies and farming systems) would make a relatively larger contribution than it would for such crops as maize. What remains at question is whether or not cost effective technologies exist and will be employed. A related, basic, development issue is the social benefits and costs related to a shift in basic production and consumption patterns. For example, the following analysis will show that at current prices and costs there is little incentive for Groundnut Basin farmers to move to higher technologies but that there is significant potential in the south. The relative benefit from a shift in consumption from millet to maize could be considerable. For example, on the basis of relative yields and caloric values, one hectare of maize could replace about two hectares of millet. The replacement rate could actually be as high as 3 to 1, if relative calory production per day of labor and selected technology is applied. The following sections consider this question in more detail.

Table 1

Senegal: Area planted, Production and Yields - Major Crops
(Five Year Average, 1985-1989)

Crop	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambo-counda	Total Senegal
					Fatick	Kaolack	Total	Zig'chor	Kolda	Total		
Area (1000 ha)												
Millet/Sgm	21.1	153.3	131.3	146.2	149.1	301.5	450.6	12.9	86.0	98.9	100.3	1,102
Maize	2.9	--	--	--	3.7	26.4	30.0	4.1	36.1	40.2	28.4	102
Paddy	15.5	--	--	--	0.3	0.2	0.5	24.9	29.6	56.5	3.8	76
Cowpea	4.4	38.8	19.1	19.6	4.3	0.9	5.2	1.2	0.4	1.6	1.4	90
Manioc	--	--	11.8	0.4	1.3	0.2	1.6	0.8	1.0	1.8	0.0	16
Oil Nuts	1.5	71.9	82.3	81.3	95.7	263.2	358.9	25.5	85.9	111.4	65.2	772
Table Nuts	--	--	--	--	1.8	13.0	14.9	--	2.4	2.4	0.8	16
Cotton	--	--	--	--	0.5	2.6	3.0	--	17.8	17.8	10.3	31
Total	45.5	264.0	244.5	247.4	256.	608.0	864.6	69.4	259.3	330.6	210.2	2,205
Production (1000 mt)												
Millet/Sgm	11.7	62.5	74.5	88.1	97.2	239.6	336.8	9.9	79.1	89.0	85.4	748.0
Maize	6.3	--	0.1	--	4.8	37.5	42.4	4.1	45.7	48.9	30.9	128.4
Paddy	71.7	--	--	--	0.8	0.2	1.0	32.6	34.7	67.2	7.6	147.6
Cowpea	1.0	18.5	8.0	9.7	2.0	0.4	2.4	0.7	0.2	0.9	0.6	41.0
Manioc	--	--	37.1	0.0	4.1	1.2	5.3	4.5	6.9	11.4	0.4	54.2
Oil Nuts	0.8	60.6	60.4	63.6	98.9	288.0	386.8	28.5	106.8	135.3	71.0	778.5
Table Nuts	--	--	--	--	2.3	14.9	17.2	--	2.6	2.6	0.8	18.2
Cotton	--	--	--	--	0.4	2.4	2.8	--	20.7	20.7	10.8	34.4
Yield (kg/ha)												
Millet/Sgm	555	408	567	603	652	795	747	769	920	900	851	679
Maize	2,158	--	--	--	1,312	1,424	1,410	1,000	1,265	1,217	1,085	1,284
Paddy	4,622	--	--	--	2,517	1,046	2,021	1,306	1,170	1,191	2,010	1,935
Cowpea	226	478	417	493	461	456	460	571	447	541	449	456
Manioc	--	--	3,140	0	3,081	5,431	3,414	5,484	6,911	6,266	--	3,489
Oil Nuts	551	842	734	783	1,033	1,094	1,078	1,118	1,243	1,214	1,090	1,008
Table Nuts	--	--	--	--	1,267	1,144	1,159	--	1,100	1,100	1,000	1,153
Cotton	--	--	--	--	922	944	941	--	1,162	1,162	1,047	1,102

Source: Derived from data in Annex II.

Available Technology and Its Use

The availability and the eventual use of a technology depends on environmental, economic, institutional, and political elements. In Senegal all of these factors combine to generate a system which generally uses low to intermediate technology. The data in Tables 2 and 3 demonstrate (broadly) where, and for which of six major crops, various levels of technology are employed. The information can be summarized as follows:

Crop Type	Technology
Rainfed crops	low to medium
Irrigated crops	medium to high
Cash crops	medium to high
Non-irrigated crops	
North Senegal	low
Central Senegal	low to medium
South Senegal	medium to high

Although it may be somewhat over-simplified, a generalization of technology use can be made: low technology in areas with low rainfall and poorer soils; medium and high technology in areas with higher rainfall and relatively better soil. Overall, however, the level of technology employed by Senegalese farmers can be classed as low to medium. It should be noted, however, that in most cases (especially the Groundnut Basin) this includes the use of animal traction.

Beginning in the mid-1960's the Government of Senegal made a concerted effort to introduce "modern" technology, particularly in the Groundnut Basin, and more recently in the River Valley and in the cotton producing areas of Tambacounda and eastern Kolda. The primary intervention was subsidies and/or minimum cost (to the farmer) distribution of inputs (via cooperatives) and guaranteed prices implemented by a series of regional development agencies. The "Programme Agricole", the primary vehicle for this intervention, was initiated in 1966 and was finally abandoned in 1980. In 1984 the "Programme Agricole" was replaced by the "New Agricultural Policy", as further defined by the "National Cereals Policy" of 1986. The history of the "Programme Agricole" and the various development agencies has been well covered in previous analyses and will not be repeated. However, it has left a legacy which is relevant to the present analysis. Several points are worth mentioning: 1) Enormous amounts of highly subsidized fertilizer, groundnut seed and equipment were distributed on credit - in the mid-1970's the fertilizer subsidy rate was often as high as 70% and always in the 50-60% range - in the late 1970's about 80,000 tons of fertilizer were used annually; 2) By 1980 (the end of the PA) there were 45 thousand pairs of oxen, 222 thousand horses and 207 thousand donkeys - the Sine-Saloum (Kaolack and Fatick) had, by far the largest numbers; 3) Credit repayment rates were low and in especially bad years debts were forgiven (four times); and, 4) Large numbers of farmers had access to, or experience with, fertilizer, improved groundnut seeds, and animal traction "packages".

Table 2

Millet/Sorghum, Maize and Paddy Yields Under Low, Medium and High Technologies

Region	Millet/Sorghum Yield (kg/ha)					Maize Yield (kg/ha)					Paddy Yield (kg/ha)				
	Technology				5 Year	Technology				5 Year	Technology				5 Year
	Low	Medium	High	Note	Average	Low	Medium	High	Note	Average	Low	Medium	High	Note	Average
Dakar	--	--	--			--	--	--			--	--	--		
St. Louis *	400	550	700	rainfed	555	--	1700	--	irrigated	1628	--	5000	5500	irrigated	4622
Louga	250	400	450	rainfed	408	--	--	--			--	--	--		
Thies	400	550	700	rainfed	567	--	--	--			--	--	--		
Diourbel	400	550	700	rainfed	603	--	--	--			--	--	--		
Fatick	500	700	900	rainfed	652	--	--	--		1312	--	--	--		2517
Kaolack	500	700	1100	rainfed	795	1400	1700	2000	rainfed	1424	--	--	--		1046
Ziguinchor	600	800	1200	rainfed	769	--	1200	1500	rainfed	1000	1200	--	2500	transplant	1306
											1000	1500	2000	upland	(all)
Kolda	600	800	1200	rainfed	920	--	1200	1500	rainfed	1265	1000	1500	2000	swamp	1170
											--	1200	1500	upland	(all)
Tambacounda	600	800	1200	rainfed	851	--	1600	2200	rainfed	1085	--	--	--		2010

Table 3

Cowpeas, Groundnuts and Cotton, Yields Under Low, Medium and High Technologies

Region	Cowpea Yield (kg/ha)					Groundnut Yield (kg/ha)					Cotton Yield (kg/ha)				
	Technology				5 Year	Technology				5 Year	Technology				5 Year
	Low	Medium	High	Note	Average	Low	Medium	High	Note	Average	Low	Medium	High	Note	Average
Dakar	--	--	--			--	--	--			--	--	--		
St. Louis	--	--	--		226	--	--	--		551	--	--	--		
Louga	--	400	500		478	--	--	--		842	--	--	--		
Thies	--	500	700		417	800	850	950	rainfed	734	--	--	--		
Diourbel	--	500	700		493	800	850	950	rainfed	783	--	--	--		
Fatick	--	--	--		461	900	1000	1100	rainfed	1035	--	--	--		922
Kaolack	--	--	--		456	900	1000	1100	rainfed	1094	--	--	--		944
Ziguinchor	--	--	--		571	800	1000	1200	rainfed	1118	--	--	--		
Kolda	--	--	--		447	900	1000	1200	rainfed	1243	700	1300	1500	rainfed	1162
Tambacounda	--	500	700	Baket	449	900	1000	1100	rainfed	1090	550	1000	1200	rainfed	1047

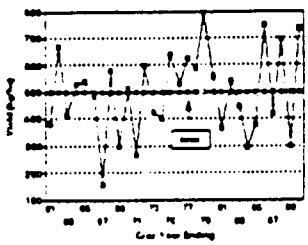
Source: Technologies, (Martin, 1988), average yields, MDRH/DS various reports.

(tech1)

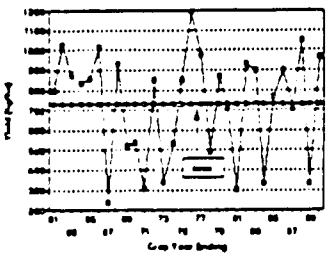
Figure 2

Millet/Sorghum, Maize, Rice and Groundnut Yields for Selected Regions (kg/ha)

Millet/Sorghum



Groundnuts

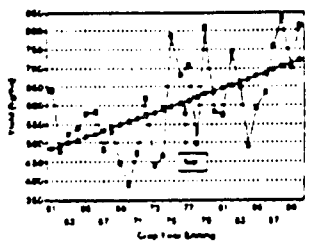


DIOURBEL

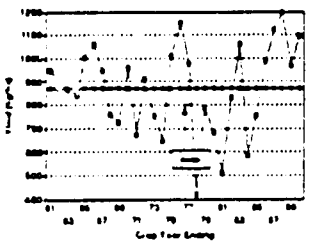
Growth Rates

Millet/Sorghum none
Groundnuts none

Millet/Sorghum



Groundnuts

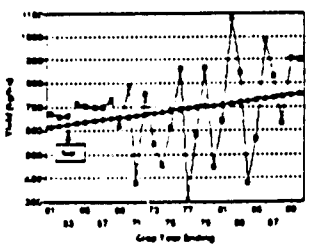


KAOLACK/FATICK

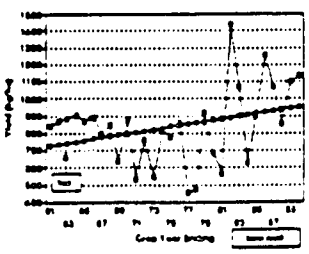
Growth Rates

Millet/Sorghum 1.3%/year
Groundnuts none

Millet/Sorghum



Maize

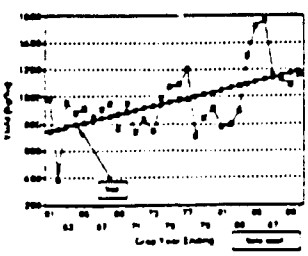


TAMBACOUNDA

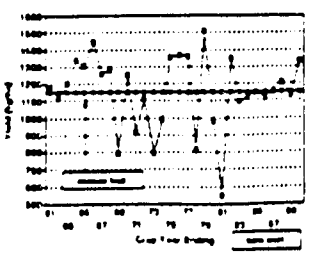
Growth Rates

Millet/Sorghum 0.7%/year
Maize 0.9%/year

Maize



Rice (Rainfed + Flood)



CASAMANCE

Growth Rates

Maize 1.6%/year
Rice none

Note: Lines are linear trend calculated from data in Annex II.

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In the Regions of Diourbel and Sine-Saloum (Kaolack and Fatick) yields for groundnuts show no evidence at all that changes in the fertilizer program had any appreciable impact. Millet/sorghum and maize yields in the southern parts of Senegal have improved over time, but in all cases at a rate well below the rate of growth of the rural population. In all areas and for all crops the dominant feature is an enormous year-to-year variation, which suggests that a more appropriate "intervention" could have been considered. Even in Tambacounda, where SODEFITEX has been active in promoting maize, with steady input supplies and marketing support, maize yields have been erratic, with an amplitude that appears to be increasing. Despite the availability of technologies which can increase yields by as much as one hundred percent, rice yields in the Casamance show absolutely no trend. Most of this may be attributed to the local culture, which reserves rice production to women, who have little access to credit and/or improved inputs and to soil degradation from saltwater intrusion on the flood lands used for swamp rice production. Improved and short season seeds, animal traction and other changes in farming techniques have clearly helped to offset the decline in the physical quality of the soil. The wide and increasing variation in yields suggests that a more basic approach may be needed before additional "improved input" packages can continue to contribute to higher, sustainable output levels.

The association between soil quality (organic matter, etc), the efficient use of the available water and the product return to chemical fertilizers discussed in the previous chapter indicate that, in most of Senegal, resource management may now be more important than finding ways to encourage farmers to apply cash intensive technologies. In fact, when farmers are questioned about their expenditure priorities, most purchased inputs are ranked very low.

Technology Choices and Farmer Attitudes

A great deal of the analysis of actual and potential technology depends on an assumption about farmers' objectives and options. It is common to use benefit/cost ratios to evaluate alternative technologies (both within and between crops) on the assumption that the farmer's objective is to maximize net revenue. This is clearly not the case, since Senegalese farmers seldom elect to use the crop/technology combinations with the highest BC ratios for a number of reasons: agricultural policy in general, legal and institutional restrictions, lack of credit, inadequate extension, absence of input and output marketing systems, risk aversion, resource limitations, and a whole range of cultural patterns. On the other hand, these analyses can help us to identify the possibilities for improvement in output and incomes, etc.

Take, for example, BC ratios for fertilizer use in Kaolack (southern, Nioro - more humid and northern, Boulel-dry) shown in Table 5. In the dryer north (Boulel) the BC ratios for groundnuts and a cereal crop were both 2, while in the more humid south they were 5 for groundnuts and 3.5 for the cereal crop. Since a general rule of thumb is that the BC ratio needs to be at least 2 for a farmer to consider the new investment, there is little to no reason to expect adoption in the dryer area (north) but clearly some incentive for higher technology on groundnuts in the south.

BC ratios for maize, millet and sorghum, calculated on the basis of farmers expectations about yields based on 1987 rainfall for farms in the extreme east of Kaolack, the southwest part of Tambacounda, and the south central part of

Kolda show a similar pattern in that the ratios are low, but increase toward the south and the southeast of the country (Table 6). The ratios are all relatively low, especially for millet and sorghum (less than or just above 2 in four of the five cases). They are considerably higher for maize (over 3), which confirms its relatively high potential in southern and southeast Senegal.

Table 5

Benefit/Cost Ratios
Returns to Fertilizer - Kaolack

Crop/days to mature	Nioro (South)	Boulel (north)
Groundnuts (120 day)	5.0	2.2
Sorghum (135 day)	3.5	
Millet (90 day)		2.0

Source: [Kelly, 1987, pg 29]
Calculations include the value of hay, average yields 1965-82 and 1987 prices.

Table 6

Benefit/Cost Ratios
Returns to Fertilizer
(South and Southeast Senegal)

Village	Location	Millet	Sorghum	Maize
Koungheul	extreme east Kaolack	1.3		
Maka	southwest Tambacounda	1.7	2.2	3.7
Dioulacolon	south central Kolda	2.7	1.9	3.5

Source: [Goetz, 1990, pg 235]

The information provided by the BC ratios is reinforced by farmer responses to questions about their investment priorities Both Kelly and Goetz asked groundnut basin farmers about their investment priorities. Kelly's data are for the central and southern Basin (90 farmers) and Goetz's data (198 farmers) are for the southern Basin and Kolda. Results showing farmers' priorities (either first or second) are summarized in Table 7.

Table 7

Farmers' Investment Choices: How They Would Spend 15,000 FCFA
(Percent who would purchase according to priority)

First or Second Choice	Kelly	Goetz	Note
Buy food	67.8%	75.3%	Kelly collected
Buy seed (groundnut)	82.2%	47.5%	data in 1985/86.
Buy/repair equipment	16.7%	25.3%	
Hire labor	(*)	20.2%	Goetz collected
Buy Fertilizer	7.8%	9.1%	data in 1987.
Livestock	8.9%	(*)	
Other	11.1%	37.9%	(*) included in other.
Number of Observations	90	198	

Source: [Kelly, 1988 pg 33], [Goetz, 1990 pg 84]

In all cases the farmers indicated an extremely low priority for fertilizer but a fairly high priority for groundnut seed and food. Overall, only between eight

and nine percent of the farmers would purchase fertilizer as a first or second choice as a way to use an additional 15,000 FCFA. In fact, even as a third choice, only about 10 percent indicated they would choose fertilizer as an investment. Food and groundnut seed purchases were the highest priorities, reaffirming to some degree the conflict between cash and food crops in the farm economy.

According to Kelly's data, most of the farmers who would purchase groundnut seeds would purchase equipment next, then fertilizer; and those who would first purchase food would then purchase seeds, followed by equipment and fertilizer. Thus, it is clear that on the basis of benefit/cost ratios from historical yields or from farmers expectations about yields, or on farmers' stated investment priorities, there is a strong trend toward lower and medium level technology in most of Senegalese agriculture.

Farmers attitudes toward resource management technologies are less well known. However, research in the Kaolack area [Hardy, 1989, pg 35] indicates that the main reason for fallowed fields was the lack of groundnut seed (67% of the fallowed fields), while about 24 percent of the fallowed fields were being held to "rest" the soil. It is encouraging, at least in Hardy's study area, that over a third of the farmers had planted trees.

Technology and Selection of Crops and Cropping Patterns

Because the range of potential crops and cropping patterns varies depending on geographic region, this section of the Analysis will deal with crops in four major geographic areas: the River Valley, the Groundnut Basin, Southern and Southeastern Senegal, and the Niayes. The focus will be on "modern" input technologies and production potential (between and within crops) as well as on farming methods and soil and water management practices. As was pointed out in Chapter I, considerably more priority has been accorded to production and developing production technology than to resource management (soil and water) so it should not be surprising that the majority of the technology is oriented toward fertilizer, chemicals, equipment and seeds.

ISRA, or ISRA with special project initiatives, conducts the majority of the crop and livestock research in Senegal. Historically, the regional organizations executed the extension function. Since the regional institutions have been (or are being) restructured or eliminated under the New Agricultural Policy and the structural adjustment programs, a major extension project is being undertaken by the World Bank (PNVA). PNVA is expected to overcome the research-extension linkage problem which has prevented research recommendations from reaching farmers' fields. Chapter V of this report contains an institutional analysis, including ISRA, the extension system and their roles and capabilities. This portion of the report concentrates on existing technology and its likely impact at the farm level. Table 8 is a summary of information related to agromonic packages and Table 9 shows some yield and soil recovery information related to conservation practices.

A fairly large number of technologies have been developed and, as shown by the percentage yield increases over traditional practices, most of them can make significant contributions to productivity. The large number of technologies available for rice in the River Valley reflects the high priority that has been placed on that region and crop.

Equally as encouraging, given farmer reluctance to purchase fertilizer, is that water management, erosion control and agro-forestry can also contribute to large productivity increases (in a range of 40 to 180 percent). These "technologies" have the advantage that they do not require large amounts of cash input. They have the disadvantage that they take time and labor to implement and time for the benefits to accrue. For some of the measures it may be necessary to take land out of production, which may have both food and land security implications ("abandoned" land may be reallocated to another person and/or population pressure may make it difficult for the farmer to forego the lost production).

It should also be noted that there are community lands that are not suitable for farming and which have been seriously overgrazed and over-cut for wood. ISRA research in southern Kaolack (village of Keur Dianko) has demonstrated that if protected, even for two years, this land can achieve a fantastic regeneration of native trees and grasses. Since these kinds of land are used by several villages, rural community commitment to rational land use is a necessity. The same is true for watershed management. ISRA experience in the area has demonstrated that villagers will participate, but that it requires organization and training.[2]

[2] ISRA researchers report that a one hectare plot which they had set aside to check natural regeneration rates was voluntarily protected by villagers when they burnt the surrounding land (They remained near the plot all night to be sure the fires did not spread into the protected area.

Table 8

Available Crop Technologies, by Crop and Region
(Number are percent increase in yield compared to traditional practices)
(xxx indicates that trials and recommendations are available)

Technology	Groundnut Basin					Ziguinchor/Kolda			Niayes	River Valley	
	Groundnuts	Cowpeas	Maize	Millet	Sorghum	Rice	Groundnut	Maize	Veg/frui	Rice	Tomato
Land leveling						xxxxxx			xxxxxx	xxxxxx	
Soil preparation Varieties (short season) Seed quality Plant density Sowing/transplanting Nursery management	xxxxxxxx xxxxxxxx	250	50 - 100	xxxxxx	100 to 200	40 to 100	xxxxxxxx	xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx	xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx xxxxxx	xxxxxx
Fertilizer (date, dose)	xxxxxxxx						35	50		xxxxxx	xxxxxx
Treatment		xxxxxxx				7			xxxxxx		xxxxxx
Thinning Weeding(manual,chemical)		xxxxxxx		xxxxxx	xxxxxxx			xxxxxx	xxxxxx	xxxxxx	
Crop associations Crop rotation		xxxxxxx		xxxxxx				xxxxxx			
Integrating livestock											
Water management Soil conservation				30 to 180		xxxxxx				xxxxxx	
Improved equipment											
Agro-forestry Acacia albidia	Depending on the tree, soil nutrients (+20%) and organic content are increased. 44 150 Millet yield increase 145 kg per 0.1% increase in organi matter.										
Post-harvest protection		xxxxxxx									

Source: USAID/ADO technology review (various sources). (options)
Note: The percentage yield information is representative, more specific information is available in the source document.

Table 9

Percentage Yield Increases with Interventions

INTERVENTIONS	PERCENT INCREASE IN CROP YIELDS(a)	PERCENT INCREASE IN CROP YIELDS(b)	PERCENT SOIL RESTORATION (a)	FARM CALENDAR FOR INTRODUCTION OF INTERVENTION	YEAR YIELD INCREASE TAKES EFFECT	LABOR REQUIREMENTS PERSON DAYS PER HECTARE	
						(a)	(b)
WINDBREAKS	18		2.5	ONSET RAINY SEASON	5	4	4
ACACIA ALBIDA	24	152	6.0	ONSET RAINY SEASON	6	10	
LIVE FENCES	5		2.5	ONSET RAINY SEASON	4	16	44
AGRIC. CHEMICALS	75		5.0	PLANTING SEASON	1		
COMPOST/ORG. FERT	80		6.0	PLANTING SEASON	1	11	
CONTOUR RIDGES	6	50	8.0	OFF-SEASON	1	142	150
DRY PLOWING		22		OFF-SEASON	1		0.4
LIVE FENCE + RIDGES		30		ONSET RAINS+OFF SEASON	1		163
RIDGES+GULLY CONTROL		50		OFF-SEASON	1		4.5/meter

(a) Christophersen, K. 1988. Opportunities for Sustained Development, Vol. III, Financial Analysis, E/DI:Washington, DC. p. 8-9.

The annual crop yield reduction caused by soil depletion under the traditional farming system is estimated at 6%. The soil restoration rates define the extent to which the 6% yield decline (base case scenario) is offset by the interventions. For example, windbreaks slow the rate of decline to 3.5% per year (6 - 2.5% = 3.5%). The 3.5% rate of decline becomes the base on which the annual (assumed) yield increases are calculated. Labor requirements are the base case scenario assumptions.

(b) Per cent yield increases for this column are numbers from sources other than those cited by Christophersen and represents a broader range of the possible effects of any one intervention. Also the combination of interventions should provide greater total physical benefits than the sum of the two separately.

Sources:

Acacia Albida: Charreau, C. 1974. Soils of tropical dry and dry-wet climatic areas of West Africa and their use and management. A series of lectures. Agronomy Mimeo 74-26. Ithaca, NY. USA:Cornell University, Dept. of Agronomy. Note: The 152% yield increase was reported for millet. Charreau reported a 44% increase groundnut yields due to Acacia Albida.

Contour ridges: Dezillcau, D. and Mincza, F. 1988. "Experience No. 13: Rissiam/Bam Burkina Faso (Digues filtrantes)" pp. 239-260 in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989.

Dry plowing: Juncker, E., and Sene, M. 1990. "Comparaison de plusieurs dents pour le travail du sol en sec en traction bovine." ISRA/RBS/IRAT:Kaolack, Senegal.

Live fence plus contour ridges: Rodriguez, L. "Experience No. 19: Recherche-Developpement a Ziga/Yatenga Burkina Faso (Lutte anti-erosive et amenagement de terroir)" pp. 249-268, in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989. Note: Rodriguez reported an average yield increase as 30%. However, the range of increases was between -20% to 200%. This yield variability is the subject of ongoing research.

Contour ridges plus gully control: Schmitt, P.A.C. 1987. "Experience No. 14: No-Rounou/Bam - Burkina Faso (Collecte et epanage des eaux de crue et de ruissellement)", pp. 261-280 in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989.

The Senegal River Valley

Driven by a national policy to achieve maximum food self-sufficiency and the water control made possible by the Manantali Dam, the region has been accorded the highest development priority. Accordingly, irrigation system development in the St. Louis Region has received the largest share of Senegal's investment in the agricultural sector (Chapter I).

The development of irrigated agriculture in the Valley has opened the region to a potentially wide range of crops and introduced the possibility for as many as three cropping cycles per year: the rainy season (hivernage), a "cold" season, and a "hot" season For a variety of reasons (largely labor, credit, land preparation and water management problems) cropping intensity is low. A goal of 1.3 - 1.5 was set, but it seldom exceeds even one. Figure 3 demonstrates why there are cropping pattern/crop intensity conflicts. The top portion of Figure 3 shows planting and harvesting periods for rainfed and flood "decrue" crops and the bottom portion is for irrigated crops. In all cases, land preparation and harvest for non-irrigated crops conflicts with planting and/or harvesting of irrigated crops. In addition, there is a conflict between planting and harvesting all 1st and 2nd season crops except hivernage and hot season rice. Even though it may be technically feasible to produce two crops on the irrigated land in the Valley, operationally it appears unlikely that this will occur unless significant changes are made in land management and in how water is charged to the farmer.

Water and labor management in the River Valley must be improved if double cropping is to become a standard practice, so the high fixed costs of the irrigation systems can be spread over a larger volume of land to reduce water costs. The gains could be substantial, especially for the large perimeters in the Delta, Podor and Matam where the annual cost/ha/year is estimated to be about 213,000 FCFA/ha or 47 FCFA/kg of rice - over 50% of the official rice price. Since the State subsidizes much of the cost, farmers in the large perimeters are charged 73,000 FCFA/ha, so for rice the actual water cost is about 16 FCFA/kg. The importance of this cost differential will become increasingly important as more and more of the responsibility for the irrigation systems is transferred to the farmers. There are two other types of irrigation systems operating in the Valley, Irrigated Village Perimeters (PIV) and private fields. The PIV have also been subsidized (about 40%) but the private operators pay the full cost because they operate privately owned pumping systems.[3]

Given the emphasis on irrigation, government policy and donor support has had a significant influence on technology in the Valley. In order to look at the relative attractiveness of alternative crops and technologies and to provide information for subsequent analysis, the budgets in Annex III have been used to calculate production costs and returns to labor for the various crops and seasons in the three main sectors of the Valley. The returns to labor are calculated as FCFA/day and thousand calories/day of labor. The cost of production is calculated as FCFA/kg (both including and excluding labor). This approach is used because the supply of irrigated land is limited so a producer will make crop and crop technology choices based on labor productivity (either in terms of cash or food produced).

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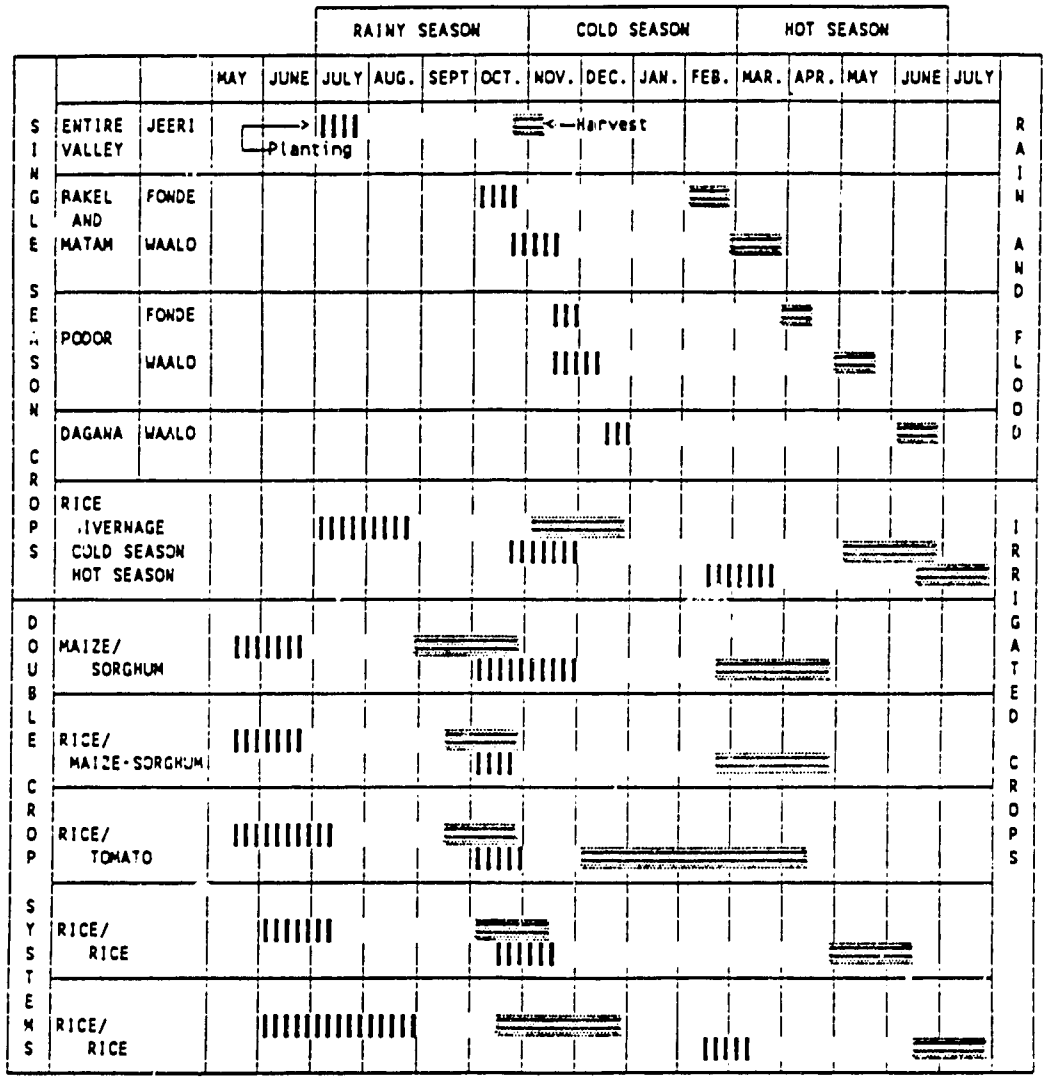
[3]The budgets included in Annex III include costs actually paid by farmers and are per hectare per year.

Figure 3

CROPPING SYSTEMS IN THE SENEGAL RIVER VALLEY



SOURCE: [JAMIN, DEC. 1987], [LeBloas, Juin 1986], [NDIAYE, JAN.1989]

Certainly, actual decisions will be made on the basis of some combination of these two factors. These same calculations are done for each of the main national geographic regions. The data for the River Valley are shown in Tables 10 and 11.

Ignoring such limiting factors as market availability, and on the basis of present costs and returns, hivernage rice and cold season tomatoes (in all parts of the Valley) clearly dominate the other crops in terms of value per day of labor. Irrigated maize and sorghum would not seem to be reasonable alternatives to rice since they return 300-500 FCFA/day of labor while the return for rice is generally 5 to 10 times higher.

Depending on the daily wage rate, maize and sorghum (especially maize) would be marginal under any circumstances. Note that rainfed millet and groundnuts in the Bakel area provide a better return than either irrigated maize and sorghum, possibly accounting for the observed shift to such crops in the area and some of the problems experienced by the Bakel project.

Given the substantial difference in labor requirements between irrigated and rainfed cereals, farmers in the Bakel area can cultivate nearly three times as much millet as irrigated maize with the same amount of labor. This would amount to 1200 kg of millet vs. 2000 kg of maize, the difference would be absorbed by the higher non-labor cost to produce maize. There are other considerations, especially the risk associated with rainfall levels in Bakel (rainfed agriculture is not a real option in the other parts of the Valley).

Overall, the argument is for a lower technology in this area. The strategic implications point to improving marketing systems for such crops as tomatoes and onions. There are also important marketing considerations such as the size and location of the market for these products and competition with outside suppliers. These issues will be discussed in Chapter IV, which deals with marketing and processing agricultural commodities.

Table 10

Technology Options in the Senegal River Valley: Returns to Labor (FCFA/Day and 1000 Calories/Day) 1990

Area	Crop	Return to Labor (FCFA/Day)					Return to Labor (1000 Calories/Day)				
		Technology				Home	Technology				Home
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Field
River Valley-Delta	Rice-Hivernage	2270	2081		1852		67	62		55	
	Rice-Hot Season	2253	2136		2013		68	63		66	
	Maize-Hivernage		564		-58			28		-3	
	Maize-Cold Season		478		-52			23		-3	
	Sorghum-Hivernage		732		561			33		25	
	Sorghum-Cold Season		634		389			29		18	
	Tomato-Cold Season		2590		1347			18		9	
River Valley-Matam	Rice-Hivernage		1147		1011			35		31	
	Rice-Hot Season		967		818			29		25	
	Maize-Hivernage		336		250			17		12	
	Maize-Cold Season		312		125			15		6	
	Sorghum-Hivernage		525		412			24		19	
	Sorghum-Cold Season		358		262			16		12	
	Sorghum-Decru			335	293				17	15	
	Tomato-Cold Season		2066		1227			14		9	
River Valley-Bakel	Rice-Hivernage		1141		1005			35		31	
	Rice-Hot Season		959		812			29		25	
	Maize-Hivernage		214		139			12		8	
	Maize-Cold Season		251		170			14		9	
	Sorghum-Hivernage		392		296			21		16	
	Sorghum-Cold Season		251		170			14		9	
	Tomato-Cold Season		2001		1154			14		8	
	RAINFED										
	Millet/Sorghum	541	465	546	381	711	27	24	28	19	36
	Cowpeas	-68	5				-3	0			
	Groundnuts	542	552	851	495						
Technology:											
Land Preparation											
Delta		machine	machine		machine	manual	Rainfed crops in Bakel: high and medium technology use animal traction for land preparation and weeding. For low technology and late planting all operations are manual.				
Matam			manual		manual	manual					
Bakel			manual		manual	manual					
Seeding		manual	manual	manual	manual	manual					
Weeding		manual	manual	manual	manual	manual					
Chemical Fertilizer		X	X								
Plant Protection		X	X								
Organic Fertilizer						X					
Harvest											
Delta		machine	machine	machine	machine						
Matam			manual		manual						
Bakel			manual		manual	manual					

Table 11

Technology Options in the Senegal River Valley: Production Cost Including and Excluding Labor (FCFA/Kg) 1990

Area	Crop	Including Labor (FCFA/Kg)					Excluding Labor (FCFA/Kg)				
		Technology				Home	Technology				Home
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Field
River Valley-Delta	Rice-Hivernage	48	46		50		38	35		38	
	Rice-Hot Season	45	43		43		35	32		32	
	Maize-Hivernage		73		106			53		78	
	Maize-Cold Season		76		110			53		78	
	Sorghum-Hivernage		64		70			44		49	
	Sorghum-Cold Season		67		79			44		53	
	Tomato-Cold Season		16		23			13		19	
River Valley-Matam	Rice-Hivernage		50		[illegible]			27		29	
	Rice-Hot Season		57		[illegible]			33		36	
	Maize-Hivernage		91		102			42		48	
	Maize-Cold Season		94		123			44		59	
	Sorghum-Hivernage		71		82			26		31	
	Sorghum-Cold Season		88		103			34		40	
	Sorghum-Decru			105	118				8	9	
	Tomato-Cold Season		14		21			9		14	
River Valley-Bakel	Rice-Hivernage		50		54			27		29	
	Rice-Hot Season		58		63			33		36	
	Maize-Hivernage		91		102			42		48	
	Maize-Cold Season		88		102			34		40	
	Sorghum-Hivernage		71		82			26		31	
	Sorghum-Cold Season		88		102			34		40	
	Tomato-Cold Season		15		22			10		15	
	RAINFED										
	Millet/Sorghum	62	68	61	80	48	30	29	14	18	7
	Cowpeas	93	91				46	39			
	Groundnuts	34	34	30	36		22	19	16	20	

Technology	High	Medium	Low	Late	Home Field	
Land Preparation						
Delta	machine	machine	(See note)	machine	manual	Rainfed crops in Bakel: high and medium technology use animal traction for land preparation and weeding.
Matam		manual		manual	manual	
Bakel		manual		manual	manual	
Seeding	manual	manual	manual	manual	manual	For low technology and late planting, all operations are manual.
Weeding	manual	manual	manual	manual	manual	
Chemical Fertilizer	X	X				
Plant Protection	X	X				Decru is all manual
Organic Fertilizer					X	
Harvest						
Delta	machine	machine	machine	machine		
Matam		manual		manual		
Bakel		manual		manual	manual	

Groundnut Basin

The benefit/cost ratios already discussed (Tables 5 and 6) pointed to a general tendency for Groundnut Basin farmers to employ lower technology. That data also indicated that there was some incentive for higher technology for maize and groundnuts in the southern part of the Basin. Data calculated on the basis of returns to labor reinforce this conclusion, but point to an even lower technology. See Table 12 (returns to labor) and Table 13 (cost of production). The return to labor for groundnuts is highest for the low technology option in each of the four sub-regions of the Basin. This is a little different that was shown by the BC ratios because: (1) the groundnut price has since been reduced from 90 to 70 FCFA; (2) farmers are now required to store their own seeds (previously SONACOS stored and distributed seed); (3) although the BC ratios were calculated without the fertilizer subsidy which was then in effect, that sector has been privatized so farmers are forced to make decisions under a different set of rules. The results reinforce farmer attitudes, which rank fertilizer very low as an investment. The reasons are clear - the returns to increasing inputs do not justify the additional cost and labor.

The Northern Groundnut Basin has no advantage in groundnut production relative to the rest of the this region, although the returns to labor help to explain why farmers continue to try to produce. The highest potential for this region rests with cowpeas, which have serious insect related storage and production problems. Researchers under the Bean/Cowpea CRSP report huge yield increases, if improved varieties and technology are used [Schwartz, 1990, pg 12]. Yields improvements as high as 250 percent have been reported, with yields of over 800 kg/ha (vs a long term average of below 300) with 200 mm of rainfall. The potential for this crop is high, provided appropriate systems are used. When the variety CB5 was introduced in the mid-1980's production jumped enormously. It has since fallen because there was no market for the output and storage problems made it impossible to carry the crop forward.

One issue which is pertinent to the development strategy issue is shown under the column heading "Home Field". These are low technology operations on very small fields near the farm houses. They differ from the other fields in that because of their location, they receive more organic fertilizer from farm animals held near the houses. The difference between these fields and the others are substantial in that returns from them exceed even the high technology option. The chapter on resources pointed out the general soil degradation which has taken place in the Basin. Table 10 helps to quantify the consequences. In terms of calories produced, these fields will consistently produce 25% more per day of labor - a substantial benefit with minimal cash cost. There is little information available on crop response to fertilizer on these fields, but it can be expected to be substantial. As it stands, one of the obvious considerations is the water retentiveness of these soils. As has been pointed out (Table 7, Chapter II) water requirements for crops may be reduced by as much as 50% on water retentive soils - organic matter is a requirement. Thus, from both the point of view of stabilizing and of increasing productivity of Senegalese agriculture, an effort to improve the quality of the soil would appear to be essential. The difference between returns to the high technology option and the "home fields" does not support a contention that chemical fertilizer is the answer in this region.

Table 12

Technology Options in the Groundnut Basin - Senegal: Returns to Labor (FCFA/Day and 000 Calories/day)

Area	Crop	Return to Labor (FCFA/Day)					Return to Labor (1000 Calories/Day)				
		Technology				Home	Technology				Home
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Field
Northern Basin	Groundnuts	0	0	0	0						
(Louga)	Millet/Sorghum	0	0	0		0	551	[illegible]	526		748
	Cowpeas	0	0				441	300			
Central Basin	Groundnuts	2166	2237	2850	2443						
(Thies, Diourbel,	Millet/Sorghum	697	620	735	535	850	34	30	36	26	41
No Kaolack, Fatick)	Cowpeas	354	402				15	17			
Southeast Basin	Groundnuts	0	0	0	0						
(Southern Kaolack)	Millet/Sorghum	0	0	0	0	0	604	635	727	478	825
	Maize	0	0			0	1797	2037			2499
Southwest Basin	Groundnuts	0	0	0	0						
(Southern Fatick)	Millet/Sorghum	0	0	0	0	0	677	623	688	498	820
Technology:											
Land Preparation		animal	animal	animal	animal	animal	Groundnuts in the Southwest use fungicides in all technologies.				
Seeding		animal	animal	animal	animal	animal					
Weeding		animal	animal	animal	animal	animal					
Chemical Fertilizer		X	X								
Plant Protection		X									
Organic Fertilizer						X					
Harvesting		manual	manual	manual	manual	manual					

Table 13

Technology Options in the Groundnut Basin - Senegal: Production Cost Including and Excluding Labor (FCFA/Kg)

Area	Crop	Including Labor (FCFA/Kg)					Excluding Labor (FCFA/Kg)				
		Technology				Home	Technology				Home
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Field
Northern Basin	Groundnuts	0	0	0	0		28	59	55	63	
(Louga)	Millet/Sorghum	0	0	0		0	74	72	75		54
	Cowpeas	0	0				124	180			
Central Basin	Groundnuts	28	28	23	27		17	17	13	17	
(Thies, Diourbel,	Millet/Sorghum	55	59	49	64	42	22	21	9	12	5
No Kaolack, Fatick)	Cowpeas	164	158				78	53			
Southeast Basin	Groundnuts	0	0	0	0		32	30	25	29	
(Southern Kaolack)	Millet/Sorghum	0	0	0	0	0	54	50	43	61	37
	Maize	0	0			0	37	28			12
Southwest Basin	Groundnuts	0	0		0		34	33	28	32	
(Southern Fatick)	Millet/Sorghum	0	0	0	0	0	50	52	46	61	35

The Casamance and Southeastern Senegal

The Casamance (Ziguinchor and Kolda Regions) and Southeastern Senegal (central Tambacounda) provide an environment under which a wider variety of crops can be grown than in the Groundnut Basin. As was pointed out in the previous chapter, this part of Senegal contains most of the currently unused, arable land. The major disadvantages in these regions are distance (in the case of Tambacounda) and physical separation from the rest of the country (by Gambia for the Casamance). These areas also differ from the Groundnut Basin in that higher agricultural technology would seem to be appropriate, which is consistent with the better rainfall and soils in these regions. Because of these relatively greater potentials, south and southeastern Senegal have (along with the River Valley) been selected by the GOS as priority development areas with an emphasis on expanding maize production. But, even here, irrigated agriculture has been the principal focus.

The potential, both for increased use of higher technology and for the production of maize is supported by the data in Tables 14 and 15. Unlike the Groundnut Basin, returns to labor are higher for the high and medium level technologies for most crops grown in these regions. Also unlike the Groundnut Basin, the "home fields" do not dominate the other technologies.

There are three things worth noting; first, the high and medium technologies for rice are "potential", not actually used by farmers; second, very little rice produced in the Casamance is marketed; and third, the supply of land available for lowland rice is limited and has been severely degraded by salt intrusion. Thus, the yields used in the budgets may be above actual farmer experience. All of these factors would push farmers toward a lower technology. Reclaiming these soils, if done in a cost effective way, will increase the return to labor applied to lowland rice by between 25 and 50 percent. Since women are the main producers of lowland [illegible] there is a definite gender related advantage.

The data in Table 14 also indicate a distinct advantage to maize and groundnuts vs other crops. There are clearly market related problems with maize as a cash crop but the potential is substantial. From the farmers' point of view, groundnuts are clearly superior to cotton as a cash crop. In fact, given the low rates of return to cotton and the present push to eliminate subsidies to cotton producers, there is a definite likelihood that producers will shift to maize and groundnuts. Confectionery groundnuts are, or ought to be, the most likely cash crop candidate (aflatoxin levels will have to be resolved - a storage and marketing problem). Thus, marketing problems will have to be resolved in the Casamance and in Southeastern Senegal before these high potential crops can be effectively exploited.

Fruits and vegetables are important crops in the Casamance. At issue here are questions about appropriate water supplies and water cost for vegetables and markets for both. These issues are discussed in the following section, which deals with the Niayes and fruits and vegetables in general.

Table 14

Technology Options in South and Southeastern Senegal: Returns to Labor (FCFA/Day and 1000 Calories/Day)

Area	Crop	Return to Labor (FCFA/Day)					Return to Labor (1000 Calories/Day)				
		Technology				Home	Technology				Hom
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Fi
Lower Casamance	Millet/Sorghum	611	505	564	381	487	25	21	23	16	
(Ziguinchor)	Maize	459	974	612		787	24	51	32		
	Rice - Lowland	652	365	416	334		19	11	12	10	
	Rice - Transplant	818		552			24		16		
	Groundnuts	668	499	482	619						
Middle Casamance	Millet/Sorghum	316	547	543	361	603	13	22	22	14	
(West Kolda)	Maize	524	786			790	28	41			
	Rice - Lowland	531	328	412	335		16	10	12	10	
	Rice - Rainfed	335	577	230			10	17	[illegible]		
	Groundnuts	865	624	435	546						
	Cotton	517	461	319	164						
Upper Casamance	Millet/Sorghum	645	489	797	417	583	27	21	34	18	
(East Kolda)	Maize	687	973			792	36	51			
	Rice - Lowland	557	350	416	336		16	10	12	10	
	Rice - Rainfed	298	524	217			9	15	6		
	Groundnuts	943	782	948	556						
	Cotton	601	553	323	220						
Mid-East Senegal	Millet/Sorghum	445	367	646	575	575	23	19	33	29	
Central Tamba	Maize	1422	1352			1303	83	79			
	Groundnuts	1212	1083	1302	944						
	Cotton	369	287	178	116						

Technology:						
Land Preparation	animal	animal	manual	manual	manual	Insecticides applied on all cotton technologies.
Seeding	animal	manual	manual	manual	manual	High and medium technologies for rainfed rice are "potential".
Weeding	animal	manual	manual	manual	manual	
Chemical Fertilizer	X	X				
Plant Protection	X					
Organic Fertilizer					X	
Harvesting	manual	manual	manual	manual	manual	

Table 15

Technology Options in South and Southeastern Senegal: Production Cost Including and Excluding Labor (FCFA/Kg)

Area	Crop	Including Labor (FCFA/kg)					Excluding Labor (FCFA/Kg)				
		Technology				Home	Technology				Home
		High	Medium	Low	Late	Field	High	Medium	Low	Late	Field
Lower Casamance	Millet/Sorghum	73	79	71	104	82	42	12	2	3	
Ziguinchor	Maize	71	45	61		45	54	20	21		
	Rice - Lowland	73	98	97	117		39	44	12	15	
	Rice - Transplant	54		76			9		6		
	Groundnuts	59	68	70	59		30	21	19	22	
Middle Casamance	Millet/Sorghum	94	79	77	111	69	64	32	8	10	
(West Koldaj)	Maize	69	55			45	55	28			
	Rice - Lowland	81	105	98	116		48	41	15	16	
	Rice - Rainfed	93	75	152			63	20	24		
	Groundnuts	52	59	75	65		29	24	24	27	
	Cotton	99	103	125	166		64	66	56	68	
Upper Casamance	Millet/Sorghum	69	79	54	92	67	40	36	13	9	
(East Koldaj)	Maize	65	50			45	51	28			
	Rice - Lowland	79	101	97	115		46	41	14	16	
	Rice - Rainfed	99	81	161			59	33	23		
	Groundnuts	50	53	52	64		29	27	26	26	
	Cotton	93	96	124	155		58	60	55	57	
Mid-East Senegal	Millet/Sorghum	68	76	53	71	71	39	35	12	4	
(Central Tambacounda)	Maize	45	37			25	35	22			
	Groundnuts	49	53	52	57		29	27	25	26	
	Cotton	110	117	152	193		72	77	71	72	

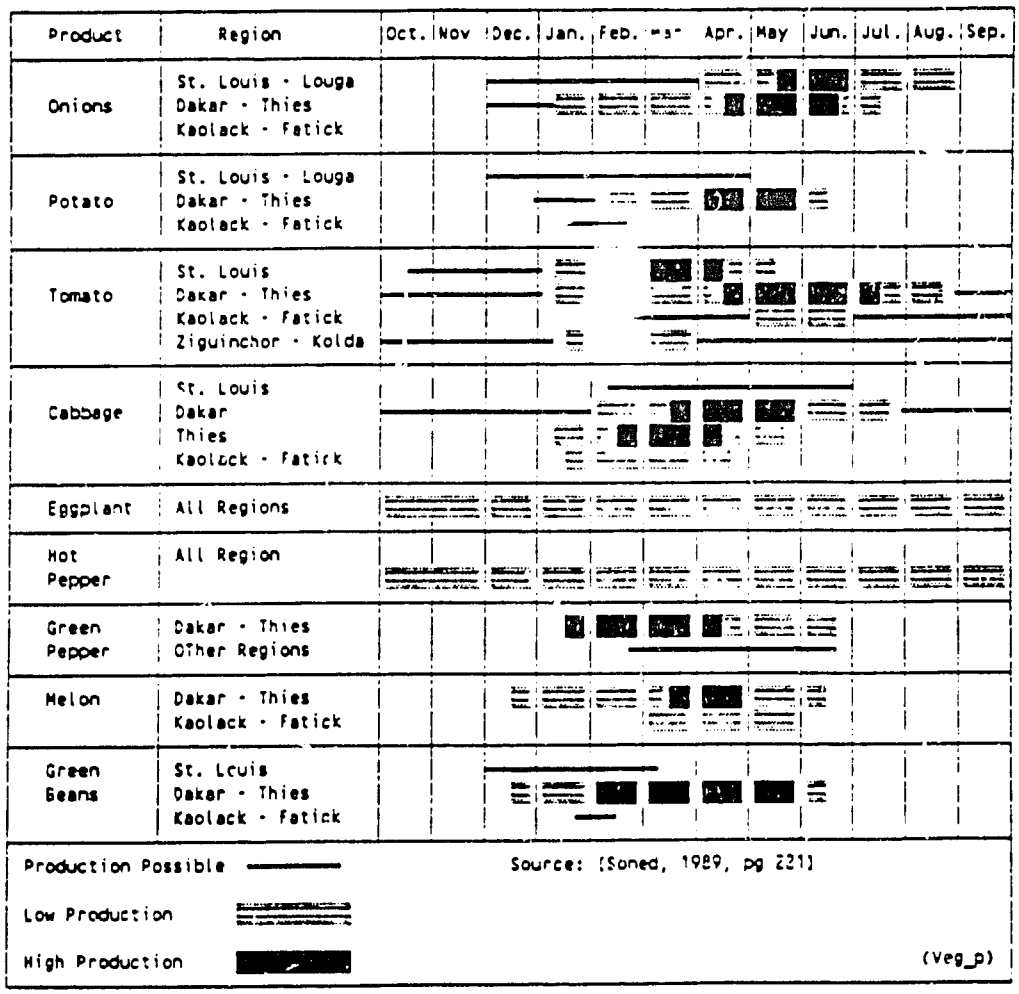
Technology						
Land Preparation	animal	animal	manual	manual	manual	Insecticides applied on all cotton technologies.
Seeding	animal	manual	manual	manual	manual	
Weeding	animal	manual	manual	manual	manual	High and medium technologies for rainfed rice are "potential".
Chemical Fertilizer	X	X				
Plant Protection	X					
Organic Fertilizer					X	
Harvesting	manual	manual	manual	manual	manual	

The Niayes and Horticultural Crops

Vegetable production is concentrated in the River Valley (tomatoes and onions), in the Niayes (for a range of crops), and in the Casamance (mainly fruits). There are some fruit producing operations in Thies - mostly mangos for the Dakar market. Crop budgets for several vegetable crops are include in Annex III for the Valley and the Niayes. Crop budgets for fruits and vegetables in the Casamance were not available. ISRA/CDH has identified, by product and region, periods during the year when vegetables are produced (high production periods, low production periods, and periods when production would be possible if water and related problems were resolved). This information is shown in Figure 4.

Figure 4.

Possible, Low, and High Vegetable Production Periods, by Region and Product



The main vegetable production periods are between February and June, with some production beginning in January and carrying into July and August. Senegal produces between 120 and 125 thousand metric tons of vegetables each year, with most of the production (71%) in the Niayes area. (Table 16). The Dakar/Thies portion of the Niayes accounts for over 60 percent of all vegetable production and account for the larger share of the production of all individual vegetables, except onions. St. Louis and the Louga portion of the Niayes are the largest onion producing areas (almost 70% of the total). Production arrangements vary, depending on the eventual destination of the crop. Crops meant for export (green beans) are usually produced under contract and some tomato producers in the St. Louis Region receive assistance (credit, advice, inputs) from one of the tomato processing plant (SNTI). The others are sold on the open market, almost exclusively by women.

Table 16

Vegetable Production 1987/88 Season, by Product and Region
(Percent of Production)

Crop	Percent Production of Crop in Region					Percent of All Crops
	Niayes				Other	
	Dakar	Thies	Louga	St. Louis	Regions	
Potatoes	28.4	60.7	6.0	4.4	0.5	10.8
Onions	7.7	13.4	30.7	38.8	9.4	18.7
Cabbage	37.4	41.2	6.6	5.6	9.1	18.4
Tomato	34.0	38.0	2.2	11.3	14.5	17.6
Green Beans	35.7	63.5	0.8	--	--	4.5
Melons	31.6	40.4	4.7	--	23.3	5.1
Hot Pepper	58.0	31.6	9.3	--	1.1	2.1
Eggplant	30.3	24.3	6.6	--	38.7	5.0
Other Veg.	27.7	18.4	8.3	26.5	19.1	17.6
Total	28.3	33.4	10.3	15.4	12.6	100.0

Source: (Abt Associates, 1989, pg 15) (MDRH data)

Onions, cabbage, and tomatoes are the most important crops (each accounts for about 18% of total vegetable output), followed by potatoes (10% of total production). The cost of producing tomatoes and onions in the Niayes is considerably higher than it is in the River Valley. There are two main reasons:

(1) Irrigation in the Niayes is considerably more labor intensive and costs about twice as much as in the River Valley. The difference is about 100 days/hectare, which adds an incremental 5 FCFA/kg.

(2) Producers in the Niayes would apply about 20 tons/ha of organic material (groundnut meal and if they follow recommendations), which is not applied by producers in the River Valley, which adds about 6 FCFA/kg to the cost of production.

Table 17 summarizes production cost and farm-gate price information for the Niayes and the River Valley. Caution: comparing the prices for tomatoes between the River Valley and the Niayes is not appropriate because the tomatoes

in the River Valley are for tomato paste production and the tomatoes in the Niayes are for fresh consumption. Onions, however, are comparable products.

Table 17

Production Costs, Farmgate and Dakar Retail Prices
(Selected Vegetables, FCFA/kg, 1990)

Vegetable		Niayes	River Valley			Dakar 1989 Retail
			Podor	Matam	Bakel	
Tomato						
Production	H	46.0	15.0	15.0	15.0	
	T	54.0				
Farm-Gate		70	30	30	30	
Margin (high)		24	15	15	15	
Onion						149.2
Production	H	79.0		17.0	17.0	
	T	91				
Farm-Gate		150		50	50	
Margin(high)		71		33	33	
Potato						180
Production	H	86.0				
	T	95				
Farm-Gate		150				
Margin(high)		64				
Green Beans						
Production	H	93.0				
	T	118				
Farm-Gate		150				
Margin		57				

Source: Crop budgets Annex III.
H = high (modern) technology. T = low (traditional) technology

The data in Table 17 suggest that there is a potential for increasing farmer incomes by improving production technology and marketing of onions and tomatoes. Although the cost-of-production data for the Niayes is based on recommendations (that is producers probably are not using all of the inputs or getting the stated yields), it shows that considerable improvement in productivity can be achieved by introducing labor saving equipment. Additionally, observation suggests that women (and to some degree, children) are heavily involved in water lifting; relieving their work load by up to 100 days/hectare would have a substantial impact in terms of basic life style and more time for additional production. Given the potentials, and considering the possible environmental impact of increased well based irrigation in the Niayes, more analysis of farming practices, labor distribution and water supply and quality should be undertaken. There are marketing problems to be resolved (transportation, storage). These are addressed in the following chapter.

Technology and Comparative Advantage

The preceding discussion of technology was centered on farmers and their incentive to adopt improved technology. There is an additional aspect to be considered - Senegal's comparative advantage in the production of various crops using various technologies and the associated costs and returns. The policy agenda (that is, policy + programs + laws and regulations) may be used to shift producer incentives toward a production system which may or may not be the most efficient use of available resources. While there may be numerous political, economic, historical and/or environmental reasons for any given resource use pattern, any deliberate attempt to guide them should at least be made with some understanding of the consequences. This part of the report will investigate these issues as they are reflected by several "coefficients": domestic resource costs, protection coefficients and protection adequacy[4]. The various coefficients, calculated for millet, maize, rice, groundnuts and cotton for several geographic locations and various levels of input intensity (technology), are shown in Table 18. Some definitions are given below:

Definitions

Net Effective Protection Coefficient (NEPC): The ratio of value added (returns to land, labor and capital) expressed in domestic financial costs to value added expressed in border economic costs converted at the shadow exchange rate. It includes taxes and subsidies on both the final output and the various inputs. It measures incentives or disincentives for production. Interpretation: greater than 1 - producer benefits (subsidy). less than 1 - producer is taxed.
Domestic Resource Cost (DRC): measures the efficiency of a particular production activity in generating foreign exchange (exports) or saving foreign exchange (import substitutes). The DRC is the ratio of the cost of non-tradable inputs (measured at their opportunity costs) to value added measured at border economic prices and converted at the shadow exchange rate. In short, the DRC is the cost in local currency to generate (or save) one unit of foreign exchange. It is a measure of comparative advantage. Interpretation: between 0 and 1 - comparative advantage. less than 0 or greater than 1 - no comparative advantage.
Protection Adequacy Coefficient (PAC): the ratio NEPC/DRC. It measures the degree to which various protective measures compensate (under or over) for differences in comparative advantage. Interpretation: greater than 1 - more than adequate (incentive to produce). less than 1 - inadequate (disincentive to produce). equal 1 - just adequate.
Shadow Rate of Exchange: Assumption is that the existing exchange rate is 40% overvalued.
Economic Border Prices: FOB or CIF prices Dakar. The 1987-1989 world price average is used.

[4] The coefficients are taken from [Jones, 1990]. This paper includes a careful discussion of how various measures are calculated and interpreted. The information is especially useful for this analysis because the various calculations (for the most part) are based on the crop budgets which have been used for the calculation of labor returns. (See Annex III).

Table 18. Net Effective Protection Coefficients, Domestic Resource Costs and Protective Adequacy Coefficients: Millet, Maize, Rice, Cotton and Groundnuts (1987/89 Average Prices Calculated at Dakar)

Region	Net Effective Protection Coefficients					Domestic Resource Costs					Protective Adequacy Coefficients				
	Millet	Maize	Rice	Cotton	G'nuts	Millet	Maize	Rice	Cotton	G'nuts	Millet	Maize	Rice	Cotton	G'nuts
Lower Senegal River															
Intensive	--	--	3.01c	--	--	--	--	3.25c	--	--	--	--	0.93c	--	
Semi-Intensive	0.92	1.14	2.81c	--	--	0.88	1.35	3.11c	--	--	1.05	0.84	0.90c	--	--
Extensive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Upper Senegal River															
Intensive	--	--	2.99d	--	--	--	--	--	--	--	--	--	--	--	--
Semi-Intensive	1.51	1.89	2.95d	--	--	2.05	2.71	2.7d	--	--	0.74	0.70	1.09d	--	--
Extensive	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
North Central G'nut Basin															
Intensive	0.86	--	--	--	1.46	0.96	--	--	--	0.98	0.90	--	--	--	1.49
Semi-Intensive	0.86	--	--	--	1.51	1.04	--	--	--	1.22	0.85	--	--	--	1.24
Extensive	0.73	--	--	--	1.41	0.91	--	--	--	0.99	0.80	--	--	--	1.42
Southwest Groundnut Basin															
Intensive	--	--	--	--	--	0.74	--	--	--	--	--	--	--	--	--
Semi-Intensive	--	--	--	--	--	0.87	--	--	--	--	--	--	--	--	--
Extensive	--	--	--	--	--	0.80	--	--	--	--	--	--	--	--	--
Southeast Groundnut Basin															
Intensive	0.89	1.17	--	--	1.49	--	0.52	--	--	1.18	--	2.25	--	--	1.26
Semi-Intensive	0.89	1.22	--	--	1.39	--	0.64	--	--	1.98	--	1.91	--	--	1.29
Extensive	0.89	--	--	--	1.35	--	--	--	--	0.92	--	--	--	--	1.47
Casamance (Ziguinchor)															
Intensive	1.06	1.43	3.27a	0.78	1.64	1.35	1.32	4.58a	0.80	1.79	0.79	1.08	0.71a	0.98	0.92
Semi-Intensive	1.02	1.27	3.35a	0.82	1.50	1.50	0.99	6.11a	0.99	1.95	0.68	1.28	0.55a	0.83	0.77
Extensive	0.99	--	--	0.94	1.44	1.39	--	--	1.45	2.06	0.71	--	--	0.65	0.70
Casamance (Kolda)															
Intensive	1.06	1.43	3.53b	0.79	1.64	1.35	1.32	5.89b	0.67	1.79	0.79	1.08	0.60b	1.18	0.92
Semi-Intensive	1.02	1.27	2.49b	0.80	1.50	1.50	0.99	3.95b	0.70	1.95	0.68	1.28	0.63b	1.14	0.77
Extensive	0.99	--	--	0.88	1.44	1.39	--	--	1.08	2.06	0.71	--	--	0.81	0.70
Tambacounda															
Intensive	1.07	--	--	0.80	1.59	1.26	--	--	0.78	1.51	0.85	--	--	1.05	1.05
Semi-Intensive	0.88	--	--	0.80	1.54	1.51	--	--	0.84	1.62	0.58	--	--	0.95	0.95
Extensive	1.03	--	--	0.94	1.47	1.03	--	--	1.38	1.37	1.00	--	--	0.68	1.07

Source: [Jones, 1990] (a) Flooded rice, (b) Rainfed rice, (c) Large peremeters, (d) Small peremeters PAC: >1 overprotected, =1 adequate, <1 under

The data in Table 18 reaffirm a number of conclusions: that local rice enjoys an enormous protection (NEPC at or greater than three in all regions and for all technologies); rice is extremely costly in terms of domestic resources used (DRC between 3 and 6, indicating that 3 to 6 FCFA are used to substitute for one FCFA of imported rice); and after adjusting for exchange rate overvaluation the degree of protection to rice in the river valley is just about adequate (i.e. it compensates for the comparative disadvantage). These coefficients are calculated as produced in the regions and transported to Dakar. Some commodities (especially from the Casamance) would not reasonably be marketed in Dakar, so it may be more appropriate to make the comparison at local markets. Jones [Table 14, 1990] did these calculations, but still obtained DRC values between 2 and 3 for rice in the Casamance. There may be other considerations as well. For example, there may be little alternative to rice in the flood lands of the Casamance River. In any case, higher technology for rice production in Senegal appears to be a very inefficient use of domestic resources.

The situation is somewhat better for millet and maize, especially at the lower input levels. Millet in the Southwest Groundnut Basin and maize in the Southeast Basin have a clear comparative advantage and ought to be encouraged. At average world prices between 1987 and 1989, cotton is also an efficient use of domestic resources and, in general, has neutral "protection".

Neutral to somewhat positive comparative advantage exists for low technology groundnut production in the groundnut basin, but (at 1987-89 prices) has no comparative advantage in the Casamance or in the Region of Tambacounda. All of these measures are naturally dependent on costs and prices, so that a certain amount of care must be exercised in drawing conclusions for the long-term. For example, world groundnut prices averaged $603/ton over 1987-89 and result in the DRC's in Table 18. The 1990 average was $931/ton, which produces DRC's which are all below one, in all geographic locations, and for all technologies - most near 0.50 [Jones, 1990, Table 18]. The final Chapter of this report will pursue the question of price movements and relationships and impact measurement in more detail.

Implications: Crop Production and Carrying Capacity

Crop Production

Niayes

According to the data in Table 3 of Chapter II, the Niayes has an additional 6,000 hectares of potentially irrigable land. The main problem with exploiting this resource is the impact the additional wells would have on the water table and water quality. Water quality is already beginning to deteriorate and the water table is beginning to drop. We conclude that although there will probably be some increase in area, it will not be significant. The Cayor Canal (to transfer water from the River Valley to Dakar) has been proposed as a way of bringing the land into production. This is a long term, extremely expensive project unlikely to be initiated any time in the near future. Thus, from a purely production point of view, we conclude that the production potential is now nearly fully exhausted, and that labor and cost savings on existing operations ought to be the primary consideration.

River Valley

There is a profit incentive in favor of onions and tomatoes in the River Valley and this area has, by far, the greatest potential for expanded production of both commodities, especially if based on a double cropping system. The main problems here are marketing for onions and extension and land management for both crops. Double cropping will have to be expanded, especially in the delta region, if the high cost of the irrigation system is to be justified. It is particularly important that better land/farm management practices be introduced to facilitate the production of tomatoes, because there is an existing market for nearly twice as many tomatoes as are now being produced (This will be discussed in more detail in the next chapter).

Groundnut Basin

The majority of the rural population lives in the Groundnut Basin, and it accounts for the majority of the cultivated land and cash crop production. This region also has the greatest constraints to increased productivity and production. There are, however, possibilities for improvement. The large difference between output from the small, low input, "home" fields and the other, larger fields suggests that with proper management productivity could be improved by as much as 75 percent if the organic content of these soils can be improved. A combination of predators (insects, birds and weeds) and rainfall variation cause enormous year-to-year variations in yields. Reducing this variation through land and water management and improved stress tolerant varieties could add between 25 and 50 percent to output, with existing technology.

Casamance and the Southeast

The Casamance has an environmental advantage for fruit production, an area about which there is little cost and marketing information. The major problem will be transportation and quality control. Research into vegetable and fruit production and marketing systems and market potentials should be undertaken before large investments are considered. Existing production systems, especially lowland rice, can be much more productive. Current efforts at land reclamation are addressing this problem.

Confectionery groundnuts and cashews are high potential cash crops. Cotton production, while it will probably continue, is likely to be replaced by groundnuts and maize, unless there is a substantial and sustained increase in world prices for cotton. Marketing and processing of cashews and quality and health considerations for table nuts will present the greatest obstacles for these crops.

This region has the potential to expand cereal grain production, especially maize. Long-term storage, marketing in general and basic consumption patterns are the major obstacles to realizing this potential. There is some potential for use in animal feeding, but the magnitude of this opportunity is not known. While there are some local opportunities, in general, societies need to have a cereals surplus and be relatively wealthy before fattened animals can become a significant factor ... this is not the case in Senegal.

Carrying Capacity

The majority of the conclusions drawn from the analysis in this chapter relate to land and water resource management (existing systems in the River Valley, improving resources in the Groundnut Basin and maintaining the resource base in the south and southeast) and improved marketing and marketing information (for fruits, vegetables and maize).

The overall impacts of the existing and the likely expansion of output are summarized in Figure 5, which shows import needs for major food crops (historical 1976/77-1989/90 and projected to 2010. These data have been developed using the general framework employed to prepare the annual food needs assessment, the related parameters are shown in Table 19.

Table 19

Historical and Projected Growth in Output - Per Capita Consumption for Major Food Crops

Food Crop	Per Capita Consumption			Historical 1976-89 Growth *	Growth Scenarios		
	Urban	Rural	Total		Low	Medium	High
	Un-milled (kg/capita)			(%/year)	(%/year)		
Millet/Sorghum	27.7	123.2	87.1	2.7	2.0	2.5	3.5
Maize	11.4	18.9	16.0	5.8	2.0	4.0	7.0
Paddy	143.6	63.6	93.9	4.2	2.0	3.0	4.0
Cowpea	1.0	5.0	3.5	2.4	2.0	3.0	4.0
Total (milled)	144.2	194.9	175.7	3.3			

* Growth rates are calculated by regressing output (semi-log function output=f(time)) over the 1976/77-1989/90 crop years. With the exception of maize, the regression functions explained only a small portion of the variation in output (millet 16%, maize 85%, paddy 34%, cowpeas 17%). In other words, random variation accounts for much more of the variation in output than is accounted for by trend.

Three output growth scenarios are given, low, medium, and high. These scenarios are relatively conservative in that the high growth scenario is only slightly higher than historical trends. The reasoning behind these numbers is as follows:

Millet/sorghum - the geographic locations where most of the production takes place have high population densities, with little prospect for expansion of land area. Climatic and soil constraints limit prospects for immediate yield increases but there are possibilities if soil and water management are improved. Because of these constraints and the time it would require to initiate a meaningful program, expansion of production to and in the south is set at about the rate of rural population growth for the low and medium scenarios.

Maize - maize output has been increasing at a rate of almost six percent per year. Producers are beginning to encounter marketing problems and, unless these problems are resolved, producer incentives will be greatly reduced. Thus, the low scenario provides for no change and stabilized

production at rural family needs, the medium scenario at a slightly higher growth and the high option assumes that marketing, storage arrangements and consumption patterns adjust to facilitate growth at seven percent (compounded this amounts to a 97% increase in production in 10 years).

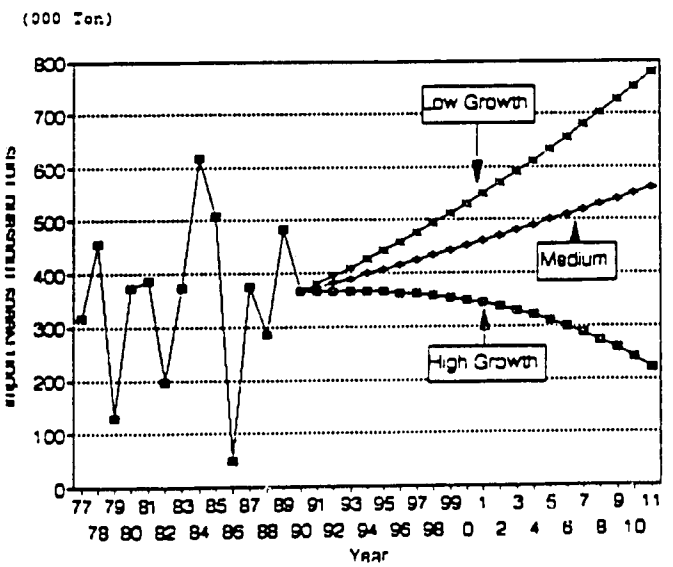
Paddy - paddy production has been increasing at about four percent per year, largely because of development of irrigation perimeters in the River Valley. Development of large irrigation works is being drastically slowed, with a shift to small, private fields. Paddy production in the Casamance region has been severely hampered by salinization of the flood plain along the Casamance River. In the longer term, soil reclamation efforts such as the Southern Zone Water Management Project. will help to increase production. Rainfed rice should increase at about the population rate of growth.

Cowpeas - excluding the temporary impact of introduction of CB5 in 1985, cowpea output has increased at 2.4 percent per year (essentially the rate of growth of the rural population. If protection from insects (both during growth and during storage) and better technology is adopted, then there is potential for considerable growth in output, especially in the northern Groundnut Basin. This is a relatively minor part of total food crop consumption and is set at 2, 3, and 4 percent for the low, medium and high options.

Applying these parameters to production levels beginning in 1990/91 and accounting for population growth produces an import needs picture as shown in Figure 5. Unless trading patterns between Senegal and its neighbors change dramatically, these import needs would be met by importing rice from Asia and America, rather than by regional trade in coarse grains.

Figure 5

Food Import Needs Under Three Growth Scenarios

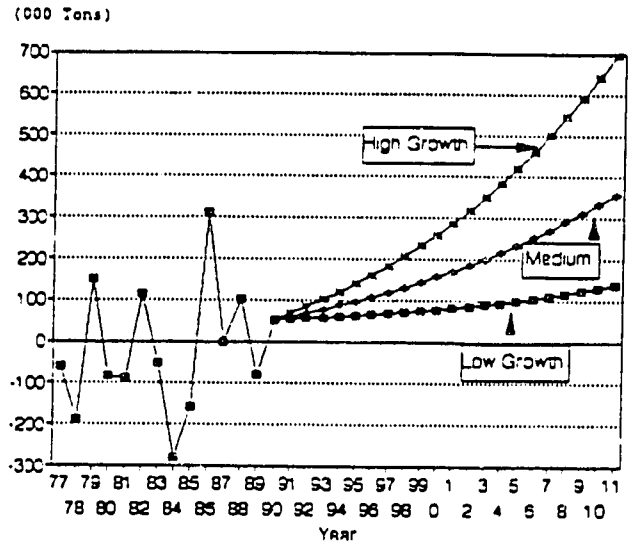


The differences between the three scenarios are substantial, but, considering normal year-to-year variation in output, would fall within the bounds of historical import needs for a considerable length of time. Food self-sufficiency is clearly not an attainable goal. In fact, at the high option extended 20 years, Senegal would still import over 50% of its food needs (from the four crops). As the data show, stabilizing the year-to-year variation in output could make a larger contribution to domestic food supplies than even a relatively high rate of growth in output.

To look at the opposite side of what is implied by the food import needs shown in Figure 5, the associated rural surplus (production less rural consumption) is shown in Figure 6. This shows, to some degree, the prospects for food crop marketing implied by the three scenarios.

Figure 6

Rural Surplus Under Three Growth Scenarios



With the exception of rice and tomatoes in the lower Senegal River Valley and vegetables in the Niayes, only a small portion of locally produced food crops enter commercial channels. Part of the reason why so little is marketed and why imported rice has penetrated so far into rural markets is demonstrated by the large variation in the rural surplus; there was a deficit in 9 of the last 14 years. Even under the "high" growth scenario the rural surplus does not exceed the historical range of variation until it is maintained for about 15 years. Unless higher output levels are stabilized and maintained, farmers would likely retain a large part of any increase to assure family food security. This suggests that on-farm storage should be a part of any production increasing or stabilizing strategy.

The information in Figures 5 and 6 should not be taken as projections, it is intended, only, to demonstrate the impact of a range of relatively modest productivity enhancing measures. Furthermore, the information is restricted to

grains, i.e., the simultaneous impact on cash crops is not considered. What the data does show is that with relatively modest rates of increase in productivity, the farm community can feed itself and provide a marketable surplus. Farmer behavior (i.e. their choices relative to cash vs food crops) would determine whether or not such a surplus would be forthcoming or whether they would take advantage of a more secure "food situation" to shift back into cash crops. One of the advantages of programs aimed at improving basic resource productivity is that all production would benefit, including cash crops and feed production for livestock. Thus, the information in the two figures is only a first approximation. A more thorough analysis of strategic options will be undertaken in Chapter VI. Farm grain marketing, particularly that which now takes place outside commercial channels would be influenced because the farm community has a broad range of surplus/deficit families. This, along with the other marketing and processing activities, is discussed in the next chapter.

An implicit measure of carrying capacity (similar to the one given in Chapter II for fuelwood) is contained in Figures 5 and 6. In very rough terms, the 0.6 hectares of land planted to major cereal crops by each active worker supported about two persons or 3.3 people are fed per hectare of cultivated cropland (2/0.6). National population density per hectare of arable land (from Table 5, Chapter II adjusted to a per hectare basis) is about 1.8 persons/hectare -- if all of the arable land was to be used for cereal crops every year. All of the land cannot (at least should not) be farmed every year. A minimum fallow reserve of one-third (farming the land two of each three years) would increase the density to about 2.7 persons/hectare, and reserving 40 percent of the land for cash crops to meet other food consumption and expenditure needs and adjusting population to 1990 levels, increases the density to 4.7 persons for each hectare of cultivable cropland (i.e. under good growth conditions, a carrying capacity adequate for about 57% of the population) . Even if soil productivity does not continue to decline at the 3-5 percent rate estimated by Pieri (see Chapter II) with population growth at 2.7 percent per year, the ratio would decline to 50% in five years and 44% in ten years. With continued declines in productivity, as well, the ratio would be about 40% in five years and 28% in ten years. Clearly, land productivity cannot decline at four percent per year forever, it will eventually reach a minimum - which would probably signal an ecological disaster. (The soil use/soil quality map in Chapter II, Map 4, shows that there are large areas where this is already true.) There are at least three possibilities for easing this situation:

- Fewer people, at least a reduction in the rate of population increase;
- More arable land, soil reclamation, expanded irrigation (remembering that there are serious problems associated with the economics of the existing irrigation systems); and
- More output per hectare on land now being used and protection of the new lands to be brought into production.

All of the information presented to this point has emphasized that there are different constraints and different potentials in various geographic locations. Obviously, the land carrying capacity and the implications for the future are also different by geographic location. An analysis of this issue was undertaken by a joint effort between the Mission, the Africa Bureau Office of Technical Resources and the U.S. Geological Survey/Eros Data Center. The results from this analysis are shown in Table 20 Table 20 shows the aggregate

carrying capacity and the gross value of output calculated under six conditions: combinations of current and improved yields: current and expanded areas cropped; and current and allocated crop mixtures (allocation of land to each crop to maximize calory production).[5]

Table 20

Senegal: Human Carrying Capacity Under Current and Expanded Areas, Current and Improved Yields, and Current and Allocated Crop Mixtures.

Item	Current Area and Crop Mixture		Current Area and Allocated Crop Mixture		Expanded Area and Allocated Crop Mixture	
	Current Yield	Improved Yield	Current Yield	Improved Yield	Current Yield	Improved Yield
Farm Value (Bil.CFA)	125.8	158.6	132.1	158.6	201.2	244.6
Cereal Crops	65.9	91.4	60.7	78.3	90.4	119.4
Cash Crops	59.9	67.2	71.3	80.3	110.8	125.2
Human Carrying Capacity (million)	3.880	5.425	3.667	4.745	5.454	7.230
Capacity/Population Ratio (%)						
1988 Population	57%	79%	53%	69%	79%	105%
2020 Population	19%	26%	18%	23%	26%	35%
Population: 1988 = 6.869 million people; 2020 = 20.772 million people						

Source: USGS/EROS Data Center Database.

[5]The analysis begins, by arrondissement, with the 1987-89 areas and yields for the major cereal crops (millet, sorghum, maize, paddy, and cowpeas), the major cash crops (groundnuts and cotton), and the 1988 population. Cereals carrying capacity was calculated according to calory needs and calory production per hectare (assuming that 80% of a daily requirement of 2300 calories is met by cereals) and calory production. Carrying capacity (as defined here) is calory production divided by 80% of 2300 calories - i.e. the number of people whose calory needs are met by given crop production. The results are expressed as the ratio of total human carrying capacity to total population (the degree to which population is below or above the land carrying capacity). Table 20 shows the aggregate carrying capacity, calculated under six conditions; combinations of current and improved yields, current and expanded areas cropped, and current and allocated crop mixtures (areas in each crop). The gross value of output is calculated using local market prices collected by CSA (assumed to remain constant). The various combinations were created as follows:

Current areas, yields and crop mixtures are the 1987/89 average, by arrondissement (data from GOS/MDRH/DAS);

Improved Yields are calculated by taking the ratio of medium to high technology by region according to Martin's data. (See Tables 2 and 3, Chapter III.);

Expanded area was calculated by arrondissement. Arable Land was determined according to soil characteristics, reserved area (forest, etc) was excluded, no more than 50% of potential (arable) land was allowed to change from its natural vegetation, 50% of available arable land was reserved for fallow (includes land for human habitation).

Allocated areas to crops were determined by soil types and rainfall (cowpeas 400-700mm, millet and groundnuts 400mm+, Sorghum 700mm+, corn 800mm +, rainfed rice 1000mm+) and some land allocation restrictions. Area already in cotton and rice was left constant at the 1987/89 average. Groundnuts were allowed 50% of the remaining available land. Food crops were allocated to the remaining land according to the soil and rainfall criteria and maximum calory production/ha (but a single crop was not allowed to use more than 75% of the land).

Under the assumptions used and with the 1987/89 yields and land planted in the major crops, Senegal's human carrying capacity is 3.9 million people compared to an actual population of 6.9 million - a carrying capacity/population ratio of 0.57. In other words, the current cropping system is supporting 57% of the population.[6] Extending population to the year 2020, bringing all land into production (subject to conditions specified in footnote 5), introducing improved technology and allocating crops to maximize calory production produces results shown in the last column of Table 20 - Senegal would produce food for only 35 percent of the population. Since this analysis has no specific time dimension (that is, it shows carrying capacity under current conditions and after yields have been improved or new land brought into production), the rate of adoption of new technology is not considered. Under these conditions, using more land and improving yields (while protecting some of the natural vegetation), the long-run is not just bleak - it is dismal. Reducing population growth is fundamental, but an extremely long-run measure. Improved yields via better resource management and input use is probably the only hope for the near term.

Strategic Focus

The remainder of the formal analysis in this chapter will focus on that part of Senegal which is at or south the 500 mm rainfall level (which corresponds to an 80% probability of 400 mm of usable rainfall annually and a 90 day growing period). This geographic focus excludes the Senegal River Valley and the large, essentially livestock oriented, ferlo pasture regions. There are three reasons for this geographic focus:

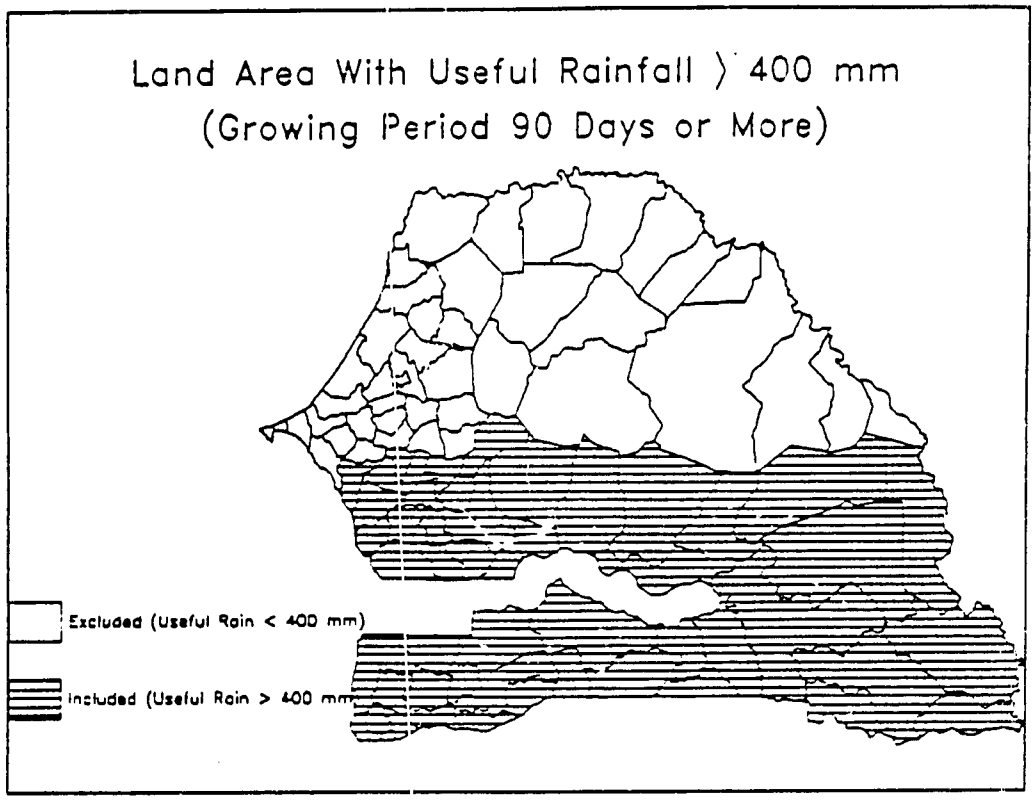
- livestock was excluded at the beginning;
- the Senegal River Valley is already adequately supported by a number of large donor programs (World Bank, EEC, Germans, Italians); and
- the selected area includes almost 79% of the potential agricultural land outside land reserves, and represents the region which must provide the foundation for a productive agriculture in Senegal (See Map 4, Chapter II and Table 3).

This criteria corresponds, approximately, to an annual average of 500mm. The advantage of the criteria is that it includes both distribution and duration of the rainfall - extremely important for sustained plant growth. Map 1 shows the area defined by the criteria and the related definition. The area (according to administrative boundaries) which most closely matches the 400mm/90 day criteria includes Fatick, Kaolack (plus one arrondissement from southern Thies), Ziguinchor, Kolda and Tambacounda (except the arrondissement which contains Bakel). Table 21 shows some land characteristics, land use and population information for the area included and excluded by this criteria. The reader should be aware that the source and definition of land quality in Table 21 is entirely different than for the data in Table 1, Chapter II. The information in Table 21 shows the land area outside land reserves which is classified as potentially usable, while the data in Table 1, Chapter II has not accounted (for

[6] This is the same as was calculated using a much less detailed process. The advantage to the present discussion is that it provides the information at the arrondissement level - which will be important for eventual monitoring under the DFA.

example) for potentially arable land in the unclassified forests. The analysis which follows uses a definition of maximum permitted land use which results in approximately the same total area as shown in Chapter II (3.9 million hectares vs 3.8 million shown in Chapter II - see Annex VI, Tables 4 and 6 for detailed data).

Map 1



Source: See Map 3, Chapter II for the various isohyets. The 400 mm useable rainfall isohyet was taken from [MI/DAT, 1984].

Definition: The period (and level) of useful rainfall is defined as the 10 day period when rainfall is first equal or greater than 15mm and not followed by a 10 day period with rainfall below 15mm. The accumulated rainfall over this period is the level and the number of days is the growing period.

The 80% probability levels are the level and period which occurs at least 80% of the time. For example, the 400mm useful rainfall level (at various reporting stations over time) would be determined by the number of years when the useful rainfall was at least 400mm for 80% of the years. A similar procedure is used to determine the related number of days.

Table 21

Land and Land Use Characteristics: Land Included and Excluded by the 400 mm Usable Rainfall Zone

Land Use or Land Characteristic	Area			Percent		Percent
	Included	Excluded	Total	Included	Excluded	Total
Total Area	11,030	8,683	19,713	56.0%	44.0%	100.0%
No Agric. Potential	4,232	6,544	10,777	39.3%	60.7%	54.7%
Moderate Potential	6,798	2,139	8,936	76.1%	23.9%	45.3%
Reserved Area	1,806	2,271	4,076	44.3%	55.7%	20.7%
No Potential	1,360	647	2,008	67.8%	32.2%	10.2%
Moderate Potential	445	1,624	2,069	21.5%	78.5%	10.5%
Potential Outside Res.	5,437	1,491	6,929	78.5%	21.5%	35.1%
Farmed (1989/90)	1,357	759	2,116	64.1%	35.9%	10.7%
Unused (1989/90)	4,080	733	4,813	84.8%	15.2%	24.4%
Area Planted to Crops (1989/90)	1,357	759	2,116	64.1%	35.9%	10.7%
Groundnuts	495	269	765	64.8%	35.[illegible]	3.9%
Cotton	24	0	24	100.0%	0	0.1%
Total Cash Crops	519	269	789	65.9%	34.[illegible]	4.0%
Millet	565	388	953	59.2%	40.8%	4.8%
Sorghum	114	16	130	87.7%	12.3%	0.7%
Maize	91	1	93	98.5%	1.5%	0.5%
Paddy (rainfed)	58	1	59	98.8%	1.2%	0.3%
Niebe	3	62	65	5.0%	95.0%	0.3%
Sub-Total	832	468	1,300	64.0%	36.0%	6.6%
Manioc	3	13	16	19.4%	80.6%	0.1%
Sweet Potatoes	1	0	1	100.0%	0.0%	0.0%
Fonio	2	0	2	100.0%	0.0%	0.0%
Voanz	0	0	0	100.0%	0.0%	0.0%
Beref	0	8	8	0.0%	100.0%	0.0%
Sub-Total	6	21	27	22.2%	77.8%	0.1%
Total Food Crops	838	489	1,[illegible]	63.1%	36.9%	6.7%
1990 Population (000's)	3,[illegible]	4,664	7,696	39.4%	60.6%	100.0%
Rural	2,459	2,159	4,617	53.3%	46.7%	60.0%
Urban	573	2,506	3,079	18.6%	81.4%	40.0%
Land Available Ha/pers.	1.8	0.3	0.9	Land Available is the potential outside land in reserves.		
Rural	2.2	0.7	1.5			
Urban	9.5	0.6	2.3			
Land Farmed/rural pers.	0.6	0.4	0.5			
Unused Potential/rural	1.7	0.3	1.0			

Source: Crop Areas: MDRH/DAS; Land Areas and Potential [USGS/EROS, 1990]
Note: Potential is determined by soil characteristics. This does not imply arability because it does not include rainfall criteria - land in the "Included" column should be considered arable while unused potential in the "Excluded" column is most likely not arable. The "potential" area also contains about 15% unusable land due to inclusions (this has not been subtracted).

Some of the land and population characteristics for the area shown in Map 1 and Table 21 are summarized below:

Percent of National land area	56%
Percent of National moderate potential land	79%
Percent of National land cultivated	64%
Percent of National rural population	52%
Percent of zone population which is rural	81%
Percent of Potential land in the zone Land not farmed	75%

	National land accounted for by crops in the Zone	Zone land in individual crops (1989/90)
Millet	59%	41.6%
Sorghum	88%	8.4%
Rainfed maize	99%	6.7%
Rainfed rice	100%	4.3%
Cowpeas	5%	0.2%
Other Food Crops	0.1%	0.4%
Groundnuts	65%	36.5%
Cotton	100%	1.8%

Measured according to soil characteristics alone, the portion of Senegal which falls south of the rainfall criteria of 400 mm of usable rainfall per year contains 76 percent of the land with moderate agricultural potential nearly all of the potential land if reliable rainfall is included as part of the criteria. The use of this criteria does not suggest that the excluded areas should be abandoned. In fact, as the erosion potential and land use maps in Chapter II have already shown, the areas north of this isohyet have some particular risks and needs. They are:

Constraints

- the soil is highly degraded and the land is heavily populated;
- as a result, large areas of marginal and highly erosion prone land are under cultivation;
- "technological packages" (with the exception of improved varieties of cowpeas - and associated storage and post harvest treatment) which include chemical fertilizers do not provide adequate response to justify their use; and
- as a result, rural food and fuel production are not adequate, even in good years.

Strategic Options

- USAID options under the DFA time horizon of 5-7 years appear limited because the principal means of even stabilizing this area are soil reclamation and reducing population pressure - both extremely long term measures;
- The expansion of appropriate agro-forestry (associated with soil protection and reclamation) is one manageable possibility which has several advantages:

- the Mission, through the Senegal Reforestation Project, already has related experience (it might require some reorientation of the Project focus from groups to individuals);

- the Mission (along with other donors) has already invested resources in analysis and evaluation of the new Forestry Code, which if properly applied, will provide ownership and control rights to tree producers - which will serve as an incentive and open a possible revenue source;

- interventions which begin to produce measurable impacts within the required time horizon are available (acacia albida used as windbreaks, for erosion control, and for soil restoration begins to produce benefits within five to six years, with yield improvements of from 20 to 50 percent and soil restoration at six percent per year (the rate of soil degradation is estimated at between 3 and 6% per year so this "intervention" would result in yields which stabilize at the higher levels);

- improved local supplies of fuelwood produce a direct advantage for women and the young because they spend appreciable amounts of time collecting firewood;

- trees and shrubs are an important source of animal feed during the long dry season, which helps to sustain livestock populations - an important source of income in this part of Senegal (this is important for all members of the family, but it has specific implications for women because they manage large numbers of small animals).

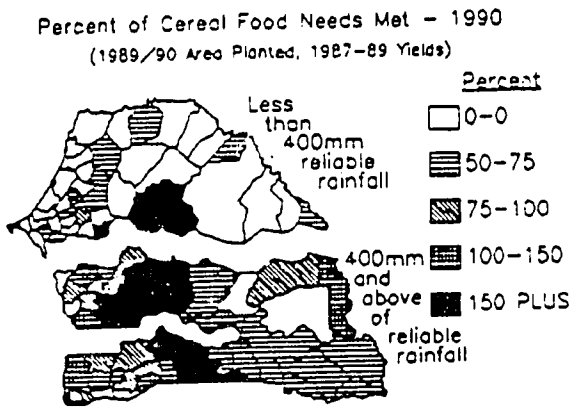
- The area north of the 400mm usable rainfall zone contains the majority of the commercial vegetable production in Senegal. There are specific risks associated with increasing production in most of this area, because much of it depends on well water for irrigation and the water table is already becoming degraded. Human demand for potable water, especially in the urban centers, will continue to be a major competitor for this resource. There are opportunities, however, to improve productivity on existing land, and to improve marketing timeliness and efficiency - especially for export marketing. There are also opportunities to improve tomato and onion production and marketing in and from the Senegal River Valley.

The development potential (and therefore the array of strategic options) for the area south the 400mm usable rainfall isohyet is vastly different from the area to the north. As already mentioned, it contains the majority of the potential land (76%) and almost all of the unexploited potential (especially if rainfall is considered). Almost 80 percent of the moderate potential land outside land reserves in this zone is still unused (it contains 85% of the national unused potential). After subtracting 15 percent for unusable inclusions and reserving one-third of the remainder for fallow and/or natural vegetation, cultivated area could still be increased by over 1.7 million hectares - 130 percent of the 1989/90 total planted. The only other part of the nation which has even a remotely similar potential is the Senegal River Valley (250 thousand hectares realistically possible - for irrigation and at enormous cost). It is reasonable to conclude that this zone represents Senegal's major hope for sustainable growth in agriculture.

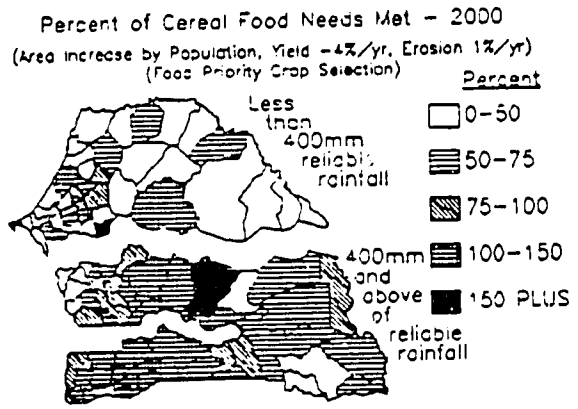
Despite the considerable potential, a large part of the rural population living in this area is food deficit. Map 2 shows, by arrondissement, the percent of total cereal needs met in 1990 (calculated using 1987-1989 average yields and assuming that 80% of total calory needs of 2300 calories/day are supplied by cereal grains and cowpeas). Two points are notable: virtually all of the surplus production is below the 400mm isohyet (80%-400mm reliable), and even in the higher rainfall regions of the Casamance and Tambacounda, several of the arrondissement produce at or below total local food needs (the arrondissement filled by blanks or horizontal lines). There are several reasons for this: small, traditional farms which rely on family labor (as opposed to animal traction) and thus farm smaller areas; soil degradation (especially in Ziguinchor and western Kolda) which has forced farmers from relatively high yielding lowland rice to lower yielding upland rice production; largely undeveloped input and output marketing systems; and the existence of a wider and more stable range of food sources other than cereals. Nationwide, in 1989/90 Senegal produced about 60% of the food grains required to satisfy the population's calory needs (28% in the north - because of the high urban population - and 109% for the south). Details are in Annex VII. Note: the maps show "local" surplus/deficit conditions. That is, they are relative to the local population, so a high deficit or surplus may not mean that the arrondissement makes a significant contribution to the national total.

Maps 3 and 4 show two "situations" for the year 2000, each for a different level of resource protection and land use. The year 2000 was selected because it is close to the termination date for the new USAID strategy.

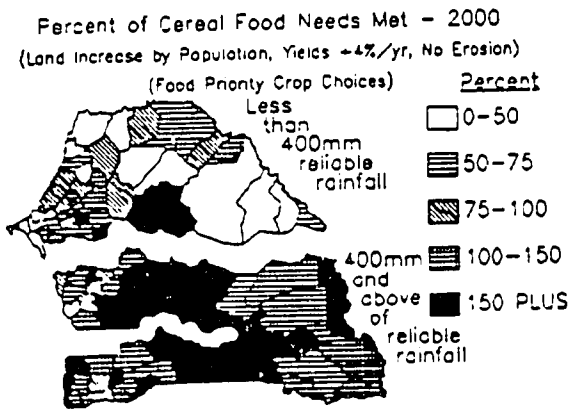
Map 2



Map 3



Map 4



Map 3 shows the percentage of food needs met in 2000 under a "do nothing scenario" (Table 22 shows some summary data. The basic data and an explanation of how these calculations were done is in Annex VII, Table 3 to 6). The "do nothing scenario" was developed using a 4 percent per year soil degradation rate and a one percent per year soil loss (erosion) rate. It is also developed under the assumption that farmers continue to shift to food crops to assure their own food security and that the area they are able to cultivate is determined by the number of rural people (i.e., the existing farming system is extended at the rate of rural population growth). The impact of the USAID Southern Zone Water Management Project has been included, because it is already underway.

Map 4 shows a food balance situation after 10 years of programs which increase productivity four percent per year with no soil lost to erosion (Table 22 shows the related summary data). The rate (and location) of use of new land and the choice of crops is the same as for Map 3.

Table 22

Year 2000 Population, Area Planted, Area per Rural Person and Percent of Food Needs Met in Arrondissements Included and Excluded by the 400mm Reliable Rainfall Isohyet:

Area Determined by Population Growth, Food Production Priority Determines Crop Choices
Yields Decline 4%/year, Erosion Loss 1%/year

Item	Included	Excluded	Total
Population	4,130	6,411	10,540
Urban	847	3,697	4,544
Rural	3,282	2,714	5,996
Hectares (000)	1,543	662	2,205
% Other Crops	0.1%	0.2%	0.1%
% Grain Crops	88.0%	95.8%	90.4%
% Cash Crops	11.9%	4.0%	9.5%
Land/Rural Pers.	0.5	0.2	0.4
Percent of Food Needs	78	22	44
SOIL LOSS/YEAR			1.0%
PRODUCTIVITY LOSS	4.0%	4.0%	(b)

Table 23

Year 2000 Population, Area Planted, Area per Rural Person and Percent of Food Needs Met in Arrondissements Included and Excluded by the 400mm Reliable Rainfall Isohyet:

Area Determined by Population Growth, Food Production Priority Determines Crop Choices
Yields Increase 4%/year, No Erosion Loss

Item	Included	Excluded	Total
Population	4,130	6,411	10,540
Urban	847	3,697	4,544
Rural	3,282	2,714	5,996
Land Planted	1,636	753	2,389
% Other Crops	0.4%	0.3%	0.3%
% Grain Crops	64.7%	96.1%	74.6%
% Cash Crops	34.9%	3.8%	25.1%
Land/Rural Pers.	0.5	0.3	0.4
Percent of Food Needs	142	35	77
SOIL LOSS/YEAR			0.0%
PRODUCTIVITY GAIN	4.0%	4.0%	(p4)

The "do nothing" implications are not encouraging. As Map 3 shows, the arrondissements which were food surplus in 1990 (as few as they were) would become about self sufficient. Overall, the nation would produce enough food to meet 44 percent of cereals food needs (78% in the south and 22% in the north). This scenario would also have dire consequences for the cash crop sector. In 1990 about 37 percent of the cultivated land was in cash crops, under this scenario, area in cash crops would fall to 9.5 percent. In short, the do nothing scenario means very little cash income from cash crops and extremely serious food shortages.

This analysis has not attempted to estimate the implications for migration rates, but it is clear that there would be some movement from the north toward the south (and certainly to the cities). Although the 10 year horizon used here is probably not long enough for much to happen, there would probably be enough movement to shift some of the arrondissements in Kaolack from slightly surplus to deficit. It is also clear that food prices and food imports would increase considerably. It is not clear how the population would be able to pay for the food.

The increase average productivity by four percent per year scenario produces a case which would mean significant amounts of economic activity related to grain marketing and processing. (Map 4 and Table 11). The south would be able to produce a significant surplus of food (42%) as well as committing about 35 percent of the land to cash crops. The situation in the rural north would also improve considerably, which means that marketing systems development could concentrate on supplying the urban centers. At this point a strategy would have to begin to deal with on and off farm storage, marketing infrastructure and processing. This is particularly attractive from the point of view of improving rural incomes because about two-thirds of the grain marketing margin goes to rural the community (This is discussed at length in Chapter IV).

Is such a scenario feasible? Yes, but it depends on rates of adoption and the yield benefits from specific interventions. For example, to get an average 40 percent increase in yields after 10 years, the participation rate would have to be 80% for an intervention with a 50% yield increase and only 40% for an intervention with a yield increase of 100%. Depending on the array of interventions adopted, between 4 and 8 percent of the farmers (land) would need to adopt each year. This is probably the highest reasonable rate, but seems to be feasible. The incentive to adopt and the ability of the system to deliver the appropriate technologies will be addressed later.

There is an aspect about the scenarios which generate food surpluses which was already discussed - that is farmer attitudes toward food and cash crops. The returns to labor which were discussed earlier, showed that farmers would tend to prefer cash crops (especially groundnuts). Thus, once the farmers meet their food security needs, unless relative prices change dramatically, they would most likely shift to cash crops. For example, using the data from Table 22 (the 4%/year yield increase scenario) and assuming that after first planting to meet their own food needs, farmers would plant the remainder of the land in cash crops, farmers in the region south of the 400 mm reliable rainfall isohyet would plant about 60 percent of the land in cash crops. In 1990 they planted about 38 percent of the land to cash crops so, in addition to the increased value of the food produced for home consumption, there would be a 66 percent increase in income per farm (60 - 38 + the 40% yield increase). Since most of the interventions discussed do not require cash expenditure (although some of them may mean that income is lost, for example increased fallow) most of the revenue increase would be net increase, so the 66 percent rate of return should be reasonably attractive to farmers.

Conclusion

Senegal has limited land and water resources which are, in fact, not capable of supporting the national population. Growing population and increasing urbanization and highly variable rainfall have resulted in extreme exploitation of these resources; important sub-surface water sources are becoming contaminated, forest and shrub lands are not capable of sustaining woodfuel needs, and the soils in a large part of the country have become severely degraded and vast areas are highly susceptible to further degradation through erosion. As a result, in many years, the rural population is not capable of producing enough food for its own needs, let alone contribute to feeding the growing urban population (already almost 40% of the total population). A review of the current resource base and its use, when confronted by population projections, does not provide a particularly encouraging picture of the prospects unless a serious effort is made to protect existing resources and to improve current use.

Senegal has some land and water resources which have not yet been exploited and it has a comparative advantage for the production of crops suitable to these regions (millet, maize, cotton, and groundnuts). These resources will clearly have to be brought into production, and probably relatively soon. The advantage to Senegal is that these lands are located in a zone which has sufficient rainfall for most cereal crops. The disadvantage is that most of these soils are extremely susceptible to erosion once the vegetative cover is removed. Farming, as practiced in much of the country, contributes further by removing virtually all crop material from the soil. The organic matter content of Senegal's soils drops rapidly once the vegetative cover is removed, which means reduced productive capacity, less water retention, lower responses to inputs such as fertilizer and increased vulnerability to even marginal changes in the weather. It has been estimated that through the 1970's, soil productivity declined at between 3 and 5 percent per year. While in some regions (especially the Groundnut Basin) this may have stabilized (it is as bad as it can get), any newly opened land risks a similar fate.

The decline in soil productivity has been compensated, to some degree, by the use of improved seeds etc., but there is clearly a limit at which this will reach the point of diminishing returns (Maldon, for example suggests that for millet there are no real genetic advances to be made). This doesn't mean that there are no possibilities for increased productivity. The technology review has shown that soil and water management techniques can add between 70 and 180 percent to millet and sorghum yields. Other crops, especially in the zone which has the "new land" potential and enough rainfall, can be more productive, with the proper "packages"; yields of rainfed rice, maize and sorghum, for example can be increased 50-100% with the proper packages and acacia albida (because of the soil nutrients it pulls from the deep soil and increased organic matter) is reported to increase groundnut yields as much as 40% and millet yields as much as 150%.

The solution to the problems outlined above require a commitment to both parts of the "carrying capacity" dilemma: a reduced rate of population growth and better resource management. The solutions do not necessarily mean higher cash expenditures by farmers, but they do imply an intense effort to communicate benefits and consequences of good or bad resource management to farmers (as well as administrators). There are also some labor implications. In the Casamance, for example, rice is grown by the women and there may be some question about how

much control they have over land and land use decisions; it varies by region, but women are generally the major food producers (especially vegetables, and lowland rice in the Casamance) while men are the main cash crop producers. Thus, any program would have to account for differing goals (food vs cash) and different levels of decision power and resource control. The "compound" or family group social system may also have implications. Since an individual may not know from year-to-year what land he or she will be allocated by the compound head, there may be less incentive to adopt or continue conservation measures. That is, given the land tenure system in Senegal, soil and water conservation measures probably will have to be focused on the compound rather than the individual farmer. This is an extension issue which will be addressed in Chapter V.

CHAPTER IV
CONSUMPTION, MARKETING AND PROCESSING

The previous three chapters have investigated Senegal's resource limits and potentials. It has been repeated (perhaps ad nauseam) that the country has a serious, resource based, productivity problem and that, unless steps are taken to improve soil and water use and to control population growth, the "problem" will soon exceed disaster proportions. But, these are not the only issues. There is also a range of basic crop marketing (including trade), crop processing, food consumption, agricultural policy and institutional factors to be considered along with the resource questions. This chapter will deal with some of these issues. Chapter V will present an analysis of specific institutional issues. In this chapter, commodity marketing and processing includes the inputs and outputs associated with agriculture and forestry in Senegal. As is the case with the rest of this report, livestock and the related input and output marketing activities are not considered in any detail. The chapter is divided into three principal sections; crops, agricultural inputs and trees.

CROPS

Marketing and processing agricultural crops in Senegal can be divided into four broad categories: food grains (rice, millet/sorghum, corn and cowpeas); fruits and vegetables; traditional cash crops (groundnuts and cotton); and 'special' cases (wheat, sugar). Each category has its own unique institutional and geographic potentials and constraints. The previous chapters have outlined many of the constraints and potentials, largely from a production point of view. This chapter will complete the marketing/processing link between producer and consumer (or external trade) and some of the associated institutions.

Farm Income

The gross real value of crop output varies widely from year to year - for the usual reasons (climate, pests, crop cycles and prices). In addition to the annual variations, as has been shown in the preceding pages, declining productivity and population pressure have contributed to a shift from cash to food crops, as well as to a reduction in the area planted (production) per farmer. The consequence has been stagnation in total output and a steady decline in the real value of marketed crops. In real terms, over the 1960/61 and 1989/90 crop years, the value of marketed crop output declined by 2.5 percent per year (Table 1 and Figure 1 show the data for 1976-1989, Annex II contains data for the full period)[1].

The real value of all output has tended to decline (but there is no detectable statistical trend). And, since area planted has remained relatively constant, output per hectare shows the same relationship. The split between the value of crop output retained for home consumption and the value attributed to marketed output has shifted dramatically; in 1976/77 marketed output accounted for almost 68 percent of the total and in 1989/90 it accounted for only 40

[1]The rate of change in the value of marketed output was calculted by a regression function (natural log of ouput as a function of time).

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percent of the total. The drop in real cash income (from marketing crops) has obvious implications for farm family welfare because it seriously restricts their ability to purchase health, education and other services and suggests that investment in technology which requires cash input will be severely restricted.

Despite the declining share of cash crops in the value of all crop output, the primary source of crop based rural income is still groundnuts (about 46% of the total - Figure 2). And, as would be expected given its share in area planted, millet is the second largest (36%) - maize and paddy account for six and nine percent, respectively. In the aggregate, rainfed crops account for at least 95 percent of the value of all crop output.

Table 1

Value of Total and Marketed Crop Output
(Constant 1979 FCFA)

Crop Year	Constant 1979 FCFA						
	Gross Output	Marketed Output	Home Use	Gross per ha.	Gross per wkr.	Marketed per wkr.	Home Use per wkr.
	(Bil.)	(Bil.)	(Bil.)	(FCFA)	(FCFA)	(FCFA)	(FCFA)
1976 /77	87.782	59.954	27.828	34,715	53,605	36,612	16,993
1977 /78	44.771	25.033	19.738	18,910	26,784	14,976	11,808
1978 /79	84.146	44.465	39.681	33,470	49,321	26,062	23,258
1979 /80	54.163	21.918	32.245	23,797	31,107	12,588	18,519
1980 /81	42.824	10.770	32.054	17,662	24,102	6,062	18,041
1981 /82	79.489	38.300	41.189	32,245	43,846	21,126	22,720
1982 /83	70.098	37.484	32.614	29,175	37,900	20,266	17,634
1983 /84	37.777	15.354	22.423	17,657	20,023	8,138	11,884
1984 /85	50.965	14.163	36.802	23,924	26,483	7,360	19,124
1985 /86	80.818	25.173	55.645	35,184	41,179	12,826	28,352
1986 /87	72.286	32.427	39.860	33,945	36,119	16,203	19,917
1987 /88	78.210	32.125	46.085	35,445	38,328	15,743	22,585
1988 /89	55.296	20.782	34.514	24,668	26,581	9,990	16,591
1989 /90	62.799	24.787	38.012	29,230	29,616	11,689	17,927

Source: Annex II.
Note: per wkr. = 50% rural population.

Figure 1

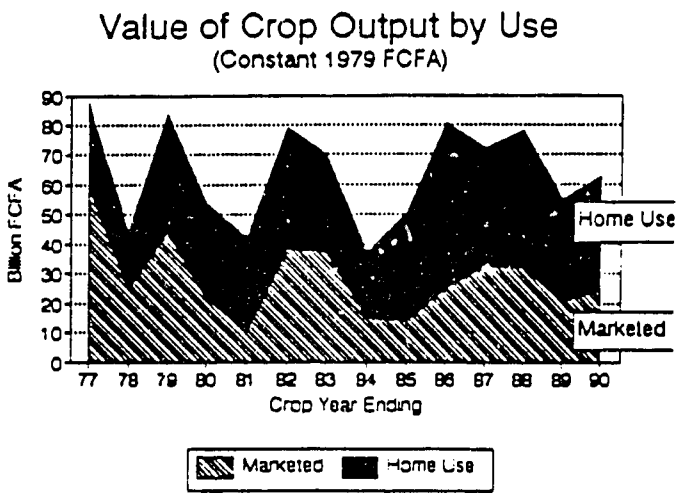
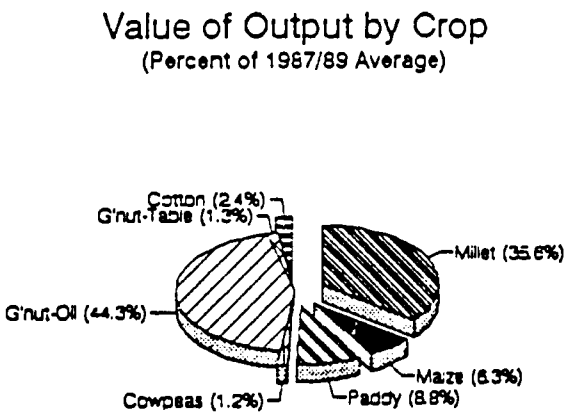


Figure 2



The importance of crop production and marketing in total rural income differs, depending on the ecological zone and the type of rural community. In the more urbanized rural areas (market villages) and in the lower rainfall zones, income from sources other than crop production is obviously more important. Tables 2, 3, 4 and 5 provide some examples of what major income sources have been for a range of "situations". Tables 2 and 3 show income sources for two villages in the middle Senegal River Valley (Matam, 1989). Table 4 show sources of income for three villages in the Northern Groundnut Basin (Louga, 1988/89), and Table 5 shows the same information for three villages in the Central Groundnut Basin (Fatick, 1988/89)[2].

Table 2

Sources of Income: Doumga/Matam in FCFA
(FCFA and % of total, 1989)

Source	Average Per Family	Percent of Sub-Total	Percent of Total
Credit	20,877	8.8%	5.4%
Migration	143,900	60.7%	37.0%
Salaried	67,870	28.6%	17.4%
Social	4,282	1.8%	1.1%
Sub-Total	236,929	100.0%	60.9%
Livestock	46,757	37.2%	12.0%
Cereals	79,069	62.8%	20.3%
Sub-Total	125,825	100.0%	32.3%
Artisant	7,997	3.5%	2.1%
Commerce	18,277	69.6%	4.7%
Sub-Total	26,273	100.0%	6.8%
Total	389,027		100.0

Source: IDA (Report #5. pg 56) IDA
Note: Monetary income was 302,147 per family for 15 families (119 people) in 1989.

Table 3

Cash Income Sources : Thiemping/Matam
(FCFA/Family and % of Total, 1989)

Source	Average Per Family	Percent of Total
Off-Farm		
Migration	361,472	62.0%
Pension	16,325	2.8%
Sub-Total	377,797	64.8%
On-Farm		
Artisanry	2,332	0.4%
Commerce	39,645	6.8%
Credit	6,996	1.2%
Crops	9,328	1.6%
Fishing	79,291	13.6%
Gift	16,908	2.9%
Labor	9,328	1.6%
Livestock	18,074	3.1%
Transport	23,321	4.0%
Sub-Total	205,223	35.2%
Total	583,020	100.0%

Source: IDA (Report #5, part 2, pg 22)
14 families in 1989.

The data emphasize difficulties inherent in making broad judgments about the sources of rural income. In the middle Valley of the Senegal River, in both villages, remittances and salary income account for at least 60 percent of the total. The difference between the two villages is also instructive; in Doumga (where the income data includes imputed value of home consumption) cereals account for 20 percent of the total; and in Thiemping (where the data are for cash income) crops account for only 1.6 percent of the total (more evidence of the low volume of marketed cereals).

[2]The Groundnut Basin data are preliminary results from a USAID financed survey based in ISRA with IFPRI technical assistance. The study covers income and expenditures for two years in 10 zones in the Basin. Data for a third zone (in the Tambacounda area) is being prepared and will be included in the report when it is available.

Table 4

Family Income by Source: Northern Groundnut Basin (Sagatta Zone - Louga)
(FCFA/Family, 1988-89)**

Sector	Sagatta (Market Village)			Khelcom Peulh			Darou Cisse		
	Number Obs.	Total Income	Percent Total	Number Obs.	Total Income	Percent Total	Number Obs.	Total Income	Percent Total
Crops	12	58,691	15.8	12	50,577	21.4	12	131,918	59.5
Gathering	12		0.0	12		0.0	12		0.0
Livestock	12	12,065	3.3	12	129,000	54.5	12	24,123	10.9
Total Ag.		70,756	19.1		179,577	75.8		156,041	70.3
Ag. Labor	12	2,622	0.7	12	35,609	15.0	12	9,393	4.2
Commerce	12	89,674	24.2	12	16,798	7.1	12	28,811	13.0
Service	12	72,046	19.4	12		0.0	12	1,271	0.6
Transport	12		0.0	12		0.0	12	2,866	1.3
Food Prep.	12	29,856	8.0	12		0.0	12	50	0.0
Artisanal	12	96,724	26.1	12	1,309	0.6	12	22,471	10.1
Gifts	12	2,083	0.6	12	250	0.1	12	417	0.2
Borrowing	12	7,427	2.0	12	3,305	1.4	12	500	0.2
Total Non-Ag.		300,432	80.9		57,269	24.2		65,779	29.7
Total		371,188	100.0		236,846	100.0		221,820	100.0

Source: ISRA/IFPRI preliminary survey results. IFPRI_INC
** Livestock income from "net" transactions (negative value indicates net investment). Crop income includes imputed value of home consumption.

Table 5

Family Income by Source: Central Groundnut Basin (Niakhar Zone - Fatick)
(FCFA/Family, 1988-89)**

Sector	Niaknar (Market Village)			Mboltogne			Mboyene		
	Number Obs.	Total Income	Percent Total	Number Obs.	Total Income	Percent Total	Number Obs.	Total Income	Percent Total
Crops	11	115,057	64.0	12	83,047	73.9	12	219,336	78.6
Gathering	11		0.0	12		0.0	12		0.0
Livestock	11	8,041	4.5	12	(1,814)	-1.6	12	23,142	8.3
Total Ag.		123,098	68.5		81,233	72.3		242,478	86.9
Ag. Labor	11	1,395	0.8	12	404	0.4	12	540	0.2
Commerce	11	17,153	9.5	12	17,409	15.5	12	29,692	10.6
Service	11	14,005	7.8	12	13,263	11.8	12	5,934	2.1
Transport	11		0.0	12		0.0	12		0.0
Food Prep.	11	1,915	1.1	12		0.0	12		0.0
Artisanal	11	22,075	12.3	12	25	0.0	12		0.0
Gifts	11		0.0	12		0.0	12	500	0.2
Borrowing	11		0.0	12		0.0	12		0.0
Total Non-Ag.		56,543	31.5		31,101	27.7		36,666	13.1
Total	11	179,641	100.0		112,334	100.0		279,144	100.0

Source: ISRA/IFPRI preliminary survey results. IFPRI_INC
** Livestock income from "net" transactions (negative value indicates net investment). Crop income

The data for the Groundnut Basin is also instructive, by both the difference between villages within a given zone and by the differences between zones. In Louga, where the economy is much more livestock dependent, crops account for a fair portion of total income (from a low of 16% in the highly urban market town of Sagatta, to as high as 60% in Darou Cisse, including the imputed value of home consumption). The data for the Central Groundnut Basin shows a similar pattern, except that income from crops completely dominates all other sources, even in the market village. Including the value of home consumption, almost 64 percent of all income is from crops in Niakhar (the market village) and crops account for 74 to 79 percent of the total in the other two villages. Since 1988 was not a good crop year, these data may even be underestimated.

The data in Tables 2-5 make it clear that while crop based income is not the only important source of total income, it makes a significant contribution even in those areas where other activities dominate, especially in the Groundnut Basin. In fact, preliminary data from the ISRA/IFPRI farm surveys indicate that rainfed agriculture is the major source of revenue for both men and women throughout the Basin, as well as in parts of Southeast Senegal. Virtually 100 percent of the villages in all 10 zones of the study ranked rainfed agriculture as most important. The second most important revenue source for men was livestock and the third most important source was a mixture of "migration" and commerce. The second most important source of revenue for women was also livestock, but commerce was mentioned more often for women than for men[4]. Of course, it isn't surprising that nearly all of the villages ranked groundnuts and millet as both the first and second important crops (this ranking begins to change to sorghum, maize, rice and cotton in the southeast).

Marketing Institutions and the Role of the State

The GOS, under various donor supported programs (especially under several World Bank Structural Adjustment Loans), has started disengagement from commodity related production and marketing activities. However, despite this program, there is still a extensive legacy of State intervention in commodity marketing and processing. While the various institutions and related policies will be discussed below, an overview of the institutions and their relationships to the marketing system and to one-another will help to explain how the system works now and how current dialogue is expected to change the system.

With notable exceptions (cotton, groundnuts and rice), extensive State involvement in marketing and processing ended in 1980 when ONCAD was dissolved and especially in 1984, when SONAR was dissolved. The input marketing system was privatized in 1988 when a USAID and French financing fertilizer subsidy elimination program terminated (again with an exception - cotton). The local cereals marketing system was deregulated in 1988 (again with an exception - rice). A overview of the various programs was given in Chapter I.

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[3] Pre-survey interviews with 228 village chiefs in 1988 [ISRA/IFPRI, 1990].

[4] The data raise an interesting question about the macro data, which shows the livestock portion of GDP about equal to crops. It is probably important to distinguish between crops, which are consumed, and livestock which is largely a store of wealth. The data shown in tables 2-5 do not show that livestock is a very important source of income.

Table 6

Selected Major Public Institutions Involved Marketing and Processing

CPSP	Rice	Monopoly on broken grain rice imports Monopoly on wholesale marketing of local rice (except SODAGRI). Collects "perequation" on imported rice.
SAED/URIC	Rice	Responsible for planning development of the River Valley. Is the only 'official' market for commercialized rice in the Valley. Operates two rice mills and contracts with one private mill. Processes the rice then sells it to CPSP (178 FCFA/kg). Ross-Bethio, Richard-Toll: URIC operated (State), Delta 2000 - private contract.
CSA	Cereals	Maintains a food security stock (60,000 tons rice). Purchases local cereals for distribution to deficit regions. Collects and publishes farm and retail price for cereals (weekly for 40 markets). (This operation will be transferred to the common fund. Financed by the Common Fund and the German Project (PSA).
SODAGRI	Rice	Responsible for development of the Anembé Basin. Purchases, mills and markets rice produced in the region. Volume purchased 1988/89 was 797 tons.
	Maize	Provides a market for local maize (1988/89 volume was 8.5 tons).
SODEFITEX	Cotton	Supports cotton producers (Tambacounda and Kolda). Collects, processes and markets cotton fiber and seed.
	Cereals	Provides a market for local cereals (1988/89 maize volume was 34 tons). Supports establishment of local grain mills.
	Rice	Purchases and mills local rice. Rice is purchased and marketed by CPSP (1988/89 volume was 589 tons).
SODEVA	Cereals	Provides extension services in the Groundnut Basin. Provides credit to certified seed producers (millet, maize, cowpeas) with funds from CNCAS (provided by the French supported PTS).
SONACOS	Ground-nuts	Process and market groundnut oil and meal (also processes cottonseed) Imports vegetable oils. Has recently started a "perequation" system on the imported oils which is to be used to support the sector (farmers). To be privatized under SAL IV.
SONAGRAINES	Ground-nuts	Responsible for groundnut collection (through cooperatives and private agents). Responsible for maintaining a base groundnut seed stock.
SOPFA	Ground-nuts edible	Responsible for development of the edible groundnut sector. Provides credit, collects, processes and markets table nuts. Will be privatized by the end of 1990.
Horti-culture		Three "monitoring" committees composed of government, producers and exporters. Potatoes and onions - fix seed import quotas. Bananas - fix import quotas. Transportation - exporter groups to negotiate air freight rates and quotas. Two main exporter associations.
CNCAS	Credit	National agricultural credit institution (25% State owned).
ITA	Food	Food technology research.
ISRA	Agric.	Agricultural Research (livestock, cereals, horticulture)
Common Fund	Cereals	Programming counterpart funds from food aid sales. Promotion of local cereals.

Table 7

Major Private Institutions Involved In Crop and Input Marketing and Processing

SISMAR	Equipment	Privately owned equipment manufacturer.
SENCHIM	Fertilizer	Fertilizer manufacture, distributor. Holds a monopoly on compound fertilizer imports and phosphate export.
	Seed	Vegetable seed distributor.
GRANDE MOULINS DE DAKAR	Wheat	Privately owned wheat mill. The same individual owns CSS (see below)
SENTENAC	Wheat	Privately owned wheat mill. Also own SOCA (see below)
	Millet	Processes millet under arrangement with the Common Fund.
CSS	Sugar	Privately owned sugar plantation and mill. Monopoly on sugar production and imports.
	Other	Experiments with irrigated cotton, etc.
SOCAS	Tomato Paste	Processes tomato paste (River Valley) No paste imports allowed.
SNTI	Tomato Paste	Privately owned tomato paste processing plant (River Valley). No paste imports allowed.

There are 11 major public institutions engaged in marketing and processing agricultural commodities and 7 principal private sector enterprises (Tables 6 and 7). The activities of the public institutions range from import and export monopolies (as in the case of CPSP for broken rice imports and SONACOS for groundnut product exports) to monopolies for processing and local wholesale distribution. The private institutions have a similar range of activities. CSS has a monopoly for sugar production, processing and imports and SENCHIM has a monopoly for compound fertilizer production, imports and phosphate exports. Most, but not all, of the private institutions enjoy some form of protection, either by import restrictions and/or by State controlled prices.

There are a large number of important "institutions" not listed in Tables 6 and 7 - village and producer organizations, NGO's (Non-Governmental Organizations) and GIE's (Groupemment de Interet Economique). These institutions play an extremely important part in production and marketing, but will not be enumerated here (See the MAPS report for more detail). Even though the larger firms and institutions are mentioned frequently in the following pages, the reader should always recall that these agents often provide the basic client contact. Since public sector institutions are deeply, if not exclusively, involved in marketing and processing local production of cash generating crops, these "crop systems" enjoy a certain isolation from world markets. In the past, when world markets where high, this has meant large windfall gains to the State. In recent years, due to attempts to maintain farm prices and because of marketing and processing inefficiencies, t has large and insupportable deficits.

Financing the markets

The marketing campaigns are financed by bank "consortiums", with a separate arrangement for each of the major commodities: groundnuts for oil (SONACOS/SONAGRAINES), edible groundnuts (SEFPA), groundnut seeds (SONAGRAINES), SAED rice purchases, SODAGRI rice purchases, cowpeas (SODEVA-no longer active), and cotton (SODEFITEX). As indicated by the number of parastatals associated with the management of the marketing funds, the State is deeply involved in marketing most of the important agricultural commodities, except millet, sorghum and maize. Since most of these "commodity systems" are also financially deficit, it is not surprising that sizable arrears have accumulated. The arrears for marketing campaign funds over the 1985 and 1988 crop years are shown in Table 8, a total of over 45 billion FCFA - 79% in the groundnut sector.

Table 8

Unpaid Marketing Campaign Credit by Crop and Year (Million FCFA)
(As of June 1990)

Crop Campaign	1985/86	1986/87	1987/88	1988/89	Total	% Total
Groundnut - Oil	--	1,740	24,816	4,509	31,064	68.4%
Groundnuts - Seed	--	884	1,812	1,652	4,347	9.6%
Groundnuts - Edible	--	594	--	--	594	1.3%
Cowpeas	541	457	--	--	998	2.2%
Rice - SAED	--	--	39	3,113	3,152	6.9%
Rice - SODAGRI	--	--	--	26	26	0.1%
Cotton - SODEFITEX	--	--	--	5,229	5,229	11.5%
Total	541	3,674	26,667	14,529	45,410	100.0%
Percent Total	1.2%	8.1%	58.7%	32.0%	100.0%	

Source: Ministere de l'Economie et des Finances.

Other than the obvious implications for banking sector liquidity, there are a number of reasons for concern about the large deficit: a large portion (59%) of it is three years old; and it is concentrated in the cash crop sectors (over 90%) and especially in the two groundnut sub-sectors (79%) which are expected to be privatized over the next two to three years. At current exchange rates privatization is going to cost someone over 190 million dollars just to clear the books and this does not cover the debts of the oil mills.

An example of the total volume of financing used to support the various marketing campaigns and the recovery rate as of June 1990 is shown in Table 9 (the 1988/89 crop year). A total of almost 46 billion FCFA was borrowed to finance the 1988/89 crop marketing campaigns: 77% for groundnuts; 16% for cotton; and 7% for rice. As of June 1990, about 32 percent of the total had not been repaid. In some cases, the repayment problem is linked to factors outside the control of the institutions concerned: CPSP, for example, is often not timely in paying SAED for its rice. CPSP, on the other hand has recently been required (by the IMF) to pay 5 billion FCFA to cover the SODEFITEX deficit. The system

appears to be organized so as to absorb liquidity wherever it may exist. The use of CNCAS to provide the majority of the financing for the 1989/90 crop marketing season is a good example.

Table 9

Marketing Funds (Consortium) for the 1988/89 Crop
(Billion FCFA)

Crop	Net Funds Received	Marketing Costs	Total Funds Received	Balance as of June 1990	
				FCFA	% Total
Groundnut	29.155	6.058	35.213	6.161	17.5%
Oil Seeds	27.340	5.164	32.504	4.509	13.9%
Edible	1.538	0.833	2.371	1.652	69.7%
	0.277	0.061	0.338	--	--
Cotton*	6.291	1.024	7.315	5.229	71.5%
Rice	2.766	0.502	3.268	3.139	96.1%
SAED	2.722	0.502	3.224	3.113	96.6%
SODAGRI	0.044	--	0.044	0.026	59.1%
Total	38.212	7.584	45.796	14.529	31.7%

Source: [MDRH, November 1989]
* Includes funds for production credit.

In principle, CNCAS is a private, agricultural credit bank. By agreement with the donors supporting the banking sector reform, the State is to have no more than 25 percent ownership (the remainder is owned by cooperatives, etc.). The GOS has not been able to sell its shares to the private sector, so it still owns more than 25 percent. In 1989, because of difficulties in arranging the various consortia, the GOS used CNCAS to fill the gaps. As a result, CNCAS provided 100 percent of the funding for SAED and SODAGRI and 54 percent of the funding for the groundnut campaign[5]. As of mid-October 1990, CNCAS had 14.7 billion FCFA outstanding from past marketing campaigns, 5.5 billion for years before 1989/90 and 9.2 billion for the 1989/90 campaign [CCCE, June 1990].

Although the marketing campaigns absorb the greater share of CNCAS lending, its principle function is the provision of credit to the rural community. CNCAS operates with lines of credit provided by a number of external institutions, most often with very attractive conditions[6]. The external funds are usually attached to a project or a region, with the result that the loan activity tends to be concentrated by region. For example, during the 1988/89 year CNCAS loaned a total of 3.1 billion FCFA: 2.2 billion in crop agriculture (70%); 402 million

[5]Percent of 1989/90 funds remaining to be paid and due to CNCAS.

[6]See [MDRH, June 1990, Annex Report pg 113] for details.

in fishing (13%); 275 million in livestock (9%); and the remainder in rural commerce, rural housing, etc. (8%). Of the 2.2 billion FCFA loaned in crop agriculture, 20 million was from the Matam III project (FED) and over a billion was from the Irrigation IV financed by the World Bank [CNCAS, March 1990, Table 10]. Thus, about 47 percent of loans in crop agriculture were designated for the River Valley by these two projects alone.

The history of production credit in Senegal has not been especially encouraging, except when there is a single purchaser who subtracts credit before making payment and when there is no alternative market, or when the credit is closely supervised. Cotton is an example, repayment rates to SODEFITEX have always been in the 99 percent plus range. Fertilizer (and other inputs) are a different case. In 1987/88 over 42 percent of the money loaned for fertilizer in the Thies, Kolda and Ziguinchor Regions had not been repaid [MDRH June 1989, pg 109]. And, only 70 percent of the 1988/89 loans for inputs and equipment had been repaid as of September 1989 (Table 10 shows the volume of loans and the repayment status for inputs and equipment for the 1988/89 year, by regional agency). The situation is not quite as desperate as the data indicate, because the loans for equipment are for three years and more of the other loans will certainly be recovered.

Table 10

CNCAS Credit for Inputs and Equipment
(1988/89 Year - million FCFA as of Sept. 1989)

Agency	Loan	Recovered	Repayment Rate %	Percent of total Loaned
Thies	104.579	16.944	16.2%	13.9%
Diourbel	5.742	2.238	39.0%	0.8%
Ziguinchor	4.165	1.676	40.2%	0.6%
Kaolack	302.686	210.379	69.5%	40.4%
Fatick	60.724	45.038	74.2%	8.1%
Kolda	7.008	5.815	83.0%	0.9%
Louga	103.553	92.685	89.5%	13.8%
St. Louis	79.307	71.088	89.6%	10.6%
Matam	47.950	45.933	95.8%	6.4%
Tambacounda	34.135	33.525	98.2%	4.6%
Total	749.849	525.321	70.1%	100.0%

Source: [MDRH, November 1989, Annex I.10]
Material (equipment) 4.2% of arrears, groundnut seeds 90%
Excludes 124 million FCFA for groundnut and millet fertilizer financed by the CCCE.
Input loans are for 9 months, equipment 3 years.

The data in Table 10 point to a situation which Senegal must resolve before there can be real growth in agriculture. When asked about constraints to technology adoption (improved seeds and chemical inputs), farmers and knowledgeable local officials inevitably respond that the main constraint is credit. Yet experience shows that an unacceptable volume of loans are not

repaid, unless they are made under "captive" conditions, or are very closely supervised. CNCAS has responded by refusing credit to entire regions and by concentrating on loans to GIE (it has also insisted on contractual commitments to repay past debts before it will make new loans). This reduces the risk but it does not contribute to a solution of the "credit constraint". A more flexible approach is required, one much closer to the clients. Local savings and loan associations are one possibility being investigated (by USAID and the French). USAID experience with the Kaolack Credit Project suggests that this can work.

Food Crops

Although Senegal has a wide range of production possibilities and cropping systems, it is possible to characterize virtually all of Senegalese agriculture as a system dominated by extreme variability resulting from climatic and land resource constraints. It is also possible to characterize the interface between production and consumption as one of constant (sometimes critical) supply deficits. Figure 3 shows what this means in terms of the balance between locally produced and imported cereals.

Figure 3

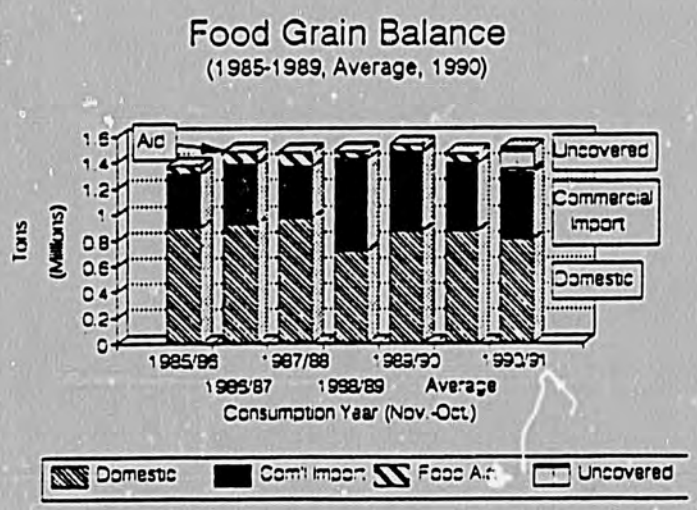


Figure 3 shows food balances for 1985/86 through 1989/90, the average over the period, and a preliminary food balance for 1990/91. (The data are for the November-October consumption year.) The figure repeats information which has already been discussed: supplies from domestic production have been variable, but declining (the lower portion of the bars); commercial imports (solid portion of the bars) account for almost as much as local production; and food aid (stripped), while relatively small as a part of the total, has been essential for maintaining consumption levels. The part of the figure which shows information for 1990/91 demonstrates a case which arises with great regularity when food needs assessments are made - a relatively large uncovered deficit. (See Table 11 for detailed information). It should be noted that PL 480 programs

are included in the 1985-1989 data but not for 1990/91 because at the time this report was prepared no PL 480 program had been defined. It is clear that until basic resource productivity is improved (given population growth, even after) such programs will necessary in order to maintain stable food supplied for the Senegalese population.

Table 11

Senegal Food Grain Balance 1990/91 Preliminary Estimate
(Millet, Sorghum, Maize, Rice and Wheat)

Item	Food Balance	Percent of Requirement	Per Capita
Per Capita Consumption (kg/year)	201	(%)	(kg/yr)
Population (000's)	7,498		
Consumption Requirement (tons)	1,507,098	100.0%	201
Production (tons)	943,255	62.6%	126
less non food uses	147,845	9.8%	20
less Stock Change	(8,300)	0.6%	1
Net Domestic Production (tons)	803,710	53.3%	107
Deficit (tons)	703,388	46.7%	94
less Planned Commercial Imports	514,500	34.1%	69
less Committed Food Aid	28,741	1.9%	4
Uncovered Deficit (tons)	160,147	10.6%	21

Source: Annex IV (Food Needs Assessment).
Note: Except for rice, the data are for unmilled grains.
Rice is included as "rice" not "paddy" - to indicate appropriate volumes.
Consumption is the 5 year average (1985/86-1989/90).

Figure 6 in the previous chapter showed that, in aggregate terms, the rural surplus has been negative in 9 of the last 13 years; even accumulated, the surplus has been negative over the last 13 years. The variation in the "surplus" (for example, negative 300,000 tons in 1984 to positive 300,000 tons in 1986) points to the importance of on-farm storage and the temporal transfer of food supplies. The figure also indicates that the temporal aspect of the transfer is short; seldom more than one or two years. A large part of this variation is linked to the dominance of millet in overall production, the millet/groundnut rotation, and "good-year-bad-year" cycles. All of which is to say that the marketed surplus is generally low and highly variable. This, combined with the relatively high rate of population growth and increasing urban concentration, has positioned the cereals sub-sector, especially rice and related policies and programs, as the dominant issue in food and agricultural policy in Senegal. Overall, all of this can be summarized as having generated a program based on short-term solutions to long-term problems requiring massive amounts of financial and technical inputs and the initiation of policies and programs which are not necessarily grounded on production/consumption or competitive realities[7]; a measure of this can be taken from the emphasis placed on industrial

[7]Political realities are a different issue. As long as donors are willing to support these programs Senegalese authorities will enjoy a much broader range of political options.

and semi-industrial cereals processing when there has been very little, and highly localized, marketed cereals surplus. Under what conditions would the private sector engage in such activities when there is no assured supply of the basic input? The answer has been to establish a series of barriers, quotas, guaranteed prices, subsidies, State "companies", etc. to compensate for economic reality and/or conflicting policies. A large deal of this 'manipulation' has been done in the rice sub-sector.

Local and Imported Rice and its Relationship to Other Cereals

Including wheat, Senegalese consume about 220 kg of cereals/person/year, and 200 kg/person/year excluding wheat. Converted to millet equivalent, consumption is about 200 kg/person including wheat, and 178 kg/person excluding wheat (Table 12)[8]. In absolute terms, rice accounts for the largest portion of the national cereals-diet (95 kg) and millet/sorghum accounts for an additional 87 kg. The relative importance of the various food crops changes slightly when converted to consumable weights: millet is first (77 kg); rice second (62 kg); wheat and corn are about equal (14 kg); and cowpeas are last (3.5 kg);

Consumption patterns differ considerably, both urban/rural and by geographic location, primarily reflecting local production patterns and the availability of imported rice. Generally, as would be expected, millet is by far the most important grain in the rural areas, and rice is the most important in the urban areas. There is also a substantial difference in regional consumption patterns. Rice is the major element in the cereal diet in the River Valley and in the Casamance, and millet is the major cereal in the groundnut basin (See Annex IV). One of the things which has helped to stimulate interest in millet processing, as well as corn production, is the large weight of rice and wheat in the diet, especially in the urban diet; wheat consumption exceeds both millet and maize consumption in the urban diet and it exceeds maize consumption in the total (urban + rural) diet and rice consumption is three to four times higher than any other cereal.

Table 12

Per Capita Consumption - Major Grains
(Kg/year/person, 1988 estimate)

Food Crop	Per Capita (kg un-milled)		
	Urban	Rural	Total
Millet/Sgm	30.1	126.1	87.0
Maize	11.7	18.7	15.9
Paddy	140.2	63.5	94.7
Cowpeas	1.2	5.0	3.5
Wheat	45.4	4.5	20.0
Total	228.6	217.8	221.1
Excl. Wheat	183.2	213.4	201.1
Millet Equiv.			
Total	197.3	203.7	199.8
Excl. Wheat	147.6	198.9	178.0

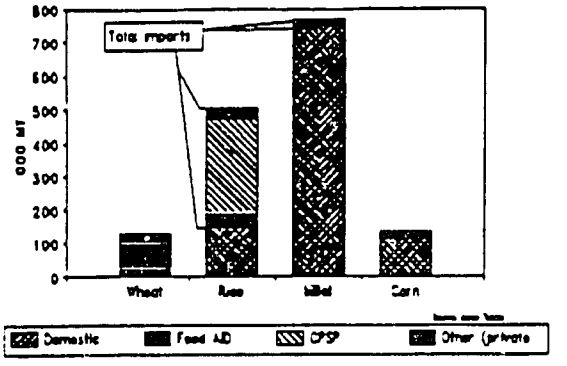
Source: Annex IV.
Millet equivalent calculated using calory ratios.

[8] Millet equivalent calculated according to relative calory content (un-milled form). This adjusts for such crops as paddy rice which, in un-processed form, has a lower calory content.

Since the majority of the rice supply (85% in 1989) and all of the wheat is acquired from external sources (Figure 4), it is easy to understand why there has been such an emphasis on local cereals processing and rice pricing policy.

Figure 4

Food Grains: Total Available by Source
(000 metric tons, average 1985-1989)



Rice impacts on the cereals marketing/processing system in two ways: via the price competition it represents for local cereals and via a set of price and marketing controls which have been established to "protect" local rice production. CPSP has a monopoly on broken grain rice imports as well as wholesale marketing of local production. CPSP collects a perequation on grain it imports, part of which is used to subsidize local production. CPSP sells the imported rice to local wholesalers at official prices. There are no particular conditions on these merchants, except that they must purchase at least 10 metric tons. The private sector may import intermediate and high quality rice, for which there is no fixed consumer price or (in principle) import restriction. Private importers must, however, obtain a license which is reviewed by CPSP before it is awarded. CPSP also imports high and intermediate quality rice. Since this rice is sold to wholesalers at a relatively low price, and since the private sector has no way of knowing what CPSP's import plan may be, this practice introduces considerable uncertainty. Conditions suggested under the PASA discussions should restrict CPSP to broken grain rice imports only to eliminate this practice.

Before the 1989/90 season, first stage collection and processing of commercialized local production was under SAED control, which collected the rice and delivered it to the URIC and Delta 2000 mills[9]. Starting with the 1989/90 crop farmers have been responsible for delivery to the mills - SAED was still

[9]Delta 2000 is a privately owned mill located at Podor. The Delta 2000 mill processes rice under contract with SAED. URIC manages the two State owned mills at Ross-Bethio and Richard-Toll.

paying the transport charges once the trucks arrived at the mill. Once processed, the rice becomes the property of CPSP, which pays SAED and organizes transport and distribution. Overall, this system embodies a large subsidy.

A comparison of 1989 imported and local rice costs, perequation rates, and subsidies is presented in Table 13. In 1989 the subsidy associated with local rice production and processing exceeded the CF (cost and freight) cost of imported rice (88 FCFA/kg subsidy vs 85 FCFA CF). International rice prices were higher than usual in 1989 so the perequation was relatively low at about 13 FCFA/kg - it therefore required the revenue from about 7 kg of imported rice to pay the subsidy on the rice sold to CPSP. Under this system (at 1989 prices) the NPA goal of substituting local rice production for imported rice would collapse at about 53,000 tons of marketed local rice. Fortunately, CPSP purchases of local rice have not exceeded 20,000 tons, so the perequation has been "safe" (about 7 billion FCFA in 1989 [CAB 1990, pg 21]).

Table 13

Cost/Revenue Comparison for Imported and Local Rice
(FCFA/Kg)

Imported by CPSP		Local Paddy Purchased by SAED and CPSP	
Cost, Freight	85.3	85.0	Farm Price
Insurance	1.3	1.7	Drying Loss
Unloading (Ship)	3.5	10.8	Collection
Pallets	.6	14.8	Milling
Loading, Transport	1.7	-2.1	Value of By-Products
CPSP Overhead	14.6		
		110.2	Total at Mill (paddy)
		164.3	Total at Mill (rice)
		14.4	Mill Margin
		178.7	CPSP Purchase Price
		1.7	Loading+Transport
Total Warehouse	107.0	180.4	Total at St. Louis
Wholesale Dakar	120.2	122.6	Wholesale St. Louis
Perequation	13.2	57.8	Subsidy
Required to support the		30.6	Irrigation Subsidy
local rice subsidy = 7.0 kg		88.4	Total Subsidy

Source: Based on [MDR/FAO, 1989, Volume II, pg 17] and calculations.

The consequences for any private sector engagement in the rice marketing and processing system are obvious. There is no way the private sector could engage in "industrial" type milling under the present regime. Some combination of higher consumer and/or lower farm prices and/or increased efficiency would have to occur to eliminate the 58 FCFA subsidy (88 FCFA if the water subsidy is included). The boundaries within which a completely privatized local rice market would have to operate can be established by comparing the farmgate "economic"

price of rice (35 FCFA in 1989) to production costs[10]. Table 10 in Chapter 3 shows a cost of production/kg, including the substantial subsidy for irrigation water in the delta region, as follows:

	Including labor	Excluding labor
Delta (large perimeters highly subsidized)	46	35
Matam (small perimeters no subsidy)	50	27

The economic price is about even with the cost of production excluding labor so, unless farmers place no value on their labor, and without a significant subsidy on water and under current cropping conditions, Senegal cannot compete with the world market, even when world prices are relatively high (as was the case in 1989). Increasing cropping intensity is one (eventually necessary) possibility. But, the differences are too great for the system be competitive. There are a number of ways of attacking this problem:

Cost reduction - the MDR has announced that taxes will be removed from agricultural implements and fuel used in agriculture.

- increasing milling efficiency and reducing milling costs - especially by privatizing the rice mills.

- reduce subsidy by shifting the cost to farmers.

- shift development from the large perimeters to the smaller, private systems.

- increase cropping intensity.

Price increases - the CFA is overvalued (estimates vary but it is estimated at between 40 and 45 percent). The PASA discussions have suggested a compensating duty on imported rice.

- the PASA discussions have also suggested an increase in the consumer price.

Change Consumption Patterns - shift from broken grain rice to higher quality rice in both production and consumption.

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[10] From Table 3 subtract the CPSP overhead = 93.4 FCFA/kg
Add transport Dakar-St. Louis mills (6.5) = 99.9
Add handling costs at mill (1 FCFA/kg) = 100.9
Subtract processing cost (14.8/.65) = -22.8
Sub-total..... = 78.1
Subtract mill margin (10% x 78.1 = 7.9) = 70.2 = "economic price"
(The mill also retains by-products valued at 2.1 FCFA)
Paddy equivalent mill gate (.65 x 70.2) = 45.6
Less collection cost (10.8) = 35 = Farmgate equivalent

All of these measures are, in fact, either in process or under serious discussion. Since privatization is a major focus, some combination of all of the measures is clearly needed[11]. One possibility is a combination of adjustment measures and a shift from the large perimeter production/industrial processing framework to a smaller, private, perimeter and small (village) milling system. With a 45 percent duty (exchange adjustment), the "economic farmgate price" is 58 FCFA/kg, which is much more favorable in terms of establishing a competitive private system with the industrial mills and at relatively high 1989 world prices. This also implies a wholesale price of around 145 FCFA and a retail price around 155 FCFA/kg (vs the 130 now fixed in Dakar).

The smaller rice mills which are found in villages in the Senegal River Valley present a more promising alternative. Operating costs for these mills (capacity of between 375 and 450 tons/year) are between 5 and 6 FCFA/kg. Since they have a low transformation rate (55%), the by-product value is much higher than is the case for the industrial mills (about 12 FCFA/kg paddy)[12]. In principle, these mills are operated as a service to farmers (because CPSP has the wholesale distribution monopoly). Farmers pay for processing and retain both the by-product and the rice. Since farmers pay between 10 and 12 FCFA for the processing, the by-product value is absorbed, and the farmer has a product costing about 91 FCFA/kg (production cost divided by the transformation rate) which can be sold for 135 FCFA at official retail prices. Privatizing the marketing/processing system can only lead to a much more dynamic local system, based on small enterprise processing and marketing. Evidence is that this dynamic is already underway - between 1980 and 1988 the number of small mills in Dagana Department alone increased from 25 to 125 (78% operational)[13].

In addition to the subsidies associated with local rice production and marketing, rice pricing policy also has an impact because the rice price is low relative to other cereals. One of the consequences has been a considerable "intrusion" of rice into diets outside Dakar[14]. A quasi-pan territorial and pan-seasonal pricing system has been established via a set of regional wholesale and retail prices which embody a transport subsidy (which increases with distance from Dakar (Table 14)). Operationally, this pricing scheme transfers some of the perequation to outlying areas. It also operates to frustrate one of the nation's primary goals - to encourage production and consumption of local cereals. One result has been a significant increase in rice transfers to the various regions. In 1980, for example, the Dakar/Thies complex received over 70 percent of CPSP rice distributions (Figure 5). In 1989, the Dakar/Thies complex received about 53 percent of total transfers (Figure 6).

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[11] USAID and the EEC are jointly financing a complete review of the rice sector (including an audit of CPSP) with a view to completing the privatization of the rice marketing and processing system.

[12] Based on [SONED, 1989], [Morris, 1986]. See [Kite, 1989, pg 8].

[13] The parallel rice trade in the Valley can be substantial, since only about 36% of total production is sold to SAED [Rabes, 1989], [Morris and Newman, 1989]. Higher wholesale and retail prices will also strengthen the Gambia "connection". In 1987, when the retail price was 160 FCFA/kg, studies in Southeast Senegal and the Upper Casamance found that 90% of rice purchases were from the Gambia [Ndoye/Ouedraogo, 1989].

[14] Rice has been part of the Senegalese diet for generations.

Table 14

CPSP Rice Transport Subsidy
(As of September 1990)

REGION	DISTANCE FROM DAKAR	WHOLE-SALE PRICE	CPSP TRANSPORT SUBSIDY
	(KM)	--(FCFA/KG)--	
DAKAR	--	120.2	--
ST. LOUIS	270	122.6	2.5
LOUGA	163	122.0	2.7
THIES	70	120.2	2.0
DIOURBEL	116	121.6	2.1
FATIK	145	122.0	1.7
KAOLACK	198	122.0	2.3
TAMBA	490	125.2	4.5
KOLDA	675	124.5	9.1
ZIGUIN'R	440	124.5	10.7

SOURCE: CPSP

Figure 5

CPSP Rice Distribution - 1980

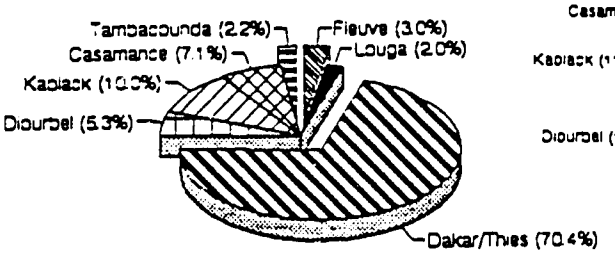
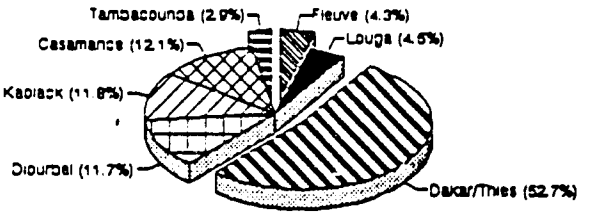


Figure 6

CPSP Rice Distribution - 1989



Total rice distribution increased at an annual average rate of about 2.4 percent between 1980 and 1989, just below the overall population growth rate, largely because the amount retained in Dakar remained steady (because of compensating private sector imports?). Rice distribution to the other regions has grown at between 4% and 7.5% per year, depending on the region (Table 15). All of this increase cannot be attributed to the transport subsidy, but it does indicate that there has been a substitution of imported rice for local cereals and a significant intrusion into rural diets. Given the low volume of marketed

surplus, it is reasonable to expect rice consumption in the urban areas to increase at about the rate of growth in population. The rates of growth in rice distribution to the various regions suggests a growth in per capita consumption of rice in the rural areas or a significant increase in the rice share in urban diets. Available data support an argument that there has, in fact, been a considerable "intrusion" into rural diets.

Table 15

CPSP Rice Operations 1980-1989 (tons)

	CPSP Distribution							
Year	Fleuve	Louga	Dakar/Thies	Diourbel	Kaolack	Casamance	Tambacounda	Total
1980	8,417	5,517	196,277	14,780	27,825	19,875	6,241	264,998
1981	11,612	5,754	196,052	18,288	27,342	23,066	6,538	271,286
1982	13,617	7,173	209,405	21,372	32,082	19,759	8,133	290,751
1983	12,933	9,876	202,270	28,664	39,237	29,983	12,337	312,491
1984	12,392	12,556	225,122	30,367	41,433	31,611	8,122	336,655
1985	10,939	10,389	209,493	28,351	33,170	29,264	5,322	305,598
1986	13,645	10,589	203,482	28,449	26,634	27,129	5,783	291,477
*1987	8,725	7,978	102,617	21,805	19,935	20,227	4,629	169,213
1988	12,934	12,999	192,589	34,012	31,432	33,817	8,044	299,894
1989	15,836	16,805	195,198	43,264	43,678	45,006	10,928	338,074
Average % Growth	5.2	7.5	-0.1	7.3	4.0	6.2	4.8	2.4

Source: [Hirsch, 1990], [DPPE/CAB, 1990]
* Privatization experiment. Private sector import is estimated at 84,000 tons.

National rural expenditure budgets which cover a period of years are not available, but current information shows high levels of rural expenditure for imported food:

In Thiemping (near Matam in the middle river valley) nearly 64 percent villagers' total cash expenditures were for imported foods, basically rice (and this is a rice producing area) [Annex IV].

Preliminary data from the ISRA/IFPRI farm consumption surveys (1989) show that in Sagatta (Louga) 63 percent of expenditures on grains were for rice and that in Niakhar (Fatick) 59 percent of expenditures for grains were for rice[15].

Data collected in eastern Kolda and western Tambacounda (1987) show that purchased rice only accounted for about 10 percent of total cereals consumption, but that about 67 percent off-farm income was spend for food (not specifically for rice) [Goetz, 1990, pg 163].

Research by Benoit-Cattin (1981) in villages near Thies, Bambey and Koungheul found that a farm household purchased rice an average of 9.3 times per year vs 1.5 times per year for millet (rice was purchased much more frequently in the Thies and Bombey areas and millet not at all in

[15] This data is summarized in Annex IV.

the Koungheul area. [Benoit-Cattin, no date, pg 7]). The volume purchased, rather than being 9:1 in favor of rice as indicated by transactions, was approximately 3:2.

These data cover a range of basic food balance situations and years, from chronic shortages in the Louga area to the reasonably secure Kolda and Tambacounda regions. It is universal, however, that farm families spend 70-80 percent of their cash incomes for food. Under these circumstances, it is not surprising that a small portion of food crop production is marketed or that farmers are unwilling (or unable) to make substantial investments in "modern" technology.

Local Cereals Marketing

There is relatively little that can be said about the marketed surplus of cereal grains, except that any program to encourage marketing and processing of local cereals for urban consumption faces this as one of the major constraints. In the 1987 study by Goetz, about 1/3 of the households were net cereals purchasers, 1/3 about even and 1/3 net sellers (for sellers the net transaction was about 7% of production) and the preliminary 1989 ISRA/IFPRI data have a similar pattern (2 to 7% of the value of sales). Obviously, most of what is sold will not enter commercial channels, but will be exchanged in small transactions between and within farm families. There is a potential for increased marketing but before this can happen four things are necessary: increased marketable surplus, storage facilities, retail markets, and market information.

Major steps have been taken to facilitate the development of the appropriate environment: local cereals marketing (except rice) was completely deregulated in 1988; CSA has instituted a market information system; and on-farm storage and local cereal processing have been a major focus for several donors, NGO's, PVO's and the GOS. While the storage and processing programs have been aimed at stabilizing local food supplies and providing labor saving equipment for harvesting and processing, they could also eventually help to transform local cereals markets.

The 1988 deregulation of cereals marketing reduced the role of CSA from a pervasive (at least in theory) intervention in price support, storage, transportation and re-sale operations, to a simpler price monitoring and food aid distribution function. Although CSA was never a major force in the national market, this liberalization helped to facilitate the development of local cereals marketing by eliminating a complex set of licenses, grain movement restrictions, and price support operations. During the 1986/87 season, just before liberalization, CSA purchased millet at the official price of 70 FCFA/kg and sold it to licensed wholesalers for 90 FCFA/kg; assembly, general overhead and distribution costs totaled 84 FCFA/kg, so there was net negative margin of 64 FCFA/kg[16]. By comparison, research conducted by ISRA in 1986/87 found that millet wholesalers who supplied the major urban centers operated profitably (profit margin of between 3 and 5% of purchase price) with gross margins between 7 and 10 FCFA/kg [ISRA, 1989, pg 195]. Recent information on marketing margins is not available, but, since these costs tend to remain relatively stable, the

[16] Part of the reason for this large loss was badly stored grain and high storage losses. The net margin on CSA operations for the 1985/86 season was only minus 7 FCFA [Morris, 1989, pg 190].

information from the ISRA study can be used to estimate the benefits of increased private sector marketing to both urban and rural merchants (Table 16).

Although all of the agents in the marketing chain operate on a small net margin (each generally 3-5% of purchase price), a greater volume of marketed surplus suggests real increases in rural families' farm and off-farm income. Two-thirds of the increased marketing activity would accrue to rural households.

Table 16

Millet Marketing Margins(Dakar): Rural and Urban Agents
(FCFA/kg and Percent of Total)

Item	Gross Margin	
	FCFA	(%)
Collection	5	17%
Rural wholesaler	15	50%
Subtotal rural	20	67%
Dakar wholesaler	5	17%
Retailer	5	17%
Subtotal urban	10	33%
Total	30	100%

Source: (ISRA, 1989, pg 195).

Given the constraint imposed by the "thin" marketed surplus, a commercial processing and marketing system has to face an additional "constraint" - rice prices relative to cereals prices and processing costs. Although there has been a concerted effort to develop a local cereals processing capacity, under current rice prices and cereals processing costs it simply is not possible for processed local cereals to compete with imported rice.

Industrial and semi-industrial cereals mills

Efforts to expand cereals processing have been relatively broad based, ranging from village level grain threshers, dehullers and mills to urban based semi-industrial and "full industrial" mills. The village based equipment is meant to encourage local consumption and ease preparation (i.e. labor saving) as well as to develop local markets for semi-processed cereals. The urban mills are meant to help expand markets for local cereals and operate in direct competition with imported rice.

The Common Fund, FAC and PSA/CSA have been the most active supporters of industrial milling. This group has plans to install 10-12 semi-industrial mills (capacity 150-300 ton/yr, each) in cities outside Dakar [Holtzman, 1989]. As of October 1990 there have been 8 semi-industrial mills installed (Thies, Fatick,

Dakar, Kaolack, Tambacounda)[17]. The Common Fund has been helping to subsidize millet processing at a large industrial mill in Dakar (capacity 20,000 tons - mostly wheat)[18]. Many of the donors, USAID included, have worked with ITA, ISRA, and SISMAR to develop equipment, food products, test consumer acceptance, and to help establish a processing/marketing system. Some of the notable accomplishments have been:

Millet bread
Millet/wheat mix
Niebe products
Grain milling equipment

As usual (perhaps appropriately) subsidies have been used to encourage the development of millet processing by the industrial mill (the Common Fund pays 30 FCFA/kg subsidy). Also as usual, without the subsidies, these mills cannot possibly compete with imported rice costing 130 FCFA/kg retail. All costs considered, without subsidy, one kg of millet meal can be processed and moved to market for 206 FCFA (142 FCFA when subsidized). See Table 17. These mills face two additional problems, adequate supply of the primary input and the high cost of maintenance and repairs. High maintenance costs, which are estimated in Table 17 at almost 50 percent of total processing cost, have led observers such as Holtzman [1989] to advocate elimination of materials import duties and value added taxes (for all types of mills and materials)[19]. The difficulty of obtaining an assured supply of grain has led to reliance on CSA (the State) to provide grain supplies.

The semi-industrial mills present a viable option. They face similar problems with respect to input supply, but they are capable of processing grain at a cost of 16 FCFA/kg vs the 25 FCFA estimated for the industrial mill (See Table 18). Wholesale rice prices are 122 FCFA/kg in Kaolack and 124.5 FCFA in Tambacounda (Table 14), so an ex-mill cost of 103 FCFA provides about a 20 percent margin for the mill. Financial costs have not been included in the calculations, so the relative competitive position is much closer. Elimination of the rice transport subsidy (7 FCFA in Tambacounda, almost 12 in Kolda, and 3 in Kaolack) would go far toward improving the competitive situation and would encourage local cereals trade. Under the present pricing system, the prospects for increasing food-processing-based economic activity in the regional centers (Kaolack for example) are still marginal because price relationships between processed millet and retail rice have been decidedly in favor of rice for two of the last three crop seasons (Figure 7).

Factors other than the retail rice price account for part of the "millet disadvantage" (the 1988/89 season was not a good one and millet prices were fairly high, but even after the relatively good harvest of 1989/90, it persists). Reducing the retail rice price from 160 FCFA/kg to 130 FCFA in 1988 certainly

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[17] These mills are manufactured by SISMAR and can be used to process either millet or maize (50/60 kg/hr for millet and about 100 kg/hr for maize.

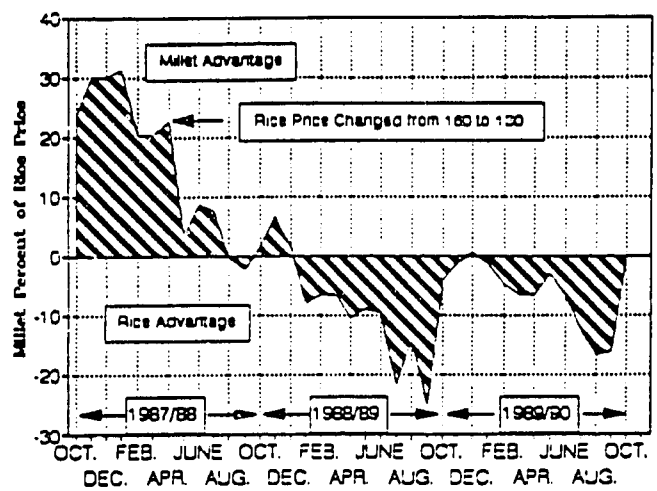
[18] Common Fund Sub-Program number 6.

[19] Holtzman estimates that these taxes add over 50% to the acquisition cost for equipment. Even if removal of the taxes cut repairs in half, the total cost would still be non-competitive. Since variable costs account for most of the processing cost, increased capacity utilization would not appear to help substantially.

did not help! Intra-seasonal price variation also plays a role. Since the marketing season is short, and there is virtually no commercial storage, the mills are constrained to a short operating year (the mill at Kaolack only operates about six months per year)[20].

Figure 7

Processed Millet and Retail Rice in Dakar
(Percent Difference Millet/Rice)



[20]With the exception of stocks held on farms and food security stocks held by CSA (60,000 tons of rice) there is virtually no intermediate or long-term storage. Gergely (1990, pg 4) reports that grain merchants' stock turn-over rates are about one month, reflecting an unwillingness (or inability) to commit the necessary resources.

Table 17

Processing Costs: Dakar Industrial Mill
(SENTENAC Millet - 1988 FCFA/kg)

Cost Item	No Subsidy	39% Subsidy*
Purchase Millet	91	56
Variable Cost		
Energy	3.7	3.7
Labor	1.6	1.6
Repair	11.9	11.9
Other	1.3	1.3
Sacks (40 kg)	4.6	4.6
Total Variable	23.1	23.1
Fixed Costs		
Depreciation	0.6	0.6
Overhead	1.2	1.2
Total Fixed Cost	1.8	1.8
Total Processing	24.9	24.9
Sub-Total	115.9	80.9
By-Product Value	-3.3	-3.3
Total (ex. TVA)	112.6	77.6
Total Finished Goods	156.4	107.8
Distribution (25%)	39.1	26.9
Total Retail (inc. TVA 7%)	206.4	142.2

Technical Information	Product (%)	Loss (%)
Millet Grain	100.0	
Clean Grain	90.0	10.0
Hulling		
Bran	15.6	1.4
Grain(hulled)	73.0	
Grinding by-product		
Broken Millet	20.1	0.8
Flour	7.5	
Ground Millet	44.6	
By-Product Value		
(27.6% x 12 FCFA/kg)	3.3	

Note: Percentages are estimates Mill operating at 10,000 ton per year (50% capacity).

July 1990 Dakar retail price for millet meal was 150-200 FCFA/kg.

Source: Adapted from [MDIA/CEGOS, 1988, Volume 3] rlz-mil
* The subsidy is paid by the Common Fund to CSA.

Table 18

Processing Costs and Margins: Semi-Industrial Mill
(Kaolack FCFA/kg - November-June, 1990)

Cost Item	Hulling Only	Milling
Purchase Millet	69.4	69.4
Transport/Storage	2.7	2.7
Sacks		3.8
Maintenance	1.0	1.0
Labor	1.7	1.7
Energy (elec.)	3.1	4.9
Misc.		0.3
Total Variable	8.6	14.4
Depreciation	3.9	1.4
Total Processing	12.5	15.8
Total Cost (Raw)	81.9	85.2
By-product Value	-6.4	-5.2
Net Processing	75.5	80.0
Total (Finished)	94.7	103.5
Final Product Value	105.2	124.1
Margin/kg product	10.5	20.6
% Margin	11.0%	19.9%

Transformation	(%)	Loss (%)
Grain (raw)	100.0	
Hulled grain	79.7	4.4
Bran	15.9	
Milling		2.4
Meal	59.2	
Flour	5.2	
Bran	12.9	
Sale Prices	FCFA/kg	
Meal	124.1	
Flour	130.4	
Bran	40.0	
Hulled grain	105.2	

Kaolack retail market price for meal was 250 FCFA/kg in July 1990.

Source: Adapted from [Salcedo, 1990] rlz-mil
Holtzman [1989, pg 35] shows similar costs for the mill at Tambacounda (16-21 FCFA/kg for electric powered, and 17 FCFA/kg for a rural, diesel powered mill).

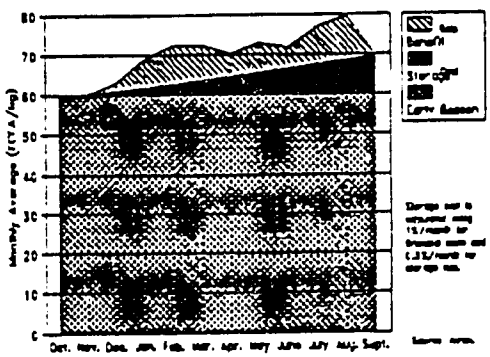
Transfer through time and space: storage and prices

Intra-seasonal price variation and the cost of storage (essentially opportunity costs and storage losses) suggest that there is an incentive to store grains between seasons, this is no particular surprise, since farmers have been doing this for centuries. The figure below contains an estimate of the benefits which could accrue if millet and/or maize is purchased at the beginning of the season and stored for later use or sale.

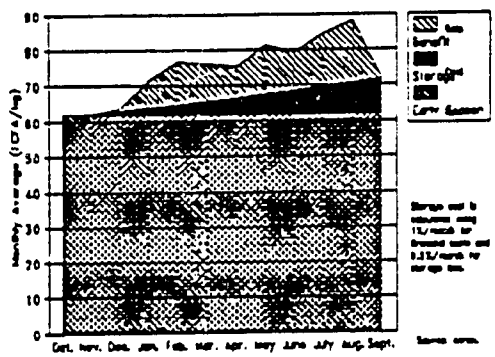
Figure 8

Monthly Average Prices and Gains from Storage - Millet and Maize
(1986/87 - 1989/90 Average)

Millet



Maize



The gains are relatively large - as much as 20 FCFA/kg for maize toward the end of the season. As long as the producer is at or near self-sufficiency, there is little incentive to market grain because to do so would mean paying as much as one-third more later in the season. On the other hand, processors could reduce average acquisition costs and extend the operating period if they were willing and/or able to establish and manage adequate storage facilities. Ultimately, the benefits would be shared between farmers and their clients.

Cereals Banks

The "Cereals Banks" are a potential way of helping stabilize, then increase cereals marketing. Unfortunately, experience to date has not been especially encouraging; of the total 571 banks created, 64 percent are operating at an average of about 10 percent capacity (total storage capacity of 22,000 thousand tons and 2,170 tons stored [CSA 1990 and Annex IV]). Average capacity is about 38 tons with about 210 members, for an average potential storage per member of 286 kg. Given

the 10 percent utilization rate, the banks appear to provide about 29 kg of active storage per member, or enough grain for one family for one week[21].

Since the cereals banks are supported by numerous NGO's and PVO's (27 different groups) they are broadly and relatively evenly distributed throughout Senegal[22]. As would be expected, there are differences in operating experience: banks in the chronic food deficit regions (especially Louga and St. Louis) tend to remain active and to operate at higher rates than banks in the more food secure regions; some banks, rather than operate themselves, "contract" with a local merchant; some of the banks, once created, engage in totally non-grain related activities; and many of the banks engage in a mixture of grain and non-grain activities.

The relatively low "survival" rate (64%) of the banks reflects a number of constraints [CSA 1990, pg 21]:

- storage (generally improper technique and poor security)
- commercial (acquiring stock in deficit zones - transport cost, etc)
  (isolation in all zones - a rainy season problem)
  (debt recovery)
- social (social and historic problems with cooperation in general)
- training (management, accounting, literacy)
- information (related to commercial knowledge and experience - timing of buying activities and prices paid and received).
- financial resources (financing is obtained from grants, interest free loans, subsidies, member fees, and commercial loans (CNCAS). Since the banks try to pay more than market at harvest and sell for less than market at "soudure", margins are squeezed. In Louga, for example, millet cost 75-80 FCFA/kg in November 1989 and was sold for 80-85 FCFA/kg in July and August of 1990 - a margin of 5 FCFA. Interest charges on 80 FCFA (one year at 15%) would be 12 FCFA for a loss of 7 FCFA/kg, ignoring storage costs and losses. The actual market price during the "soudure" was 98 FCFA/kg, so the banks could have operated at a slight profit [CSA, 1990, pg 23].

In view of the small margins and the "social" aspects of cereals bank operation, it is not surprising that many of the banks attempt to diversify to provide what must amount to an internal cross-subsidy from other commercial activities. The CSA report does not specify what the other activities are or their importance,

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[21] Membership in this survey was not well defined, so we do not know if membership is by individual or by household. Since it is reasonable to assume that membership is by household, and given about 10 people per household, capacity per capita would be about 29 kg. The storage data are also not well defined, but is assumed (and implied by the text in the report) to be total grain stored.

[22] CRS is by far the major "player", they have helped create over 250 banks. It is possible that they have over-extended because of these 250 banks only 30 are reported to be functioning as cereals banks [FAO, April 1990, pg 14].

but it does mention that several of the banks have purchased grain milling equipment.

Farm and village grain processing equipment

There are three kinds of equipment: threshers, dehullers and mills Most of this equipment is (or can be) manufactured in Senegal (SISMAR).

Mills and dehullers. Holtzman [1989, pg 7] quotes a 1986 study which estimated that there were a total 5,000 village mills in Senegal (3,000 operating). One project (FENU based in the old Ministry of Social Development) has delivered mills and engines to 468 women's groups. The equipment is free and includes startup operating funds[23].

Dehulling is not used extensively in Senegal, partially because dehulled grain does not store well and, since it is more expensive than milling and requires additional processing, repeated trips may as well be made to the mill; this is probably why so many of the installed dehullers are no longer operating (the 1986 study estimated that only 15 of 450 dehullers installed since 1962 were operating [Holtzman, 1989, pg 4]).

The small mills can (as has already been demonstrated by data for rice mills in the Senegal River Valley) help develop local commerce, especially in the "market villages". These mills cost about 8 million FCFA to install and at full capacity of 250 tons/year, can produce meal at a cost of 33 FCFA/kg (including allowance for the value of bran by-product). The economic viability of these mills is very dependent on the rate of capacity use because a large part of the processing cost is fixed to buildings and equipment (at 75 percent capacity fixed cost is about 1/3 of the total/kg - Annex IV). The retail price of rice also has an impact in that it sets the limit on commercial possibilities. Table 19 shows some example calculations for Tambacounda.

Table 19

Grain Processing Costs, Small Mill in Central Tambacounda

Item	Millet	Maize	Source
Farm Production Cost	53	37	Table 13, Chapter II
Assembly Cost	5	5	Table 16, this Chapter.
Cost Mill Gate	58	42	
Waste	3	3	5%
Grain Cost/kg Processed	61	45	
Processing Cost	31	31	See Annex IV.
Mill Margin (20% above)	6	6	
Total/kg Processed	97	82	
Less Value By-Product	-6	-6	bran valued at 30/kg
Total	91	76	76% meal, 19% bran,
Cost/kg Meal (80% conversion)	114	95	5% loss, 76/95=80%

[23] The motive behind these gifts is linked to grain preparation in rural households. This is inevitably the task of women, is physically demanding and time consuming (estimates vary from one-half to one hour per day per household [Holtzman, 1989, pg 3].

If a client supplies his or her own grain, then counting cost of production and transport, one kilogram of millet meal would cost 114 FCFA. Maize meal would be much more viable, economically, because its unit production cost is much lower. A farmer could produce, transport and process his own corn at a cost of 95 FCFA/kg of maize meal. Small farmer commerce using self-produced grain is possible, but it is marginal at market prices. At a maize market price of 70 FCFA/kg the total cost, excluding a mill margin, would be 132 FCFA/kg meal. Given a Tambacounda retail rice price of 135, the commercial potentials are limited. Eliminating the 4.5 FCFA transport subsidy on rice would help to bring the local cereal within profitable bounds.

Except for rice, problems with storage, transportation and packaging will probably limit small mill use to an "as-needed" basis. The village cereals storage programs should help, by accumulating stocks, but the ability to pay is also a factor. If a family consumes 4-5 kg of millet per day (1.5 tons in 300 days) the total cost for processing would be at least 45,000 FCFA/year, well beyond the means of most farmers. Increasing the productive value of labor, especially for women, would seem to be essential before use of this equipment is widespread. This will mean monetizing the food grains sector.

Mechanical threshing is relatively wide spread in grain surplus zones such as Kaolack but, according to Holtzman, only a small portion of the total crop is involved (perhaps 5% and linked to the marketed surplus). These machines are capable of processing up to one ton/hour, are locally manufactured (SISMAR) and cost around 5.5 million FCFA. They are operated by individuals who move them from location to location, so efficiency requires regions with concentrated production (or large farms). According to Holtzman [1989, pg 2] farmers pay between 7 and 10 FCFA/kg for this service (with operating costs between 3-4 FCFA/kg). A machine operating at 63 percent capacity can process 500 tons/year, for a total net of 2.5 million FCFA, indicating just over a two year investment payback.

Conclusion: Cereals Marketing

The preceding analysis has pointed to two major constraints and one enormous potential for expanded cereals marketing in Senegal. The constraints are the low marketed surplus (less than 10% of total production marketed) and a rice pricing policy which confers a significant price advantage to imported rice. The potential is that around 50 percent of total cereals consumption is imported (around 500 thousand tons of food aid and commercial imports), so there is a large market waiting to be exploited - if sufficient surplus can be generated.

It is evident that an increased marketed surplus and a change in rice pricing policy is necessary before a viable, commercial local cereals market can be established.

> It is patently clear that local rice cannot be expected to provide a nationwide answer to the food porblem, under any policy regime. Rice production in Senegal is simply too expensive to compete with world markets.
>
> Policies which adjust for currency overvaluation can help, as long as the marketing and processing system is permitted to operate freely.

Small, village based mills can contribute to a more cost efficient rice sector, but cannot be expected to provide service very far outside the immediate production regions.

Increased production and marketing of local cereals has several advantages and some disadvantages.

Farmers are already substituting land from cash to food crop production, with an accompanying reduction in cash revenue and, at the same time, imported rice is gaining share in rural diets.

Increased marketing of local cereals would contribute to rural incomes because marketing revenues from imported rice accrue to urban based merchants, while two-thirds of the margin from local cereals marketing accrues to the rural population.

Reduced rice imports would also eliminate a major source of State revenue.

Groundnuts are the main source of cash income for most of Senegal's farmers. Declining soil productivity and the general shift to food crops have limited this important source of revenue for the State and for individuals. Since 1976, the real value of marketed output has declined by 2.5 percent per year.

The rate of substitution between imported rice and local cereals in consumption is not known with any precision, nor has the cereals price/supply response been reliably measured. Even though indications are that the price elasticity of supply is low (perhaps 0.3 to 0.5 in the short-run and 0.8 to 0.9 in the long-run), the price elasticity of marketed surplus can be expected to be as much as 10 times higher. However, the precarious nature of rural food security argues not for increased marketing from current production, but rather for increased marketing from increased production.

Fruits and Vegetables

As a group, fruits and vegetables are among the least regulated commodities traded in Senegal. On the domestic side this permits an active, open market, largely operated by women (especially retail trade). International trade suffers, somewhat, because there are no explicit quality standards.

There are four main marketing circuits, characterized generally by the intended destination of the produce:

- local retail market: small producers/marketers or producers/assemblers/wholesalers/retailers;
- export market: small contract producers-exporter or medium and large farms (some exporter owned);
- industrial processing (largely in the River Valley): company plantation or contract farmers or independent farmers who deliver to the processing plants; and
- potatoes (officially): Producer cooperative members - Cooperative Union - Contract merchants - Retail merchants - Consumer.

Table 20

All Vegetables: Area Planted and Production by Region
(1988/89)

Region	Area (000 ha)	Production (000 ton)	Percent of Total Area	Percent of Total Production
St. Louis	1.494	28.011	18.8	23.1
Louga	0.830	13.134	10.4	10.8
Dakar	1.909	25.003	24.0	20.6
Thies	2.845	43.346	35.8	35.8
Sub-Total	7.078	109.494	89.0	90.3
Diourbel	0.069	1.038	0.9	0.9
Fatick	0.062	0.688	0.8	0.6
Kaolack	0.393	4.716	4.9	3.9
Tambacounda	0.018	0.144	0.2	0.1
Kolda	0.189	3.106	2.4	2.6
Ziguinchor	0.146	2.044	1.8	1.7
Sub-Total	0.877	11.736	11.0	9.7
Total	7.955	121.23	100	100

Source: [MDRH, 1989, Annex I.2]

All vegetables combined, production has stabilized around 100-120 thousand tons annually. Area planted has been especially stable over the last 15 years (between 6.5 and 7 thousand hectares [Annex II]. The Niayes and the irrigated areas in St. Louis are by far the most important vegetable producing regions; area planted and production in St. Louis and in the Niayes account for about 90

percent of the national total (Table 20). The Niayes, alone, accounts for over 60 percent of the national total, principally for sale in the Dakar market. The Niayes is also the major source of vegetables destined for the export market. Production in St. Louis is split between tomatoes for the two tomato paste processing plants and onions and other vegetables for local consumption. A relatively small and declining portion of total national vegetable production is exported (about 5%).

Trade and Price Policy

Trade and price policy related to fruits and vegetables is aimed at protecting local producers and processors. Explicit policy exists for tomato paste, potatoes, onions and bananas.

There are two, privately owned, tomato paste plants in the River Valley. They are the only agents permitted to import tomato paste. An import quota (triple concentrate) to meet any short-fall in local production is set by agreement with the GOS. The triple concentrate is re-processed into double concentrate. The GOS maintains four official industrial tomato prices: a farm price, a wholesale price, a semi-wholesale price and a retail price.

There are no explicit price controls on onions or potatoes but importers must submit proof that they have purchased a minimum quantity (50-60 tons) of local production before they can obtain an import license. Import quotas for seed potatoes is determined by agreement between the GOS, the growers union and major exporters.

Bananas appear to be the only fruit which has an official price - 200 FCFA/kg wholesale only.

Consumption and Domestic Markets

Senegalese consume about 71 kilos of vegetables and tubers per year (52 kilos of vegetables per person, Table 21)[23]. Onions, tomatoes and potatoes are the major vegetables in the Senegalese diet. The nation is self-provisioning in tomatoes (net trade is essentially zero), but Senegal does import substantial quantities of onions and potatoes (net trade accounts for about 42% of the total available supply of potatoes and 22% of onions, (Table 22).

The cost-of-production and returns to labor information in Chapter III have shown that, under existing prices, onion, potato and tomato production can be very lucrative to Senegalese farmers and the net trade data show that there is room for expanded marketing of locally produced potatoes and onions.

Tomatoes:

The market for fresh tomatoes is basically saturated, so the domestic market can be expected to expand at about the rate of population growth (export potentials will be covered in the following section but this can be summarized as not being a real possibility).

[23] For comparison, in the United States per capita vegetable consumption is 190 kg/capita.

Table 21

Vegetable and Tuber Consumption per Capita
(Kilograms and Calories per Capita, 1976)

Item	Consumption Kg/Capita	(*) Calories per Kg	Daily Calories Total	Calories % Total
Onions	14.4	3100	122	31.8
Potato	10.1	820	23	5.9
Tomato	7.3	2300	46	12.0
Cabbage	6.6	350	6	1.6
Eggplant	4.5	3200	39	10.3
Turnip	2.6	300	2	0.6
Carrot	1.9	400	2	0.5
Hot Pepper	0.9	7400	18	4.7
Other Veg	3.5	2234	21	5.6
Total Veg.	51.8		281	73.0
Sweet Potato	11.1	1210	37	9.6
Manioc	3.8	3630	38	9.8
Diverse	4.4	2420	29	7.6
Total	71.1		384	100.0

Source: Consumption (SOWED, 1990, pg 220). Calories from various publications. * Calories for Other Veg. and Diverse Tubers is average of the included foods. The use of calories to rank the vegetables is not meant to imply that calories are the most important contribution vegetables make to the diet.

Table 22

Potatoes, Onions and Tomatoes: Supply and Utilization
(thousand tons)

Year	Production*	Import	Export	Total Available	Production Percent of Available
Potatoes					
1985		12.863	0.703	12.862	
1986	20.738	9.740	0.624	30.477	68.0
1987	13.000	13.529	1.223	26.528	49.0
1988	13.579	11.408		24.987	54.3
1989	21.594			21.594	
Onions					
1985		13.533	2.453	13.531	
1986	39.252	14.952	15.329	54.189	72.4
1987	18.500	16.586	0.309	35.086	52.7
1988	23.501	10.526		34.027	69.1
1989	31.307			31.307	
Tomatoes (fresh)					
1985		0.035	0.115	0.035	
1986	22.846	0.034	0.212	22.880	99.9
1987	24.752	0.159	0.270	24.911	99.4
1988	22.096		0.324	22.096	100.0
1989	14,911			14,911	

Source: MDRH. * Production for consumption in indicated year.

Table 23

Industrial Tomato Production

Crop Year	Area (ha)	Yield (ton/ha)	Production (tons)
1969 /1970	6	30.000	180
1970 /1971	13	30.000	390
1971 /1972	30	30.000	900
1972 /1973	77	19.481	1,500
1973 /1974	144	18.403	2,650
1974 /1975	650	13.692	8,900
1975 /1976	1,080	11.759	12,700
1976 /1977	880	20.000	17,600
1977 /1978	800	19.500	15,600
1978 /1979	805	12.112	9,750
1979 /1980	na	na	na
1980 /1981	665	20.144	13,396
1981 /1982	773	17.424	13,469
1982 /1983	1,179	21.154	24,940
1983 /1984	1,084	18.484	20,037
1984 /1985	1,170	16.321	19,095
1985 /1986	1,212	7.107	8,614
1986 /1987	1,190	25.308	30,116
1987 /1988	1,416	25.944	36,736
1988 /1989	1,259	24.922	31,377
1989 /1990	1,493	25.000	37,325

Source: SAED annual reports. (tomato_q)

Senegal has two tomato paste processing plants, both located in the Senegal River Valley (SNTI-Senegalese owned and SOCAS-French owned). Although both firms operate behind a substantial protective barrier, they have not been able to operate at capacity, or to produce at a cost which is competitive with external sources.

According to the AMIS horticulture marketing study, tomato paste is produced at a cost of 747 FCFA/kg (including the value added tax), sold at wholesale for 767 FCFA and for 800 at retail, while the CIF price for European paste is 375 FCFA/kg (Holtzman, December 1989, pg 91)[24]. Even though the plants operate at about 50 percent capacity, there is only a small cost advantage to be had from higher operating rates because most of the unit production cost is variable (84% of the total is for tomatoes and packaging materials, 55% for the tomatoes alone)[25].

There is an official farmgate price for industrial tomatoes and one for wholesale, semi-wholesale and retail products:

[24]The report does not indicate a date for these data - it may be assumed to be 1988 or 1989. In a recent communication with the director of SNTI, USAID/ADO was told that the plant selling price was 650 FCFA/kg. If the cost data are accurate, then the plant is operating at a considerable deficit. The plant imports and processes about 2,000 tons of semi-finished product. Given the cited prices, there is an internal perequation which is subsidizing local production.

[25]An example of a mixed blessing from devaluation which would make local products more competitive on world markets but which would also raise the cost of imported inputs.

Official Industrial Tomato and Tomato Product Prices-1990

	Tomatoes	
Farmgate	30	FCFA/kg
Millgate	34	FCFA/kg
	Paste	
Wholesale	622	FCFA/one kg can
Semi-wholesale	638.9	FCFA/one kg can
Retail	660	FCFA/one kg can

Industrial tomato production has increased by almost 300 percent in the last 10 years. Part of the production increase has been from increased land area, but in recent years most of the gain has been from better yields (Table 23). The two processing plants each have a capacity of about 35,000 ton/year, so even the large increase in production has meant that total capacity is only about 50 percent employed (actually less because all of the production is not marketed to the mills).

Potato and Onion:

Both potatoes and onions have good local possibilities, but marketing problems, especially long-term storage, will have to be resolved. Senegal already has a price disadvantage relative to world markets, so introducing costly temperature/humidity controlled storage systems may not be the answer[26].

Fruits:

Consumption and/or domestic marketing information on local fruits is not available. Ziguinchor and Kolda are the major fruit producing regions in Senegal, but the potential has not been exploited, partially because of marketing problems associated with moving produce through or around Gambia. The GOS has identified two priority fruit production regions, the Anambé River Basin in Tambacounda and the irrigated regions of the Senegal River Valley. Import substitution, mainly for bananas, is the primary goal. Development of commercial production is in the very early development/research stage and must be subjected to serious analysis before substantial investments are committed. Two facts should be kept in mind: average banana imports between 1984 and 1988 were 3,500 tons, which at a farm yield of 5 ton/ha implies an area of 700 hectares (estates can get as much as 35 ton/ha); and, banana production requires a minimum of 1000 mm rainfall per year (range 1000-2000mm) so most of Senegal is "marginal" and the potential production sites are far from the consumption centers. Under any circumstances, the "people level" impact is low.

Exports

Currently, Senegal exports about five percent of its total vegetable production -mostly green beans (40% of the volume and over 50% of the value - Tables 24 and 25). Mauritania was an important market for vegetables (potatoes and onions) from the River Valley, but the current border problem has all but eliminated that market.

[26] Devaluation will eventually help narrow the difference.

France is the main market for both fruit and vegetable exports, most of which are shipped by air (in 1986 Senegal exported 4,000 tons of green beans, 3,959 tons to Western Europe of which 3,044 tons went to France [Holtzman, December 1989, pg 30-31].

The main fruit exported to Europe is mellon, which is not reported separately in the Senegalese export data. Import data for Western Europe reported by Holtzman [December 1989, pg 29] show average mellon imports during the 1980's as 1,134 tons, which accounts for a large portion of the "other fruits" category in the fruit export data (Table 26), a much larger volume than any other fruit. Mangos and bananas are the next most important fruits exported, by volume, but mangoes are much more important in terms of value (Table 26)[27].

Fruit and vegetable export marketing is done by two exporter associations, composed of 13 firms. During the 1986/87 exporting season, the top 5 firms account for 87 percent of total fruit and vegetable exports (Table 29). As shown by the volume of total exports in Tables 24 and 26 these firms operate in a relatively small and declining market. In 1987 total fruit vegetable exports were about one-half the 1983 level and, more recently, the volume of exports by the major firms has fallen by almost one-third (Table 28).

Timeliness and quality problems, combined with competition from Spain, Kenya and Egypt are the main reasons why Senegal's exporters have not been able to retain their share of the off-season market in Europe. A major cause of both the timeliness and quality problem is that over 70 percent of the produce moves by air freight and must compete with other commodities, as well as passenger freight.

Relative to the rest of West Africa, Senegal has a distance advantage and a number of commercial firms with several years of international marketing experience. Good marketing management (farm to final destination) with attention to high quality product will help safeguard the market that now exists. There is, however, no reason to expect export fruit and vegetable marketing to provide the "solution" to Senegal's development dilemma.

[27] The export data for bananas are extremely variable, and as Holtzman points out, it is possible that these data represent re-export of production from neighboring countries.

Table 24

Senegal: Vegetable Exports (metric tons)

Vegetable	1981	1982	1983	1984	1985	1986	1987	1988	1989
Potatoes for Seed	--	--	23	6	44	5	1	--	--
Potatoes for Consumption	483	1,101	1,321	843	704	624	1,223	--	--
Tomatoes	2	9	21	118	115	213	270	324	293
Cabbage	165	101	50	23	12	5	2	--	--
Green Beans	4,516	5,320	2,939	3,651	3,946	4,000	2,387	2,517	2,200
Beans	260	352	132	14	--	259	1	--	--
Cucumbers/Pickles	139	90	254	327	497	532	370	--	13
Onion/Garclic/Green Onions	48	149	149	97	2	15	309	--	--
Spinich	13	7	13	87	24	6	4	--	--
Lentils	--	--	--	--	4	--	--	--	--
Yams/Manioc	1		13	12	1	1	--	22	--
Turnips/Beets	8	59	15	1	79	7	5	--	--
Asparagus	--	8	15	11	--	--	--	--	--
Sweet Potatoes	307	1	20	1	--	--	--	--	--
Other Vegetables	2,017	3,899	5,166	4,583	4,547	4,077	753	1,519	1,026
Total	7,959	11,096	10,131	9,774	9,975	9,744	5,325	4,382	3,532

Source: DPV

Table 25

Senegal: Vegetable Exports (value in million FCFA)

Vegetable	1981	1982	1983	1984	1985	1986	1987	1988	1989
Potatoes for Seed	0	--	5	1	17	2	0		
Potatoes for Consumption	110	157	150	143	95	92	132		
Tomatoes	0	1	8	70	112	160	179		
Cabbage	5	5	3	2	1	0	0		
Green Beans	326	315	220	1,141	1,726	1,971	1,364		
Beans	7	13	5	1	0	63	1		
Cucumbers/Pickles	6	4	12	91	200	245	187		
Onion/Garclic/Green Onions	6	9	13	13	1	6	22		
Spinich	4	3	5	49	10	1	1		
Lentils	0	--	--	--	0	--	--		
Yams/Manioc	0	0	2	2	1	0	--		
Turnips/Beets	0	4	2	0	11	2	1		
Asparagus	--	3	8	6	0	--	--		
Sweet Potatoes	6	--	1	0	0	--	--		
Other Vegetables	448	583	495	759	1,238	894	279		
Total Exports	921	1,098	928	2,278	3,413	3,436	2,165	0	0
Total-Real (1979 FCFA)	769	837	653	1,415	1,940	1,817	1,070	0	0
Unit Value (FCFA/ton)	116	99	92	233	342	353	407	0	0
GDP Deflator (1979=100)	120	131	142	161	176	189	202	214	225

Source: DPV

veg_exp

Table 26 Senegal: Fruit Exports (metric tons)

Fruit	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plantains	--	--	--	--	2	2	1	--	--
Fresh	--	--	--	--	1,594	484	181	--	--
Dried	--	--	--	--	--	--	2	--	--
Total Banana	34	--	589	1,248	1,596	486	184	0	0
Pinapples	9	6	31	102	27	4	--	--	--
Grafted Mangoes	288	361	69	235	56	49	55	--	--
Cashew Nuts	170	352	248	231	--	--	--	--	--
Avacados	13	20	2	41	--	--	--	--	--
Non-Grafter Mangoes	--	--	--	--	11	--	32	1	2
Other Tropical Fruits	--	--	--	--	--	1,611	--	--	--
Citrus	--	--	--	--	--	--	--	--	5
Oranges	280	168	10	10	6	2	5	--	--
Mandarins	3	11	--	2	1	--	--	--	--
Clementines	--	1	--	--	--	--	--	--	--
Lemons	9	1	7	12	1	3	--	--	--
Apples	1	26	--	1	--	1	2	--	--
Other Critus	29	26	2	--	13	5	5	--	--
Other Fruit	1,685	2,607	4,919	5,151	4,697	1,646	2,421	--	--
Total	2,521	3,579	5,877	7,033	6,411	3,807	2,704	1	7

Source: [illegible]

Table 27 Senegal: Fruit Exports (value in million FCFA)

Fruit	1981	1982	1983	1984	1985	1986	1987	1988	1989
Plantains	--	--	--	--	2.2	1.2	0.2	--	--
Fresh	--	--	--	--	179.7	59.7	0.0	--	--
Dried	--	--	--	--	--	--	1.0	--	--
Total Bananas	6.6	--	9.4	12.2	181.9	60.8	1.3	0.0	0.0
Pinapples	0.5	0.6	6.4	12.4	6.8	6.7	0.2	--	--
Grafted Mangoes	11.6	24.1	7.8	33.6	25.8	23.4	47.1	--	--
Cashew Nuts	23.8	59.6	43.0	72.2	--	--	--	--	--
Avacados	6.3	2.4	1.5	6.3	--	--	--	--	--
Non-Grafter Mangoes	--	--	--	--	4.2	--	9.0	--	--
Other Tropical Fruits	--	--	--	--	--	217.2	--	--	--
Citrus									
Oranges	26.8	28.5	6.4	4.0	2.0	0.6	2.2	--	--
Mandarins	1.0	2.9	0.1	0.3	0.3	--	--	--	--
Clementines	0.1	0.4	0.1	--	0.0	--	--	--	--
Lemons	2.9	0.4	0.2	0.8	0.3	0.4	0.0	--	--
Apples	0.3	0.1	0.0	0.2	--	0.1	0.3	--	--
Other Critus	9.9	6.6	0.8	0.1	2.9	1.0	2.2	--	--
Other Fruit	126.5	230.6	533.4	1,057.6	965.1	776.6	847.9	--	--
Total	216	356	609	1,200	1,189	1,087	910	0	0
Total-Real (1979 FCFA	181	271	428	745	676	575	450	0	0
Unit Value (FCFA/ton)	86	99	104	171	185	235	337	0	0
GDP Deflator (1979=10	120	131	142	161	176	189	202	214	225

Source: DPV

veg_exp

Table 28

Fruit and Vegetable Exporters, Volume by Firm (metric tons)

Association and Firm	Export Year 1985/86	Export Year 1986/87	Percent 86/87 Total
GEPAS			
AGROCAE		951	20.8
SENPRIM	1,079	907	19.8
SEPAM	1,091	719	15.7
TOLL SELECTION	952	630	13.8
SOEX	243	224	4.9
Ets. T. Drame	358	189	4.1
GIPS		57	1.2
SAAF	80		
SIDCA	145		
SAFINA	780		
Total	4,728	3,677	80.4
ASEPAS			
JARDIMA	988	788	17.2
DJITE M.		77	1.7
Ets. Massie		11	0.2
NDOYE M.		9	0.2
Ets. Enco		6	0.1
WALO-PRIMEUR		5	0.1
SAO	40		
SENIMEX	12		
SCOMI	276		
Total	1,316	896	19.6
Total	6,044	4,573	100

Source: DPV

Wheat and Sugar

The sugar market is a monopoly, operating under conventions with the GOS. Wheat processing is controlled by two firms, Grande Moulins de Dakar and SENTANEC. One mill, Grande Moulins de Dakar, is dominant in terms of volume imported and processed.

CSS holds a monopoly on local sugar production, processing and sugar imports. It was created under 1970 investment codes and has, since, operated under conventions established in 1972 and 1984 and more recently a convention among the CCCE, the GOS and CSS. The more recent convention was intended to make the "system" more transparent and to establish a means of dividing expected economies between the company, the State and the consumer.

CSS has a total capacity of about 70 thousand tons/year. CSS produces sugar cane on 7,500 irrigated hectares in the lower river valley and employees about 5,000 people. CSS imports sugar (tax exempt) to cover that part of the domestic market which it is not able to supply from local production (import statistics do not indicate that significant quantities of sugar have been imported in recent years).

Prices are set by the State at the wholesale, semi-wholesale and retail levels. There is a separate price for cubes and crystalline sugar and for different kinds of packaging. In 1990 bulk crystalline sugar prices were: wholesale 321.6/kg; semi-wholesale 327/kg; and retail 340/kg. For comparison, in mid-September 1990 English refined sugar sold (CIF) for about 132 FCFA/kg [Marches Tropicaux, Sept. 14, 1990].

There are two wheat processing mills in Senegal: Grande Moulins de Dakar (capacity 100 ton/hr) and SENTANEC (60 ton/hr). The GMD is owned by the same individual who owns CSS and SENTENAC is owned by the same individual who owns SOCAS. Both mills import wheat on their own account - from europe. In 1988 111,865 tons of wheat was imported (including 5,000 tons of food aid), about 84 percent by Grande Moulins de Dakar [MDRH, 1989, pg 12].

Flour and bread prices are fixed by the State, depending on types and weight. Prices for flour are set for wholesale, semi-wholesale and retail markets. One ton of flour in 50 kg cotton sacks in 1990 carried a wholesale to retail margin of about 61 FCFA/kg (22% of the retail price). The last stage (semi-wholesale to retail) margin is very small (3% of retail).

Official Flour Prices and Margins

	Official Price (FCFA/ton)	Margin (FCFA/ton)
Wholesale	214,000	
		52,291
Semi-wholesale	266,291	
		8,709
Retail	275,000	

Source: Ministere du Commerce/DCIP

Bread prices are fixed at retail, depending on weight. For Dakar they are: 60 FCFA/200 grams; 90 FCFA/300 grams; and 115 FCFA/400 grams. Regional prices are set, with the above as a base + distance differential.

Cash Crops

Traditional cash crops (groundnuts and cotton) account for about 48 percent of the gross value of crop output and the majority of farm cash income from crop marketing. They average 93 percent of the total value of crop exports and about 19.5 percent of the value of all exports (Table 29). Groundnuts, cotton and fruits and vegetables together account for just over 21 percent of the value of all exports. In recent years the value of fish (fresh and canned) exports has exceed the value of crop exports. Together crop and fish exports average about 44 percent of the total.

Table 29

Agricultural and Non-Agricultural Exports (billion current FCFA)

Year	Groundnuts and Products	Cotton	Fruit and Vegetables	Sub-Total Agricultural Commodities	All Fish Products	Phosphate Fertilizer	Other Exports	Total Exports
1980	17.6	2.1	--	19.7	21.2	2.4	57.5	100.8
1981	9.2	2.0	1.1	12.3	27.9	4.4	91.2	135.8
1982	42.1	4.8	1.5	48.4	30.2	2.2	99.2	180.0
1983	55.5	8.1	1.5	65.1	37.3	4.1	100.5	207.0
1984	54.5	6.9	3.5	64.9	49.5	2.7	126.4	243.5
1985	23.7	7.1	4.6	35.4	54.0	0.0	108.0	197.4
1986	22.6	2.5	4.5	29.6	56.6	0.8	105.2	192.2
1987	21.0	2.7	3.1	26.8	49.0	1.3	104.8	181.9
1988	34.9	5.4	--	40.3	51.5	1.4	116.4	209.6
Average 1981/87	32.7	4.9	2.8	40.4	43.5	2.2	105.0	191.1
Percent Total	17.1%	2.5%	1.5%	21.1%	22.8%	1.2%	55.0%	100.0%
Crops	80.9%	12.1%	7.0%	100.0%				

Source: Annex I. (exports)

Edible Groundnuts

In order to capture the advantages of what is seen as a good prospective international market, the GOS has intensified efforts to increase the quality and quantity of edible groundnut production. The program is under the direction of a parastatial (SEPFA) which provides credit, collects, processes and, since 1989, markets the output. The output is purchased through a series of buying points (27 in 1988/89) between November and March. The GOS has announced that SEPFA will be privatized by the end of 1990[28].

The effort to increase production has been reasonably successful; output has increased steadily, from 2,000 tons in 1980 to 25,000 tons in 1989 (Annex II). Since the volume is relatively small, the private sector should be capable of absorbing the industry. There are, however, three problems to be overcome: aflatoxin levels; grain quality in general; and poorly constructed processing equipment, all of which a prospective private firm would have to analyze very carefully. Technology exists for detecting the aflatoxin but proper post-harvest management is necessary before the nuts would be acceptable in many countries (especially the United States, an unlikely market in any case). This is the most serious constraint to the development of external markets. Nuts with aflatoxin levels above 20 parts-per-billion cannot be imported into Europe (ITA has measured levels as high as 100 ppb in local groundnut paste) [SOFRECO, 1990 pg 51].

Quality standards (except for aflatoxin levels) with substantial price differentials exist, so the first stage requirements for a responsive market also

[28] Privatization has been a part of the SAL IV and is also a part of the Agricultural Sector Structural Adjustment Loan being discussed by PASA group.

exist (i.e. at least a quality differential). There are separate prices for seeds and for three commercial categories:

	Farm Price FCFA/kg	
	1987/88	1988/89
Seed.....	130	95
1st Choice (fresh, green nuts)	135	105
Lot A (dry)	110	85
Lot B (dry).....	90	70

An indication of the limits of the "quality" problem can be seen by the distribution of SEPFA purchases of the 1988/89 crop:

SEPFA Edible Groundnut Purchases 1988/89

		(tons)	(%)
Seed		3,038	19.5
1st Choice (green)...		2,646	17.0
Lots A and B.....		9,874	63.5
A.....	2,765		
B.....	7,110		
Total Purchased.....		15,558	100
Total Farm Produced..		20,000	

Only about 17 percent of the total purchased was of exportable quality. The Lot A and B, 64 percent of the total purchased, was (except for a small amount kept for seed) eventually sold to the oil mills at 70 FCFA/kg and SEPFA absorbed the loss associated with the oil/edible price differential on the Lot A grains.

The grain, once purchased, is processed by SEPFA at the Lyndiane plant, at a plant in Kaolack, and by SONACOS in Louga. The nuts are sold by SONACOS through an agent in Europe. The plant at Lyndiane is the only plant in the nation explicitly prepared to process the two forms of edible nuts (in shell and HPS - "hand picked special". According to the SOFRECO study of the edible groundnut sector, this plant is poorly conceived [SOFRECO, 1990, pg 122]. The plant has a theoretical capacity of 150 ton/day for in-shell nuts and 200 tons/day for HPS, but actually operates at between 20 and 30 tons/day for in-shell and 110 ton/day for HPS. A large part of the work is done by two groups of women over a three month period (640 in each group). The plant in Louga also employs a large group of women to hand sort the nuts (1,700 women/day).

Groundnuts for Oil

There are five principal agents in the oil groundnut system: three linked parastatals - SONACOS, FGPA and SONAGRAINES; the cooperatives; and private purchasing agents (OPS - "operateurs privé stockeurs"). SAL IV calls for the privatization of SONACOS within 3 years. When the privatization occurs, the system will have completed a thirty year cycle. In 1960 about 80 percent of the marketed crop was handled by private traders [World Bank, September 1987]. This fell to zero in 1967 and is now back to about 50 percent of the total.

Assembly is done under the control of SONAGRAINES through the cooperatives and the OPS. The 1988/89 crop was collected at 739 points (400 cooperative and 339 OPS). The volumes handled were equally distributed at 48 percent each - the remaining volume was accounted for by declassified edible nuts sent to the oil mills and "miscellaneous" assemblers.

SONAGRAINES is also responsible for maintaining a basic seed stock of 25,000 tons. This stock is intended to permit a rolling replacement of the national seed requirement of 100,000 tons/year. Farmers stock the remaining 75,000 tons. (The seed component of the section on agricultural inputs, below, discusses groundnut seeds in more detail).

SONACOS has four groundnut oil mills which operate, in aggregate, at about 45 percent of capacity, with the greater part of the overall capacity operating at 41 percent and below.

	Capacity (tons)	Treated in 1989 (tons)	(% Capacity)
SIED-Dakar	375,000	154,485	41.2
SIEL-Lyndiane	315,000	123,324	39.1
SIEB-Diourbel	185,000	62,630	33.8
SIEZ-Ziguinchor	165,000	124,161	75.3
Total	1,040,000	464,600	44.7

Source: [SOFRECO, 1988, pg 108]

The extremely low level of capacity utilization would be a matter of concern for any firm considering "buying" into the system. Fixed costs accounted for almost 76% of the total in 1989 [SOFRECO, 1990, pg 51], which is why the GOS is being encouraged to close the mill at Diourbel. Groundnuts are one of the most important sources of foreign exchange for Senegal, yet in the last three years the sector has accumulated a deficit of over 62 billion FCFA. The GOS responded by decreasing the farm price from 90 FCFA/kg to 70 FCFA/kg in 1988, by transferring seed storage responsibility to the farmers and by restructuring FGPA (creation of a perequation system for imported vegetable oil - to be used to support the groundnut sector).

Groundnuts face considerable competition from other vegetable oils and the prospect for growth in this market is not especially encouraging, which is probably why so little of the national investment budget is allocated to the groundnut basin. To make matters worse, an expected four percent annual rate of increase in domestic vegetable oil consumption suggests that by 2000 Senegal will not be abe to meet its domestic needs from domestic production! In 1988 SOFRECO estimated the domestic market for vegetable oil at 70,000 tons (85 percent from local production and not including artisinal production). For comparison, in 1988 SONACOS produced 105,492 tons of groundnut oil and $(1.04)^{10}$x70,000 = 103,617 tons, so in 10 years nearly the entire production would be necessary to satisfy domestic needs. As has been mentioned in the preceding pages, farmers are planting fewer hectares of groundnuts with stable, if not declining, yields. Considering growth in the rural population and its need for vegetable oil, as well as the emerging competition with food crops, it is easy to imagine a scenario under which Senegal would be a net vegetable oil importer.

Since farmers are now responsible for storing their own seed (at least 75% of the 100,000 tons needed to seed the following crop), the marketed proportion of the crop has declined relative to past years.

1989/90 Groundnut Crop

	(1000 tons)	(Percent)
Production	819	100.0
Seed Reserve	-75	9.2
Available	744	90.8
Marketed	-590	72.0
Home Use	154	28.0

Source: MDRH

Using production from the 1989/90 crop, the crop is allocated as follows: 9% seed reserve, 72% marketed and 28% for home consumption (approximately 39 kg/capita which is about 13 kg/capita of oil). Part of the "home use" is used in the farm home and part is converted to oil and sold on local markets. Although this represents an important source of income for rural families, it also represents a health hazard because the locally pressed oil still contains all of the aflatoxin (the industrial mills remove the aflatoxin from the oil but there is still a problem with producing detoxified meal).

Wholesale, semi-wholesale and retail prices are set by the State for groundnut and imported vegetable oil. Prices vary according to the type of container (glass or plastic, plastic higher). Interestingly, current prices, at all three market levels favor imported vegetable oil by about 10 percent (see below). Since SONACOS controls the market, it can manage the flow of imported vegetable oil, so it has no need to be concerned about competition with external suppliers.

Official Prices Vegetable Oils in Glass Containers

	Groundnut (FCFA/ltr)	Vegetable (FCFA/ltr)
Wholesale	352.3	326.4
Semi-Wholesale	362.9	336.3
Retail	380.0	352.0

Source: Ministere du Commerce

World vegetable oil prices vary considerably year-to-year, so there is no indication that consumers prices are or are not in line with international prices. As Annex I shows, average prices received for exported, refined, groundnut oil have averaged about 88 percent of the present local consumer price.

The GOS, as part of the PASA discussions, has instituted a perequation system for imported oil.

Cotton

Cotton is produced in the regions of Tambacounda and Kolda. All collection, processing and marketing is under the control of the parastatal SODEFITEX, which also provides credit and extension services. Inputs for cotton are still subsidized (about 40%) but these will be phased out over the next three years. As with the rice and groundnut systems, current donor dialogue with the GOS calls for less State intervention and a more flexible pricing system (one more closely linked to world markets).

The cotton marketing year is December to March. SODEFITEX operates 33 purchase teams to collect about 60 percent of the crop and a producer organization ABP (Association de Base Producteur) collects about 40 percent of the crop. Farm prices for three grades are set by the State. The current prices and the respective volumes collected in 1988/89 are:

Grade	Price (FCFA/kg)	Marketed (tons)
1st	100	38,266
2nd	90	434
3rd	55	2

Source:MDRH

SODEFITEX has successfully promoted production of the highest quality cotton. It has not been as successful in establishing either production growth or production stability (in the last 6 years production has varied between 59 and 25 thousand tons, with the lower production occurring in the most recent years). The cost of production information from Chapter III indicate that cotton (unsubsidized) cannot compete with maize and groundnuts on a "return to labor" basis. The elimination of subsidies and the institution of a price more closely linked to world markets does not bode well for growth in this sector. However, from the point of view of Domestic Resource Costs, Senegal has some comparative advantage in cotton production.

Although Senegal's textile industry, after an auspicious beginning and priority treatment in several development plans, is still largely uncompetitive, SODEFITEX still manages to sell a portion of its fiber output in the local market (in 1989 it sold 15% of the total 13,756 tons of fiber production in local markets). As with many of the other crop systems, imports are simply too competitive for the local product. Devaluation may eventually improve the market for local cotton, but the entire system must first be made as efficient as possible.

Agricultural Inputs

Seeds

Groundnut, rice and to some degree vegetable seeds are the only real action in the seed sub-sector. Information already presented has shown that farmers are very clear about their priorities as regards groundnut seed. They are appreciative of the advantages of purchasing "improved" groundnut after which they rank most agricultural inputs very low as an investment.

The primary factor in the seed sub-sector is the PTS financed by the French and the primary State agent is DPCS, which is in charge of "certified" seed in Senegal. The PTS project provides financing for seed production credit and some, limited, technical assistance. Recent changes in GOS policy with respect to groundnut seed (supported in part by PTS) has helped to shift most of the responsibility from the State to farmers and private sector seed producers. A general groundnut seed plan has been developed, with stocks of various levels held and managed by several institutions:

ISRA pre-base seed stock	13 tons	
DPCS base seed stock	70 tons	(for multiplication)
SONAGRAINES	4,000 tons	(emergency security stock)
SONAGRAINES	22,000 tons	(replacement seed for one-third of the total annual requirement)
Farmers	75,000 tons	

The seed production sector has now been largely privatized in that producer groups (GIE) financed by loans from CNCAS produce most of the seed meant to be sold to farmers. The "certified" groundnut seed is purchased and sold according to the following price schedule (FCFA/kg):

Groundnut Seed	Base Seed	Seed for Multiplication	Seed for Farmers
Pay Producer	105	85	80
Sell	150	120	110

Aside from groundnuts, very little certified seed is produced in Senegal (about 27 tons in 1989). Most of it is produced by GIE's under contract with various parastatals and DPCS.

Over 50 percent of the certified cereal seed produced in 1989 was rice (15 tons). Maize seed, from the German supported Maize Project, was next largest (6 tons), cowpeas third (5 tons). Very little millet or sorghum seed was produced (about one-half ton together, Table 30).

Table 30

Certified Seed Produced and Purchased by Parastatals in 1989 (kilograms)

Parastatal	Rice	Millet	Sorghum	Maize	Cowpeas
SODAGRI	6,418	--	5	--	40
DERBAC	1,125	--	15	--	120
SODEVA	--	500	--	--	5,000
SAED	7,709	--	--	--	--
SODEFITEX	--	--	--	--	--
PROJET MAIS	--	--	--	6,064	--
Total	15,252	500	20	6,064	5,160

Source: MDRH

Vegetable seed is produced in much the same way as cereal seeds, except that DPCS plays a smaller role and the private sector a larger role. One of the vegetable exporter associations (SERPA) and SENCHIM are becoming the major producers and distributors of the certified vegetable seed produced in-country. Pre-base seed is supplied by ISRA/CDH and base seed is still provided by DPCS. A large portion of the potato and onion seed is imported, according to quotas established by the various monitoring committees. In 1989, 6.5 of the estimated 8 tons of onion seed used was imported (imports are by the exporter firms and associations). The potato seed import authorization in 1989 was 2,325 tons, the same as in 1988. Part of the import was done by the potato cooperative (UNCAS 423 tons) and the rest by the large potato producers and other seed importers.

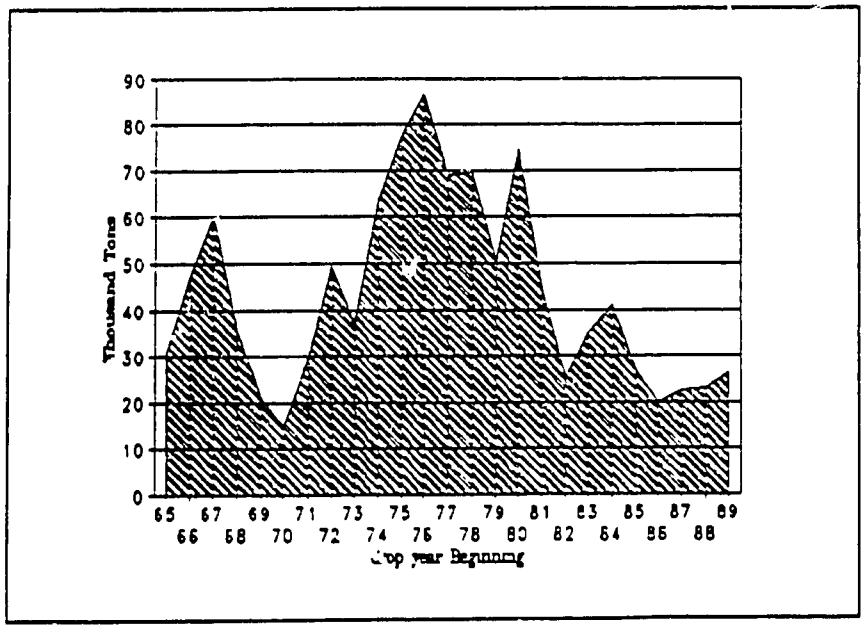
Fertilizer and Plant Protection Chemicals

The GOS has now almost completely disengaged from the distribution of chemical inputs and, as of 1988, subsidies were removed from all fertilizer and plant protection chemicals except those used on cotton (which will be removed by 1992). The elimination of subsidies and the privatization of the distribution system has resulted in considerable "adjustment" in how and where fertilizer is distributed and in how much and on what crops fertilizer is applied. The result has been a drop in total fertilizer use and a high regional concentration.

The termination of the Programme Agricole in 1980 initiated a precipitous drop in fertilizer use, from abo· 75 thousand tons for the 1980/81 crop year to 25 thousand tons for the 1982/83 crop year (Figure 9).

Figure 9

Fertilizer Consumption 1965-1989 Crop Years (Metric Tons)



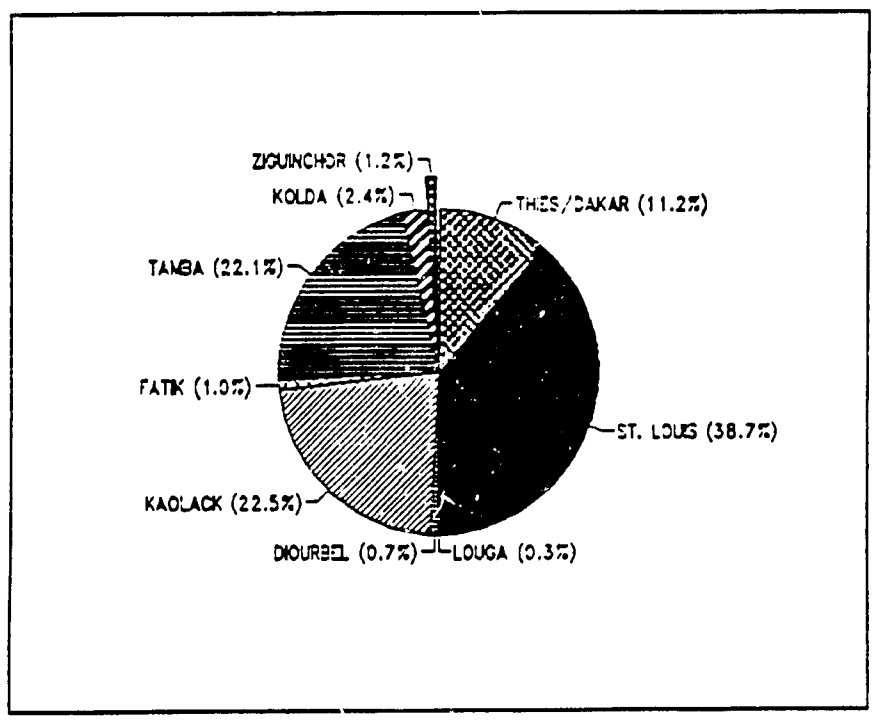
Source: Annex II.

Although fertilizer was subsidized until December 1988, use did not recover, but has stabilized around 25 thousand tons (26 thousand in 1989/90). The elimination of the subsidy will have contributed to some of the decline in consumption, but since fertilizer was subsidized through the 1988/89 crop year, the entire decline cannot be attributed to the absence of a subsidy.

The most mentioned problem is the difficulty of obtaining credit. CNCAS has begun to rebuild the farm credit system, which will have contributed to some stabilization in fertilizer demand. However, like many previous credit programs, CNCAS has encountered credit repayment problems and has suspended loan operations in several regions (Diourbel, Thies, Kaolack,..).

Figure 10

Fertilizer Use by Region (1989/90 Crop Year)



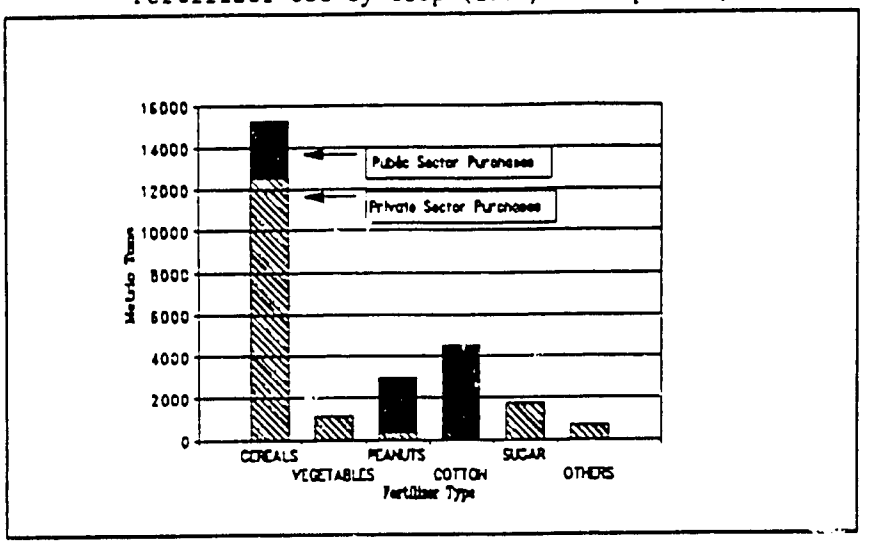
Source: Annex II.

As shown in Figure 10, the result has been that use is concentrated in areas served by parastatals, projects which provide credit and in irrigated agriculture: St. Louis consumed 38.7% of the 1989/90 total (largely for rice, but also for tomatoes and sugar); Tambacounda consumed 22% of the total (largely through SODEFITEX for cotton and maize); and Kaolack consumed 22.5% of the total (partially the influence of the German Maize Project, and partially the influence of the edible groundnut program).

The distribution of fertilizer use by crop is influenced by the same forces, except it also shows two important facts: all of the fertilizer for cotton is purchase by SODEFITEX (and subsidized) and nearly all of the fertilizer for groundnuts is purchased by the public sector (seed production and the edible groundnut program). Privatization of the edible groundnut sector and elimination of the subsidies on cotton production will not encourage more fertilizer use.

Figure 11

Fertilizer Use by Crop (1989/90 Crop Year)



Source: Annex II

SENCHIM is now the major provider of chemical fertilizer inputs distributed in Senegal. It is a semi-privately owned business (50% by ICS and a French firm SPC) engaged in the production of compound fertilizer and the marketing of fertilizer, plant protection chemicals and, recently, has entered into to production and marketing of vegetable seeds. SENCHIM has a monopoly on the production of compound fertilizer and the export of phosphate. No compound fertilizer may be imported, but the urea import market was liberalized in 1987. SENCHIM, of course, has no competition in the production or wholesale distribution of compound fertilizer, but there is competition in the marketing of urea and plant protection materials (SPIA, a producer of plant protection chemicals located in Louga, and private importers).

The two firms (SENCHIM and SPIA) are the major producers/wholesalers of chemical inputs: both firms provide their "agents" with 60-90 day credit (3-4% interest); both train their agents in the proper handling and application recommendations for their products; and both attempt to diversify on products handled. A major difference is that SPIA insists on an "exclusive" contract with its agents (they may sell only SPIA products), while SENCHIM has no such

condition and, in fact, has a "technological package" marketing strategy[29]. Recently, in collaboration with SISMAR and ISRA, SENCHIM has developed (with its own financing) a number of demonstration fields using improved seed, equipment, plant protection chemicals, and fertilizer[30].

In April 1990, USAID/ADO conducted a survey of wholesale/retail input distributors to obtain a "picture" of the private sector input distribution system (SENCHIM, SISMAR and SPIA provided a list of their clients/agents). In some respects the results were encouraging, in others they were not. The survey found 25 primary distributors, highly concentrated in St. Louis and in the south and east (6 in St. Louis and 8 in the south and east - Table 31). This reaffirms the conclusions from Chapter III - that farmers can and do employ "higher" technology in the regions where production is more stable. The large portion of firms in these regions that concentrate on agricultural inputs only also shows that the private sector can provide the inputs. It should be noted that the volumes handled in the various regions will be distorted, somewhat, by the existence of SODEFITEX and SODAGRI in Tambacounda and Kolda and by CSS in St. Louis.

Table 31

Agricultural Input Distributors (1990)

Region	Number of Distributors	Agricultural Inputs are 100 Percent of Business	
		Number	Percent
St. Louis	6	4	66.7%
Louga	2	-	0.0%
Dakar	3	2	66.7%
Thies	3	1	33.3%
Diourbel	1	1	100.0%
Kaolack	2	-	0.0%
Fatick	-	-	0.0%
Tambacounda	2	-	0.0%
Kolda	4	3	75.0%
Ziguinchor	2	-	0.0%
Total	25	11	44.0%

Source: [USAID/ADO, April 1990]

SENCHIM establishes "suggested" retail prices for each of its fertilizers in each region. A "base-point" pricing system is used (Dakar + transportation (26 FCFA/ton km) + dealer margin (6,000 FCFA/ton)). Although we do not have nationwide information of prices paid and received at different levels of the marketing channel, recent research in the River Valley suggests that there is

[29]There are some conditions. A trader must have access to appropriate storage space (rented or otherwise) and must make a deposit. In return the trader has access to credit and training in management and product sales.

[30]This program has impressed a number of donors and the GOS. President Diouf has asked them to expand the program and the World Bank has included support for this as part of the "investment" component in the planning for the Agricultural Structural Adjustment Loan now being developed.

active price competition. In fact, traders in the River Valley seem to be accepting margins below SENCHIM "suggested" levels, a clear indication of active competition [Ouedraogo, July 1990, pg 21].

The private sector faces three problems: a relatively small widely dispersed market; competition from the State; and difficulty in obtaining credit. Credit and transportation costs are the problems most often mentioned[31].

Equipment

Senegal has one principal agricultural equipment manufacturing firm, SISMAR (Societe Industrielle Sahelienne de Mecaniques de Materiels Agricole et de Representations). SISMAR was created as a private enterprise at the end of the "Programme Agricole" with the old (GOS owned) SISCOMA plants - ownership is distributed between a Belgian group (40%), a Senegalese group (51%) and BNDS (9%). The firm manufactures agricultural implements, school equipment (including pre-fabricated schools) and road building equipment.

Since SISMAR is completely private, with no government guarantees, its client base and operations are highly diversified. An important part of its market for agricultural implements is export to Cote d'Ivoire, Gambia and Guinea Bissau. Agricultural implements are less important than the other parts of its business in the domestic market, especially since the State and the various parastatals have stopped distributing agricultural equipment. SISMAR is now dependent on four private agents and several NGO's and projects which distribute grain mills and related equipment to village organizations.

Financing for agricultural equipment purchases is provided by CNCAS and by large donor supported projects like PRIMOCA and irrigation systems being developed by such agencies as the FED and the World Bank in the River Valley.

TREE PRODUCTS

Senegal's forests are controlled under the national land law, which reserves all trees (even if planted on individually controlled lands) as the property of the State. Forests and trees are regulated under the National Forestry Code, which specifies which species may be exploited, which species are to be protected, and how the national forest reserves are to be managed. With few exceptions, use of national tree resources is controlled by quotas, allocated via a permit system. The "Direction des Eaux et Foret et Chasses" of the "Ministere de la Protection de la Nature" administers the quota and permit system through a national network of forestry agents. There are two important exceptions to the quota/permit system - gathering fruits, leaves, etc. and collection of dead wood for home fuels. The various donors, especially USAID because of its Senegal Reforestation Project, have been very interested in revisions to the forestry code which will permit producers who plant trees to also control subsequent harvest and sale.

[31] USAID attempted, via its Agricultural Production Support Project, to establish a financial link between input distributors and the banking system. The financial markets were not willing to participate, mainly because of the high risk associated with agriculture.

Senegal has around 370 indigenous tree species and about a dozen important exotic species [Kernan, April 1989, pg 2]. In addition to their importance as fuel and for soil conservation, these trees provide an important source of direct human and animal nutrition, medicine, and cash income to the rural population. Unfortunately, as Kernan points out, the trees which probably provide the greatest overall economic value to the rural population are not studied (or for the greater part) included in "reforestation" projects, so very little is known about consumption or marketing of products from these trees. Table 32 summarizes some of the major uses of trees and the number of species involved[32]. As the Table shows, a large number of species are cited as "important" for human, animal and farm revenue uses, especially for firewood and construction. One important result from this survey is that officials did not mention agricultural or forestry cooperatives as an important market for tree products for farm families, probably because the largest and most valuable use of wood is for charcoal and this has a production/marketing system controlled and operated outside the farm community.

Table 32

Trees, Number of Species Used, by Major Use.

Use	Number of Species	Part Used	Species Used Most Often
Human Nutrition	63	leaf, pod, bark, fruit, sap, root, oil, flowers	Baobab
Animal Nutrition	40	leaves, fruit, pods	
Medicine	47	leaves, fruit, bark, roots, sap	Baobab
Firewood	140		
Construction	116		
Rope	59		
Windbreaks	49		
Also mentioned: honey, tanning, poles, fencing, soil enrichment.			
Revenue to Farms	45		Baobab

Source: [Kernan, April 1989, pg 3-5].

Fuelwood

Fuelwood is by far the most "important" use of trees in Senegal. According to Ribot, fuelwood accounts for about 60 percent of total forest production, largely for charcoal production [Ribot, June 1988, pg 10]. Fire fuelwood, is a non-traded, largely rural, energy source. By tradition loose wood may be

[32] These data are from a survey of local (department) officials in the Ministry of Protection of Nature and the Ministry of Rural Development and Hydrology. The results, thus, represent "expert" opinion.

gathered on all land, usually by women and children, and is not to be sold. This particular use of the forest resource is not seen as a danger to the resource because it is the fallen, dead material. The major "problem" here is supply shortages (time and distance needed to collect the material) created by deforestation of lands for agriculture and for charcoal production.

Reliable data on fuelwood production and consumption are not available, despite the many quotas and other regulatory mechanisms. Bender [September 1988, pg 11] quotes a CTFT study which estimates total fuelwood consumption (loose and to produce charcoal) at 6 million m^3 per year (5.6 million m^3 to produce charcoal and the remainder for firewood). The problem is that the 5.6 million m^3 converts (at 9.3 m^3 of wood per ton of charcoal) to just over 600,000 tons of charcoal, yet a total of only 110,000 tons of charcoal were shipped to Dakar in 1987 [Bender, September 1988, pg 11]. It is unlikely that non-Dakar consumption totaled almost 500,000 tons, which means that most of the data discussed here are not very reliable.

Charcoal

Ribot estimates that net deforestation occurs at a rate of 160,000 ha/year (165,000 ha cut and 5,000 ha replanted), with as much as 22,000 ha/year cut for charcoal (most of the cutting now takes place in Tambacounda and Kolda). He also estimates that ninety percent of all charcoal is consumed in urban areas.

The market is controlled by a few "barons", prices, cutting permits and movement permits are controlled by the government. Cutting quotas are set according to estimates of national demand. Historically, not all of the quota is allocated - a conservation measure (also creates shortage and stimulates fraud). A regional committee (governors, etc) distribute the quotas to coops and firms. There are 80 coops and 8 firms in the market. The charcoal production season is December - August, but is not completely respected.

Charcoal prices are controlled at the usual three levels: wholesale (883 FCFA/50kg sack), semi-wholesale (1640 FCFA/50kg sack), and retail (40 FCFA/kg). Ribot estimated the 1986 total production cost at 1302 FCFA/sack (about 50% transportation), which compared to the current 883 FCFA/sack wholesale price, helps to explain why it is so difficult to get reliable statistics (because of an incentive to produce and market outside official channels and because sellers are prone to weight manipulation to make up the difference). Although recent cost of production information is not available, the information available shows very clearly that prices do not reflect true costs and, in fact, favor the use of charcoal rather than alternative energy sources. This is reinforced by high prices on imported fuel (propane gas etc.- beacuse duties on these commodities are an important source of state revenue). Although rural communities do not control the local resources which are used in charcoal production, it is unlikely that even if they did, they would find it a profitable activity under current prices. A substantial restructuring of the entire system is required before rural communities can participate (local control of the resource and a free market system).

Sawnwood

Estimates (1985) are that Senegal consumes about 90,000 m^3 of sawn lumber with 60-65 thousand tons imported from the Cote d'Ivoire, mostly logs and sawn lumber (73%) [Bender, September 1988, pg 7]. National production has been estimated at about 38,000 m^3/year at five sawmills located in the Casamance. Since it has been determined that the lumber sector will not be part of the USAID program, no further discussion of this sector will be attempted. The important factor, for the USAID Mission and its strategy, is the effect of deforestation on land productivity. Information provided in Chapter II has shown that the soil in the Casamance is highly susceptible to erosion, once the trees have been removed and that the productivity of the soil falls rapidly once its cover is removed. Thus, in the interest of good soil management, and in view of the small areas which are reforested each year, the GOS and farmers should be encouraged to at least maintain some kind of organic cover to protect this soil. The USAID Senegal Reforestation Project is one example of how this may be accomplished by encouraging community participation in agro-forestry and income diversification projects.

Cashew

Cashew represents a good possibility as a diversification crop, especially for the Casamance where the necessary soil and climate conditions are excellent. Although the history of industrial treatment of cashews has not been good, the crop still has three important advantages[33]:

- it is an off-season crop which can help to extend productive farm employment;
- world market prospects are good, if not excellent and most likely production growth from Senegal would be so small that marketing the increase would be no problem;
- the domestic urban market pays a substantially higher than world market price and is capable of absorbing more;
- its treatment is especially well suited to small, operations in which women are traditionally the major workers and beneficiaries;
- in addition to being an income source, the tree contributes as a wood supply and helps, in general, with soil management;
- for a tree, it begins to produce very rapidly (3-4 years); and
- inter-cropping is possible, especially while the tree is maturing.

There is really only one major constraint - marketing and quality control and, thus, world market opinion about Senegal's cashews. Much of the "problem" can be resolved by local institutions (NGO's for example) through better farmer

[33]Unless specified otherwise, the information in this section are from [GTZ, 1989].

training in processing techniques and, market information (including dissemination of information about grades and standards - once established!).

As with most other cash crops, Senegal has experimented with the usual State monopoly for cashew collection and processing. SODENAS (Société de Décorticage des Noix d'Anacardier) was created in 1979 and was charged with developing the sector (a supporting German project in the Sine-Saloum Region was initiated in the same year). A mill was completed (with British assistance) in 1987, but because of numerous problems it only operated one year (the nuts are now processed by hand - a technique which produces the best quality nuts and which is used by most of the important producing countries). Marketing was liberalized in 1986 and there have been no real marketing controls since 1987. A set of minimum of prices have been established (60 farm, 65 from first stage assembler and 70 mill-gate). Since SODENAS has generally taken the minimum as its official price, it has not been competitive with the private sector, so its volume has been very low.

Since cashew is not a major crop, time series data on production are not available. The report on which this section is based cites the following:

Table 33

Cashew Nut Production in Senegal

Item	Tons	
Production - nuts	1,500	
Harvested - nuts	700	
Casamance		500
Project plantation		75
Mbao-Mboro		25
Other		100
Local Transformation	100	
Export and Industrial Transformation	600	

Source: [GTZ, 1989, pg 36]

An inventory in 1987 estimated that there were 1.7 million cashew trees in Senegal (81% in the Casamance and 14% in Kaolack and Fatick). New plantings in 1987 and 1988 brings the total to about 2.1 million trees. Farm level yields are expected to be 50-60 percent of what the German PASA project (Projet Anacardier Senegalo-Allemand) plantation gets (it gets an average 3.9 kg/tree - under the right conditions the yield from a mature tree is 7-11 kg). Using the estimate of 2.1 million trees and a yield of 1.75 kg/tree, potential production (in 5-7 years) is about 3.7 thousand tons. Since only about 50-60 percent of national production is now harvested, the new production can only be exploited if the marketing system is improved.

Prices received by farmers are dependent on world prices, which vary considerably: in 1987 the FOB price was 300-350 FCFA/kg and farmers received 100-125 FCFA/kg; and in 1989 the FOB price was 195-225 and farmers received 75 FCFA/kg. The fruit from the cashew is actually more valuable than the nut (it is used for direct consumption and for making wine and sells for around 200 FCFA/kg). One hectare of 100 trees, well managed, can yield 400 kg of nuts and

320 kg of fruit for a total value/hectare of 104,000 FCFA. Total labor requirements are 26 days/hectare (spread over three months) so the daily return is between 1,538 (nuts only counted) and 4,000 FCFA/day (nuts and fruit counted). This excludes establishment costs (35 FCFA/tree for 140 trees and labor of about 12 days) but, compared to the daily return from groundnuts (660 FCFA/day - Table 12, Chapter III) it should be no surprise that so many farmers have selected cashew in USAID's matching grant program under the Reforestation Project.

Depending on how much of the fruit is marketed, and establishment of a marketing system that can move all of the production, the total value of output from cashew (the potential of 3.7 thousand tons) would range between 370 million and one billion FCFA - a reasonable estimate is 500 million/year. While this may not be large on a per capita basis (the rural population in the Casamance will be around 800,000 in 6 years), it is important to remember that this is first round, off-season income and that margins from processing and marketing for the urban consumer can be very large. Little is known about the informal market for cashew. A relatively inexpensive, "fast reconnaissance" marketing/processing study would be useful.

Conclusions

This chapter has completed the non-institutional review of an agricultural and agro-business economy which is extremely dependent; a dependency which runs throughout the system - production to consumption. Senegal has lost control of one of its most basic and most fragile resources - land. For all intents and purposes Senegal has abandoned (at least in terms of investment) its most intensely cultivated and most densely populated rural area - the Groundnut Basin. The soil resource has been "mined" to such a degree that it is incapable of producing enough food to feed the nation (often not enough to feed even the rural population). As the result of stagnant (at best) production, the real value of agricultural output has stagnated over the last 14 years and the value of marketed output (cash income from crops) has declined at 2.5 percent per year. In the absence of a significant and sustained effort to improve efficiency and productivity, there is little prospect that Senegal's rural population can hope for a better life.

Untangling the political, social, environmental/resource and economic interdependence and ascribing cause and effect to eventually suggest solutions is not a simple task. But, in a broad context, certain facts are evident: the more the elements of a system are controlled and protected, the less controllable and more complicated the system. The policy to expand local rice production at any cost is a good example. The information presented in this report has shown that, without massive subsidies, Senegal cannot possibly produce rice competitively under current pricing and marketing policies. Yet, the majority of Senegal's investment in agriculture and the majority of its agricultural credit is focused on irrigated rice in the Senegal River Valley. Rice is the "wage good" in Senegal and is, thus, firmly attached to political and welfare issues. Rice represents over half of urban cereal consumption, and while it represents about 29 percent of the rural diet, its importance has been increasing. Nationwide, rice is the most important cereal in the diet. On the surface, there would seem to be three solutions: increased urban employment and incomes; production of cash crops with which to purchase more food; and increased production and consumption of local cereals.

The primary sector (crops, livestock and fishing) represents about 20 percent of GDP in Senegal, extremely low for an economy with 60 percent rural population (clearly a structural problem). A disproportionate part of the economy is based in Dakar (55%), largely in the service sector which is in turn dependent on donor resources. It is not based on productive capacity. Real prospects for growth in the urban sector are dim without growth in agriculture.

The cash crop sub-sectors ought to provide part of the answer for rural growth, except they are stagnating and generating large deficits. The four groundnut oil mills are barely operating at 40 percent of capacity and cotton (marginal in terms of overall contribution) is still highly subsidized. Major changes are needed before the traditional cash crops can contribute to economic growth in Senegal.

Expanding local cereals production and consumption is an obvious part of the solution. There are potentials and there are constraints. The constraints can be eliminated (at least minimized) and the potentials can be exploited. The analysis has shown that local rice can be grown and processed profitable at the village level. The analysis has shown that other cereals, especially corn, can be grown and processed by semi-industrial mills, if the distortions imposed by rice pricing and marketing policy are removed. The analysis has also shown that in order to exploit this potential a larger market surplus must be generated and that consumption patterns must change.

A basic change in the structure of the agricultural economy is required. Existing systems must be made more efficient (thus, the call for privatization in the rice and groundnut sectors) and alternative revenue sources must be exploited (edible groundnuts, cashew nuts, fruits and vegetables, agro-forestry). Existing soil resources must be improved and newly opened land must be protected: better soil and water management on existing farm land can improve productivity 30-40 percent; unless properly managed, newly cleared forest lands lose 50 percent of their organic content within two to three years. The cost in terms of lost output (and the potential in terms of added production) is large (it is reported that a one-tenth of one percent increase in soil organic matter increased millet yield by 145 kg/ha - about 10%). The potentials are great, a 10 percent increase in production would mean a 100 percent increase in marketable surplus (better food security for farmers, more money from marketing and a real chance to substitute local production for imported rice).

The incentive for farmers and processors to adopt new techniques and technologies has been much of the focus through this part of the report. The information available demonstrates that these "instruments" exist (the research system has already investigated many farm based techniques and technologies and food processing technologies are available). The one remaining and crucial issue is the incentive and the capability of the institutional system to deliver these tools to the user. The next chapter deals with these issues.

CHAPTER V

AGRICULTURAL INSTITUTIONS

Institutional Organization of the Sector

Economic crisis and a new development philosophy have combined to redefine the role of the state in the agricultural sector during the last decade. The state's "dirigiste" policies, inspired by a socialist philosophy and nourished by nationalist aspirations in the post-colonial period gave rise to a panoply of state organs charged with managing the economy and engineering the process of developmental from above. Drought and economic crisis of the late 1970s combined with growing donor disenchantment with Senegal's developmental performance converged to produce a new definition of the state's role which was articulated in the New Agricultural Policy (1984). The new development philosophy called for "disengagement" (the withdrawal of the state from its dominant role in a wide range of commercial, organizational and productive functions and "deflation" (a reduction in the size of the public work force). Although these policies have met significant difficulties and resistance at many levels, the state's functions have diminished markedly in the last six years and extensive reorganization of public institutions has occurred.

The disengagement of the state has been most extensive in the case of the Regional Development Authorities. These entities were created in the 1960s and flourished in the 1970s; they were broadly charged with many facets of rural development - extension, input distribution, marketing, credit delivery, farmer organizations and frequently social functions (literacy training, management of rural development projects). All RDAs except SODEFITEX (Senegal Oriental) have shrunk significantly and some have been eliminated. Troubled by the technical and economic feasibility of irrigation development and rice production in the Fleuve, SAED's (Fleuve), commercial functions are being eliminated in an effort to reduce financial losses. SODEVA (Peanut Basin) is a shadow of its former self, reduced from a high of 2,000 employees to a current level of 300. Without an operational budget, it is totally dependent on donor financing and consequently its program consists of implementing the International Food and Agricultural Development (IFAD) organization's project located largely in the southern part of the Peanut Basin. SODAGRI, the RDA located in the Upper Casamance, has diminished as well though without radical changes in its mission. If the rice sector is liberalized in accordance with the current policy dialogue under the PASA, its rice processing and marketing functions will be privatized. Only SODEFITEX continues to operate in the old mold but here too proposed policy reforms under the PASA could radically alter its financial capacity to sustain the broad range of functions it performs. Table 1 summarizes the disengagement and reduction in the work force of the RDAs.

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Table 1

REGIONAL DEVELOPMENT AUTHORITIES
"DISENGAGEMENT AND DEFLATION"

FUNCTIONS	RURAL DEVELOPMENT AUTHORITY			
	SAED	SODEVA	SODEFITEX	SODAGRI
	ZONE OF INTERVENTION			
	FLEUVE	GROUNDNUT BASIN	SENEGAL ORIENTAL	UPPER CASAMANCE
Current Functions Dev't Project	-Extension -Irrig.Dev -Farmer Org.	- Extension -Execution of -Donor Rural	-Extension -Farmer Organ. -Input Distrib. -Marketing of -Cotton and Corn. -Literacy Train.	-Extension -Irrigat. -Dev., -Rice Proc. -Rice -Marketing
Eliminated Functions(*)	-Construct. & Mainten. of Irrig. Perimeters -Tractor Pool Services -Input Distrib -Rice Milling -Rice Market.	Input Market.	No change	Input Marketing
Reduction in Work Force	1987 = 970 1990 = 490	1984 = 1300 1990 = 300	1987 = 898 1990 = 857	1986=125 1990=98
Reduc.in Extension Personnel Previously Currently			350 150	30

(*) Functions in process or already eliminated.

As the RDAs have withdrawn from their multi-functional rural development role, their responsibility for extension has been reconfirmed. In fact disengagement has meant that the RDAs have been evolving into extension services. But even this role is not secure, a large new initiative by the World Bank to create a revitalized national extension service assigns the traditional line ministries (Directorate of Agriculture, MDRH, and Directorate of Livestock (Ministry of Animal Resources) responsibility for extension in all ten regions of the country (See MRDH organization chart, Figure 1). They are complemented by the RDAs who are assigned a relatively minor role in the initial years of the Project. SODEVA is limited to working in one department in the Groundnut Basin, and SODEFITEX and SODEVA have no responsibilities! SAED is the only RDA that retains the principal responsibility for extension in its zone of intervention. Without extension functions, many of the RDAs "raison d'être" would cease to exist.

The discussion above argues that the policy reforms of the 1980s which sought to liberalize the economy and reduce the role of the state have resulted in redefinition of the public sector's functions and its institutional structure. The regional development authorities have been greatly scaled back and could disappear if current trends continue[1].

Economic pressure and donor conditionality have forced reorganization of the National Government and reductions in force. A major reorganization of the ministries was carried out in April, 1990. The Ministry of Water Resources (Hydraulics) was merged into MDR as was the subministry of Environment (Protection de la Nature). This reorganization suggests both a more coherent organizational approach to rural development and concern for size and efficiency of the public sector. The subministry of Livestock was elevated to full ministerial status. Figure 1 presents the organizational structure of the new expanded MDRH. The reorganization is noteworthy in that:

-Large, donor-financed projects have been given an autonomous status and report directly to the Minister, bypassing the traditional line services. This organizational structure presumably counteracts donor-sponsored efforts to strengthen institutional capacity.

-The Direction of Cooperative Action has been eliminated, implying a reduced role for the state in the affairs of cooperatives. This is consistent with the general demise of the state sponsored cooperative movement as shown below.

-The Seed Service has been reduced from Directorate level status to a unit under the Direction of Agriculture. Meanwhile a French-financed seed project has been given semi-autonomous status, taking with it most of the available resources for this subsector. The state has withdrawn from the commercial functions of seed production and marketing but has not yet created the necessary conditions for a private sector seed industry, i.e., seed quality control and seed certification services. This reorganization leaves this kind of institutional evolution in question.

Structural adjustment conditionality requires a reduction in the size of the government's wage bill. Incentives offered for voluntary separation have induced 312 professionals to leave the various services attached to MDRH; over 40% were extension agents in the Directorate of Agriculture and nearly 30% were from the Cooperative Service. The latter undoubtedly reflects the demise of the cooperative service; the former may speak to the redundancy, and lack of opportunity in the extension service of the Directorate of Agriculture which has not yet been revitalized by the World Bank project.

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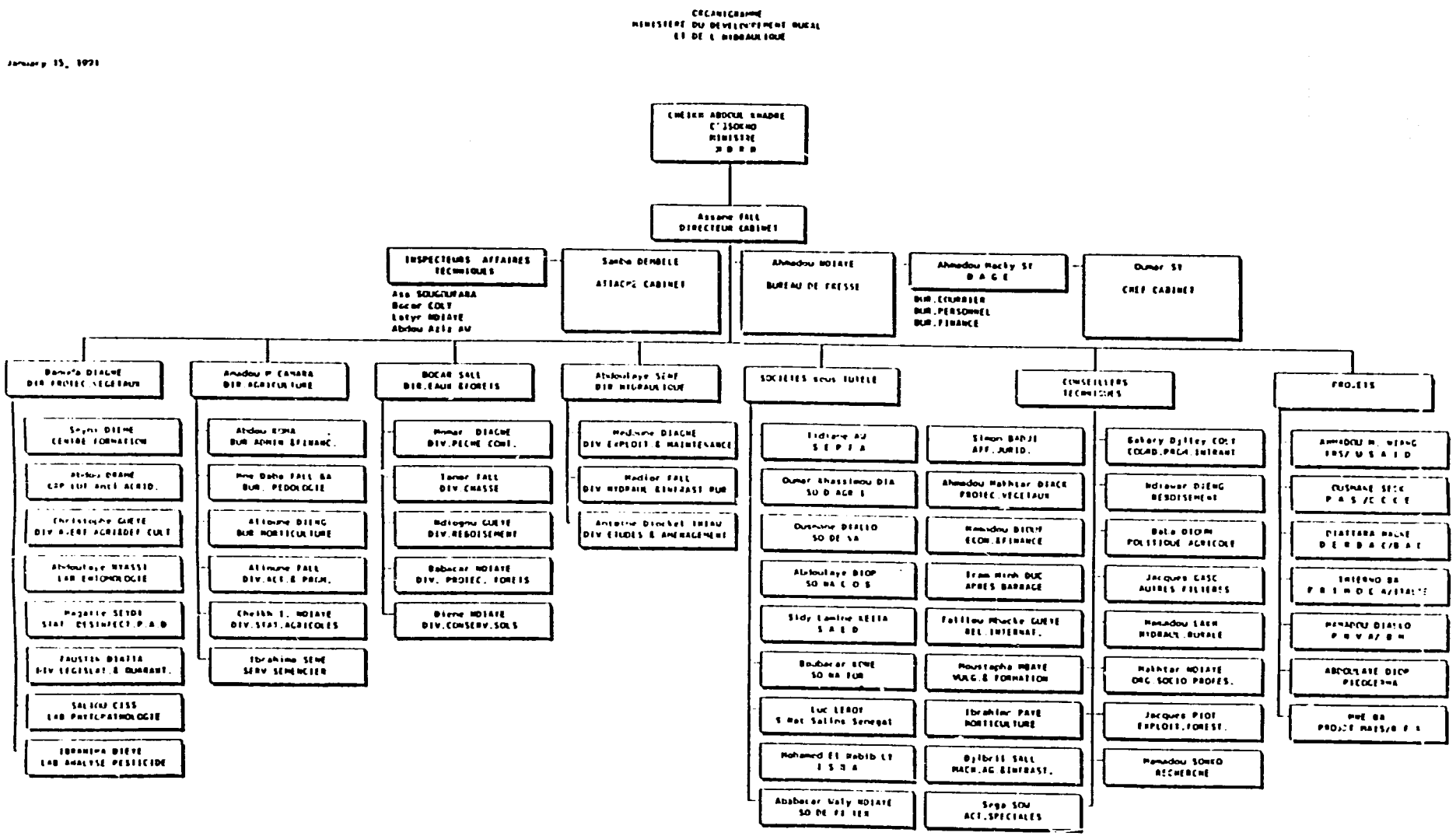
[1]Some analysts argue that real reform has been minimal. The state has not disengaged from vital commercial functions and institutional change has been superficial rather than real. Analysts of this pursuasion tend to focus on the peanut subsector. See Elliot Berg Associates, Adjustment Postponed: Economic Policy Reform in Senegal in the 1980's, October, 1990.

Figure 1


ORGANIGRAMME
MINISTERE DU DEVELOPPEMENT RURAL
ET DE L HYDRAULIQUE
January 15, 1991
CHEIKH ABDOUL KHADRE
CISSOKHO
MINISTRE
Assane FALL
DIRECTEUR CABINET
INSPECTEURS AFFAIRES TECHNIQUES
Ass SOUGOUFARA
Bocar COLY
Latyr NDIAYE
Abdou Aziz AW
Samba DEMBELE
ATTACHE CABINET
Ahmadou NDIAYE
BUREAU DE PRESSE
Ahmadou Mocky SY
D A G E
BUR.ECONOMIE
BUR.PERSONNEL
BUR.FINANCE
Oumar SY
CHEF CABINET
Bamba DIALLO
DIR PROJEC VEGETAUX
Seyni DIEME
CENTRE FORMATION
Abdou DRAME
CAP EUR Anct ACRID.
Christophe GUEYE
DIV A.ERT ACRIDEF CULT
Abdoulaye NYASSI
LAB ENTOMOLOGIE
Magatte SEYDI
STAT DESINFECT.P.A.D
FAUSTIN DIATTA
DIV LEGISLAT.& QUARANT.
SALIOU CISS
LAB PHYTOPATHOLOGIE
IBRAHIMA DIEYE
LAB ANALYSE PESTICIDE
Amadou M CAMARA
DIR AGRICULTURE
Abdou KONA
BUR ADMIN FINANC.
Mme Daba FALL BA
BUR. PEDOLOGIE
Alioune DIENG
BUR HORTICULTURE
Alioune FALL
DIV.ACT.& PROM.
Cheikh T. NDIAYE
DIV.STAT.AGRICOLES
Ibrahima SENE
SERV SEMENCIER
BOCAR SALL
DIR.EAUX &FORETS
Omar DIAGNE
DIV.PECHE CONT.
Tamer FALL
DIV.CHASSE
Ndiogou GUEYE
DIV.REBOISEMENT
Babacar NDIAYE
DIV. PROJEC. FORETS
Diene NDIAYE
DIV.CONSERV.SOLS
Abdoulaye SENE
DIR HYDRAULIQUE
Modiane DIAGNE
DIV EXPLOIT & MAINTENANCE
Medior FALL
DIV HYDRAUL &INFRAST RUR
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This pattern -- "disengagement", "deflation" and reorganization -- is characteristic in part or whole of some of the principal functions of the state as we shall see below:

-Agricultural policy analysis and formulation functions have been consolidated and reassigned to a new unit in MDRH and the underpinning statistical services were also reorganized.

-The national agricultural research system is in the midst of an ambitious reform following a reduction of over 35% of its workforce. In this case, the self-initiated reform is evidence of institutional vitality and may well lay the base for a viable, self-sustaining system.

-The extension institutions and functions are in great flux. The RDAs have been reorganized, functions are being revised and the traditional services of the Ministries of Rural Development and Livestock are being revitalized and retasked with extension functions supported by significant World Bank resources.

-Farmer organizations too are in transition; state-sponsored cooperatives are in decline, RDA-sponsored farmer organizations are vulnerable to the same harsh fortunes that have befallen their institutional patrons. New institutional reforms, rural business associations (GIEs) and rural community development associations have proliferated as state institutions have withdrawn from the field. But these organizations face some of the same challenges as their state sponsored predecessors -- unskilled membership and weak organizations facing a risky and often hostile external environment characteristic of Sahelian agriculture.

The challenge of the 1990s is to build more viable institutions to perform these vital functions which serve rural communities' interests. This is the subject of the analysis that follows.

Agricultural Policy Analysis and Formulation

Institutional capacity to carry out policy-relevant analysis and to formulate and execute informed, coherent development policy for the sector requires at a minimum current and accurate statistics and data, sound analytical capability, functional linkages between policy-relevant research and policy makers, a focused agenda, and the political capacity to implement reforms. Notwithstanding nearly a decade of policy reform characterized by significant attention and resources from the major donors and far-reaching reforms by the government, little institutional capacity has been developed to improve sectoral policy formulation, although significant capacity to do empirical, policy-relevant research has been created. It is unfortunately seriously underutilized.

Agricultural Statistics

The Division of Agricultural Statistics (DSA) of the Direction of Agriculture is located in the Ministry of Rural Development and Water Resources (MDRH); it is charged with the collection, analysis and publication of basic agricultural statistics -- cultivated area, yields and production estimates for the principal crops and some of the

minor ones[2]. This is relatively new function for the Directorate of Agriculture; from the mid-1970's until 1985 when implementation of the New Agricultural Policy (NAP) was undertaken, the Regional Development Authorities were charged with crop reporting for the principal crops. The NAP signaled an effort to create a new, national agricultural statistics service.

Resources for the development of the agricultural statistics service have been modest relative to the institutional objective;

> CILSS provided a total of approximately $100,000 between 1985 and 1990, for operating expenses and field transport; the objective was to create a uniform, consistent system for generating field data. The FAO has provided approximately $300,000 of assistance for an initial phase (15 months) completed in 1989. A second phase launched in 1990 is budgeted at $400,000. The purpose is to develop an early warning system for anticipating crop failures.
>
> AID provided $200,000 of financing through its Agricultural Production Support Project (APS) for equipment and computers, 15 motorcycles, master' degree level training in statistics for two Division of Agricultural Statistics employees and a small amount of technical assistance which was curtailed due to unforeseen difficulties. AID/APS assistance was originally to be the most ambitious of these efforts; the five year project budgeted $900,000 for the purpose of strengthening the Division's capacity to generate "timely, accurate estimates of agricultural cropped area, yield, production and input use for cereals". Some progress has been made since the effort to create a national agricultural statistical service was initiated in 1985, but the concept and the resources to realize this institution building effort were inadequate and the Division remains weak.

The methodology used to generate crop estimates is based on village size as a proxy for cultivated area in the absence of a national agricultural census. This almost certainly means the sample is not truely representative; furthermore, the methodology was constructed to generate national estimates for principal crops with reasonable confidence, plus or minus several percent. Crop estimates on a regional or subregional basis are problematic. The solution lies in a national agricultural census; the Government has asked the FAO for assistance but work has not started due to inadequate (donor) funding. Other institutional problems are equally constraining: inadequate organizational management and field supervision; totally inadequate funding for field operations, lack of transportation and equipment for field staff[3] and insufficient technical training at various levels. The challenge in addressing all of these problems is how to assure adequate, stable funding over the long-run. Statistical services are expensive and government budgets chronically short.

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[2]DSA is also responsible for collecting data and reporting on the food availability situation, peanut seed reserves maintained by farmers, agricultural input use, agricultural marketing information and recently the function of reporting on cereals market prices has been transferred to it from CSA. Aside from cereals price reporting, these other functions tend to be carried out subject to the availability of operating funds. Consequently data is only occasionally available.

[3]The Division of Agricultural Statistics estimated it needs 55 motorbikes in addition to the 45 it already has plus various field equipment.

Analytic Capacity

The capacity to conduct sectoral policy analysis in MDRH is very limited. The Division of Agricultural Statistics in the Direction of Agriculture has a unit nominally charged with doing socio-economic studies. While occasionally they undertook surveys and reported on such things as peanut seed holdings or food availability, the unit never did policy analysis per se. In 1990, MDRH set up as Agricultural Policy Unit (UPA) with support from the World Bank[4]. This unit effectively usurped any mandate the Statistics Division had for policy analysis and concentrated extremely limited ministerial resources in one place. In fact, this represents an effort to fill an institutional void; nowhere in the Ministry of Rural Development and Water Resources, nor other ministries for that matter, is there any real capacity to do policy analysis[5]. There are currently 18 technical advisors on the Minister of Rural Development's staff but generally they are not trained as analysts and in any case are neither tasked nor supported to do such work.

The Bank project actually seeks to endow the Agricultural Policy Unit with three mandates and to institutionalize these functions in MDRH.

- Policy Formulation: Price policy, input policy, respective functions of the public and private sector, subsectoral public investment priorities, etc.

  Staff: 3 agricultural economists including one specializing in marketing and price policy, 1 sociologist, 1 administrative assistant.

- Project Preparation and Appraisal: Appraisal and consistency checking of investment proposals.

  Staff: Two agricultural economists specialized in project appraisal, one livestock economist, one resource economist.

- Performance Monitoring: Physical and financial monitoring of public agencies and projects engaged in rural development.

  Staff: One financial administrator, two monitoring specialists, two administrative assistants.

Even this modest analytical capacity has not been fully put in place yet; while the Bank is funding the position of Director of the Policy Analysis Unit for an initial three year period, the other staff positions are to be permanent government employees. To date, only five of the eleven professional staff positions have been filled, apparently because government salaries without additional financial incentives are inadequate to attract qualified candidates.

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[4] The Agricultural Services Project provides support for the UPA but its principal focus is support of agricultural extension.

[5] This capacity is quite distinct from that developed in ISRA discussed below. Here the focus is operational -- generating analysis and recommendations that feed directly into the policy making process. By contrast, ISRA conducts policy-relevant, empirical research.

Under this four-year effort, the Bank is financing various materials and support services to develop long-term institutional capacity and defray operating costs during the start-up period. This includes: 1) short-term technical assistance to the Policy Analysis Unit upon demand from a university or external institution; 2) short-term training and up to three post-graduate training programs; 3) equipment including vehicles and computers; 4) equipment maintenance and; 5) travel costs. This institution-building effort is still in its early stages; it remains to be seen what durable impact it will have although there are some hopeful signs. The Agricultural Sector Structural Adjustment Program (PASA) is the most relevant example representing the largest (in terms of donor financing) and most far-reaching sector policy reforms since the New Agricultural Policy in 1984. Although the government's policy formulation has been slow and frequently short of the mark, its performance represents progress over early efforts. Furthermore, MDRH is not only engaged in the policy formation process but has been a principal interlocutor in the dialogue with donors. The Policy Analysis Unit has been the focal point for the staff work and technical level contact with the donors. Previously the Presidency and the ministries of Finance and Planning monopolized the process, leaving the technical ministries to implement policies they had not participated in shaping and in which "ownership" and technical input was low. This should change now given MDRH's substantive role in the PASA process.

The Policy Analysis Unit represents the nascent capacity to formulate analytically based policy. Its policy analysis division may ultimately develop the capacity to address questions posed by the Minister, interpret studies and research findings in light of current policy issues, commission studies, formulate policy options based on their own analysis and the interpretation of others', etc. Its institutional evolution will depend on the demands that are made on it and the support it receives.

Empirical Research

In contrast to the UPA, ISRA's applied economics program represents significant institutional capacity to conduct empirical, policy-relevant research. It pursues this mandate by carrying out in-depth studies, generally based on primary data (generated from field research). Its institutional "assets" and limitations include:

1. A highly relevant research agenda. When the program was established in the early 1980's, an explicit effort was made to develop the research agenda in terms of the policy debate of the day which was engendered by the economic crisis of the time and fiscal retrenchment associated with the first World Bank structural adjustment loan. Government policy makers, development agents, donors and scholars were consulted and subsequently a consultative group consisting of representatives of GOS agencies and the University of Dakar reviewed the research program. The program that emerged reflected the New Agricultural Policy, announced in 1984, which charted a new development direction and raised many important policy issues for which there was no empirically based analysis to provide guidance. The applied economics program was organized around three broad research themes which continue to guide research today[6]:

[6] From Newman, Crawford and Faye cited in the Strengthening Agricultural Research Project Paper, Annex G, p.2.

- The economics of agricultural production (evaluating and screening the performance of "improved" technology under on-farm conditions) including the institutional and economic issues associated with inputs distribution and use and the adoption of improved technologies.

- Marketing (with special attention to cereals) including the organization, operation and performance of specific commodity subsectors - domestic and international.

- The food security situation including supply and demand, food balances, strategies for achieving food security at both the household and national level, consumer demand, etc.

Research underway which illustrates the current program's relation to these themes includes:

- A study of small scale rice mills in the Fleuve which follows on a major ISRA study in the mid-80's. The current work is germane to issues of privatizing SAED's rice milling and marketing functions which is on the policy reform agenda of the PASA.

- Fertilizer marketing in the Fleuve. This provides empirical evidence of the performance of the private sector associated with liberalization of input distribution.

- Food Security Analysis -- A large agricultural price policy study is underway with IFPRI's assistance. It will generate the capacity to examine alternative development strategies, impact on household and national food security, sectoral growth, income, consumption, trade and foreign exchange effects.

2. Research Staff. ISRA has a well trained staff of young research economists. Of the 10 staff economists nearly all have U.S. masters degrees and two are away on long-term training doing PhD programs. This represents the largest, best-trained team of analysts anywhere in the Sahel. These resources, however, are spread thin, assigned to five different sites and five different programs. Consequently, they are relatively isolated and dispersed. To deal with this issue, a disciplinary group has recently been formed that brings the economics staff together to discuss and critique one another's work and to reflect on research priorities and problems. This group is also reviewing the possibility of reviving the BAME[7]. This would help to develop program cohesion and might facilitate setting a revised, more focused research agenda. It might also provide an identity for the program and improve the program's prestige. Before being reorganized in 1986, the BAME had established a reputation for doing high quality policy-relevant research and dissimenating it in an accessible form and in a timely fashion.

3. Linkages with Policy Makers. The applied economics program's greatest weakness is its ineffectual linkage to policy-makers and the larger development

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[7] The Bureau of Macro-Economic Analysis was established with assistance from MSU under the Ag Research and Planning Project financed by AID, 1982-1987.

community. The dissolution of BAME and the departure of most of the MSU long-term research advisors in 1986 blurred the program's image to the external community and seriously weakened its management and leadership. The new organizational structure provided the economics programs with no direction and it received little intellectual guidance. Resources dwindled making it difficult to continue field programs and the research review and approval process broke down, effectively stymieing research publications. Worse, ISRA management centralized responsibility for publications when it created a special central unit, UNIVAL, for this purpose in 1988. This effectively blocked the technique that BAME had perfected for communicating with government policy-makers, development agents, donors and others. Timely, "Information Notes" were previously used to transmit in a succint and direct way the policy implications of research as it became available. When these notes, working papers, etc., no longer appeared, the BAME's old clientele concluded that ISRA was no longer doing policy research. A management decision has recently been made to authorize the economics program to again publish and distribute its own work and departmental management is supportive of the applied economics program. These measures should help to revitalize the program and enhance its access and utility to policy-makers and others. Reconstituting the BAME by utilizing the recently organized economics disciplinary group might further strengthen the capacity of the applied economics program to conduct research and communicate findings.

Setting the Policy Agenda

As experience with the PASA shows, the initiative for setting the policy reform agenda continues to lie with donors. At the onset of the PASA process, the government presented its "Statement of Agricultural Development Policy" and followed this with an Action Plan. These GOS documents began the policy dialogue by proposing investments or studies rather than policy reforms and generally presented a view of "business as usual". Donors, working collaboratively, have largely defined the reform agenda to which the GOS has reacted. This passive role by the government raises questions that go beyond technical competence and organizational capacity to political process.

The Politics of Reform

Policy formulation during the reforms of the 1980's has been more a political than an analytical process[8]. Donor involvement has been very extensive (expatriate advisors, donor-financed studies and consultants and the donors themselves) making it difficult to discern exactly what is Senegalese policy and discouraging the development of indigenous capacity. Under these circumstances, government policy makers have often reacted to donor proposals rather than presenting their own. Policy making has thus involved skillfully playing the donors rather than developing policies to advance development objectives.

While this analysis of bureaucratic politics is right as far as it goes, it does not address the larger question about what drives the definition of

[8] John Eriksen (Macroeconomic and Sectoral Adjustment Programs in Senegal, p. 9, May, 1990) makes this argument.

policy itself, irrespective of how the formal process works. Sidi Jammeh[9] argues that policy makers historically have manipulated instruments of intervention largely in pursuit of political rather than economic objectives. The political machine, run by the Socialist Party and strongly influenced by interest groups like the Mouride Brotherhood, pursue policies that generate resource flows to these clients. Such policies have typically involved market interventions that administratively set prices and have been designed to generate "rents" to placate pressure groups rather than to promote stated development objectives. Such patronage is systemic rather than incidental; it is fundamental to how the policy formulation system works. Farmgate prices of peanuts, rice and cotton have all been set above world market prices in recent years which has helped to sustain rural incomes and maintain rural support for the Socialist Party. Consumer prices of rice have been taxedk generating significant rents, ostensively for generating state revenues, but in practice "interests" in the rice sector have apparently absorbed significant quantities of these resources. If this analysis is correct, it suggests that policy analysis and formulation should explicitly examine how specific policies will affect the political system - patrons, clients, resource flows. This will suggest something about political feasibility as well as the impact of reforms on the political system. Jammeh argues that policy reform should not seek to weaken or destroy the political machine system but rather use it and enhance the system's power and legitimacy. This will promote political stability and increase the authority of leaders to execute reforms.

In sum, donors' capacity to successfuly pursue policy reforms may be dependent on their understanding of the political system that shapes policies and the authority of this system to execute these reforms. This also suggests that political feasibility of reforms may depend on the extent to which they work within the political system rather than outside of and against it.

Agricultural Research: ISRA'S Institutional Viability and Capacity

Agricultural research was launched in Senegal by the French colonial service in the 1920s. Initially a research station was established at Bambey to develop improved varieties of peanuts and associated cultural practices. Research on food crops (millet, sorghum, cowpeas) grown in association with peanuts was introduced in the 1930s. Livestock research was also introduced during this period with the establishment of a veterinary laboratory and later expanded in the 1960s with assistance from the French "Institut d'Elevage et de Medecine Veterinaire des Pays Tropicaux (IEMVT). Research continued to be directed and carried out by French scientists until 1974 when ISRA was established as the national agricultural research institute.

ISRA is mandated to serve the entire primary sector (crops, livestock, forestry, fishing). While ISRA's basic mandate is to conduct adaptive research on production, resource management, and on-farm post-harvest problems, it also does selective applied research. Off-farm food processing technology is generally the charge of the Food Technology Institute (ITA). ISRA produces and supplies breeder seed, vaccines, improved breeding stock and technical information bulletins and publications on research findings. ISRA's Five Year

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[9]Sidi Jammeh, State Intervention in Agricultural Pricing and Marketing in Senegal, (The Politics of Budgetary Reallocation), Ph.D. dissertation, John Hopkins University, 1988.

Plan provides for approximately $16 million[10] per year of which almost 40% is financed by the Treasury, employs 619[11] full time staff, of which 19% (120) are classifed as research scientists, and operates 14 research centers and stations. These resources support 62 research programs covering 7 principal commodities, various fruits and vegetables, forages, small and large ruminants; various forestry species as well as marine fisheries. Figure 2 presents ISRA's view in schematic terms of its institutional relationship to the rest of the sector. Figure 3 presents ISRA's newly revised organizational structure, including research stations.

ISRA's viability and capacity to carry out its mandate are a function of the relevance and soundness of its research program, manpower, infrastructure, financial resources, management (research, administrative, financial and personnel), external linkages with the larger research community and its interface with various extension entities.

Research Program

ISRA developed a strategic plan setting forth its research priorities and programs over the five year period, 1989-1993 [12]. This plan defines 32 research programs covering eight agro-ecological zones and involves crops, livestock, forestry, fisheries, farming systems and natural resource management research. These are complemented by 13 national programs.[13] Table 2 summarizes the geographic distribution of these programs and their level of planned funding in absolute and relative terms.

While the plan has much merit in its effort to deal with national development priorities and set research priorities, it has been overtaken by financial crisis and domestic political pressure for reform. ISRA has responded by formulating a broad, ambitious set of reforms covering research programs, organizational structure, management, finances and personnel. Proposed reforms will be presented to its Board of Governors (Conseil d'Administration) and subsequently to its Scientific and Technical Committee which exercise scientific oversight of ISRA's program and performance.

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[10] ISRA's budget for 1990 is CFA 2.91 billion ($11.6 million). Actual funding is lower than the $16 million planned, due to delays in start up of the World Bank's new project and possibly reductions in other donor's funding levels.

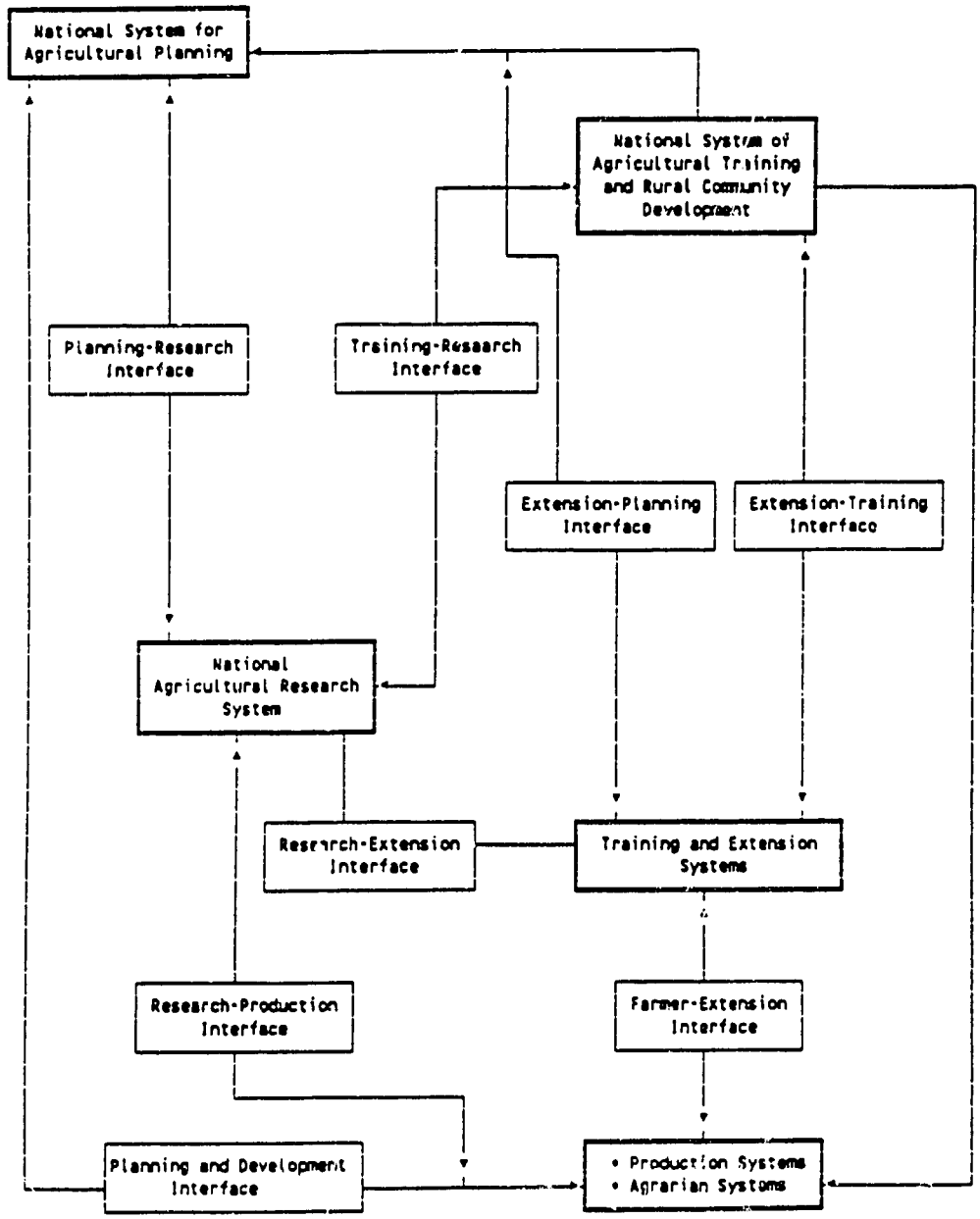
[11] ISRA, Tableau de Répartition des Agents,", September 13, 1990. This number will be somewhat lower when ISRA completes the reduction in force initiated during the summer of 1990.

[12] Stratégies et Programmation des Recherches, 1989-1993, Présentation en Synthèse.

[13] ISRA planning documents which deal with program reorganization say there are 62 reprograms, not 45 specified in the final version of ISRA's Five Year Plan. Apparently the Five Year Plan had not been operationalized as of the end of 1990 because the World Bank's Second Agricultural Research Project had not started disbursements, thus severely curtailing financing available for research programs.

Figure 2

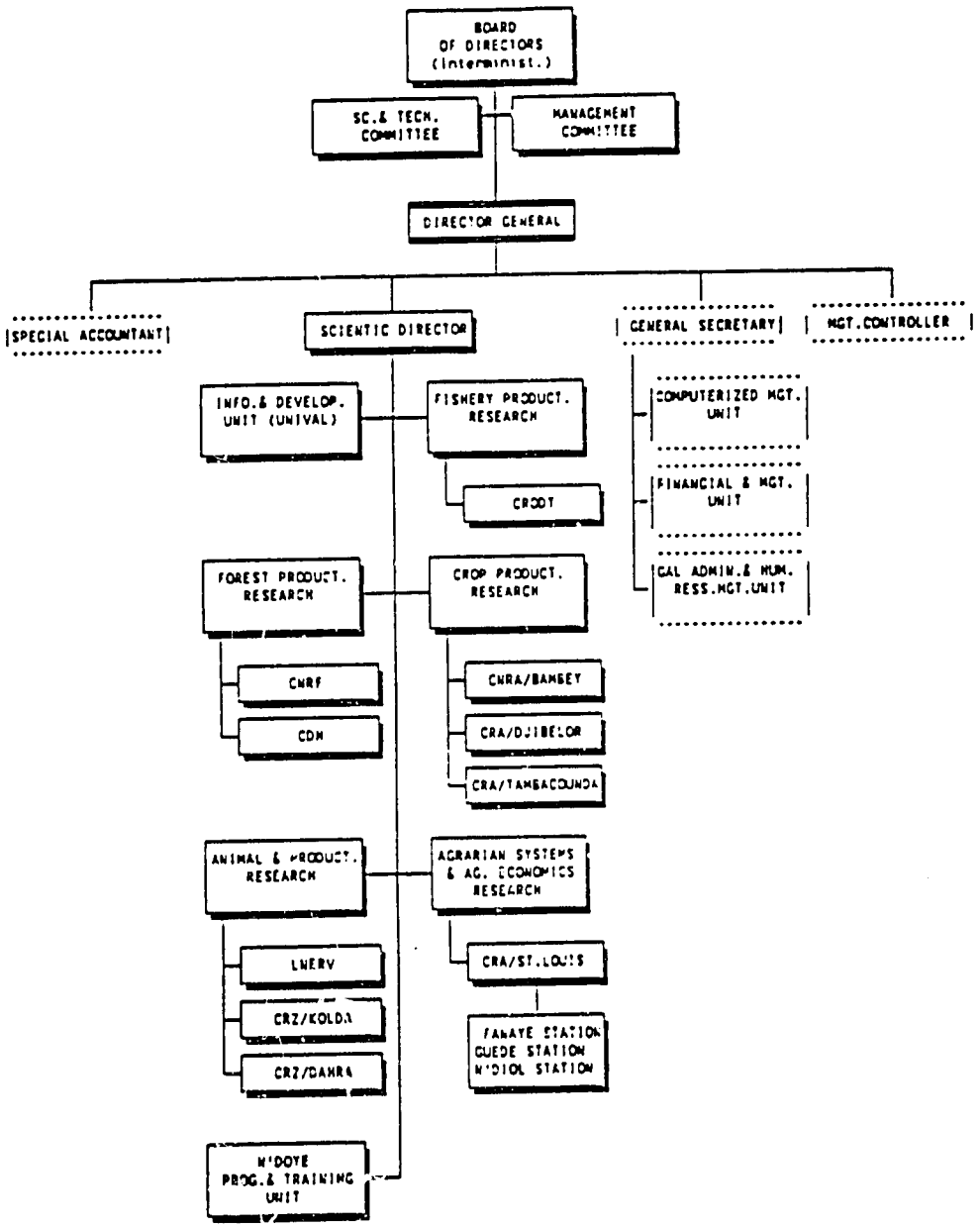
Schematic Representation of ISRA's Place and Linkages in the National Agricultural System



Source: ISRA, "Strategies et Programmation des Recherches 1989-1993, Presentation et Synthese", March 1988.

Figure 3

ISRA Organizational Chart



Prepared by USAID Staff based on information from ISRA.

Table 2

ISRA's Five-Year Plan (1989-1993)
Research Program Costs (end 1988 prices)
(Millions FCFA)

A. Geographic Distribution

	Cost	% of National Total
Senegal River Valley	1,661	8
Marine and Coastal	1,621	8
Niayes	1,300	7
North and Central Groundnut Basin	1,330	7
Southern Groundnut Basin	999	5
South-Western Senegal	1,352	7
Eastern Senegal	1,079	5
Sylvo-Pastoral Region	361	2
National Programs	4,532	23
Total Direct Costs	14,235	72
Indirect Costs	5,417	28
Total Costs of Five-Year Plan	19,652	100

B. Programmatic Distribution

	Cost (Millions FCFA)	% of Total Direct Costs	% of Total Costs
Groudnuts	462.4	3	2
Millet	341.5	2	2
Sorghum	137.5	1	1
Corn	468.0	3	2
Rice	425.7	3	2
Cowpeas	251.8	2	1
Cotton	359.8	3	2
Horticulture	1,179.7	8	6
Farming Systems	1,066.1	7	5
Natural Resources/ Mgt & Environment	1,338.0	9	7
Water Management & Fertilization	293.8	2	1
Agroforestry	202.9	1	1
Forestry	360.9	3	2
Fisheries	1,501.7	11	8
Livestock	2,198.0	15	11
Economics	518.6	4	3
Storage	68.8	0	0
Support & Other Programs	1,746.7	12	9
Seed Production	363.8	3	2
Vaccine Production	949.0	7	5
Total Direct Cost	14,234.6	100	72
Indirect Costs	5,417.3		28
Total Costs of Five-Year Plan	19,651.9		100

Table 2 (cont'd)

C. Tentative Financing Plan of the Five Year Plan

		CFAF Billions
Original Cost of the Plan Five Year Plan		19.65
Planned Reduction of Salary Costs		1.50
Actual Cost (end 1988 prices)		18.15
Financing	Government of Senegal	7.25
	ISRA's own resources	1.50
	France	2.10
	USAID	0.30
	Other	1.80
	Contribution of Proposed IDA Credit	5.04
		17.99
To be secured		0.16
TOTAL		18.15

Source: Adopted from World Bank, Staff Appraisal Report, Senegal, Second Agricultural Research Project, February 26, 1990, Annex 1.

A drastic reduction in the number of research programs is proposed (from 62 [14] to 30) with much of the consolidation affecting the departments of crops and agrarian research as shown in Table 3.

Table 3

Proposed Research Program Reduction

Department	Number of Research Programs	
	Present	Proposed
Crops	15	5
Agrarian Systems	16	4
Forestry	12	5
Animal Science	9	6
Fisheries	10	10
TOTAL	62	30

This consolidation may improve research management but any financial savings are likely to be modest. This consolidation is intended to increase scientific collaboration, assemble a critical mass of scientific expertise and consequently make more efficient use of scientific, physical and financial

[14] World Bank, Staff Appraisal Report, Senegal, Second Agricultural Research Project, February 26, 1990, p. 13.

resources while improving research methodology through both increased interdisciplinary collaboration and peer review. Research programs are ISRA's basic unit of research management. Thirty research "units" in an institute of 100 plus researchers seems a more manageable and potentially more effective organization of resources. This reform is proposed to be achieved by regrouping small programs into larger ones and not through the elimination of research programs. Consequently, research activities and financial requirements are unlikely to diminish very much.

An important but difficult issue concerns research priorities ISRA's Five Year Plan serves as formal statement of priorities, weighted by the size of resources budgeted. Even though budgeted and actual expenditures have borne little relationship to each other in the past, the Five Year Plan at least provides ISRA's idealized view of priorities, undisturbed by the financial crisis.

If actual or potential contribution to the economy as measured by share of GDP is the criterion for setting research priorities, then even a casual perusal of Table 2 raises some interesting questions. The allocation of resources between the eight agroecological zones is surprisingly homogeneous - 5% to 7% of the total budget in 7 out of 8 cases, even though the regions vary greatly in actual and potential importance of production. Similarly, commodity priorities seem askew. Recognizing that support for commodities may be hidden under other rubrics such as "farming systems", "resource management", etc. nevertheless it is striking to note that only 3% of the direct costs of the national research program budget is allocated to peanuts and 8% to coarse grains (exclusive of paddy production) whereas each accounts for about 45% of the share of total crop production and peanuts generate 17% of total export earnings and 80% all agricultural exports. Uma Lele, World Bank, comes to similar conclusions in her analysis of implicit research priorities evidenced by budget allocation patterns during the early to mid-80's when the first World Bank agricultural project was financed. Thus, there is a good case for reevaluating research priorities: first because financial crisis is forcing retrenchment and reorganization (more of this below in the financial analysis section) making obsolete ISRA's five-year plan, and second because priorities, neither formal nor defacto, are consistent with development reality.

Finally, there is the matter of the quality and performance of research programs, particularly in areas most closely related to USAID's strategic interests. This is important because it defines the basis for future research efforts. Critiques of ISRA's research program which are of greatest relevance in this context include: 1) commodity research programs are inordinately oriented toward plant breeding; 2) food crop research concentrates excessively on improved varieties and purchased inputs rather than on low-cost technologies that would improve upon existing traditional cultivation practices; 3) crop-specific and farming systems research programs are not sufficiently coordinated, resulting in crop specific research that does not address farm-level constraints identified by farming systems research; 4) farmers and extension agents don't participate sufficiently in setting specific research program priorities; and 5) livestock research findings are not adequately integrated into livestock and crop production systems research.

Notwithstanding the legitimacy of these critiques, the development of farming systems research has significantly reduced these problems over the last decade. Farming systems research has greatly improved the definition of research

problems and improved knowledge of where technologies may be applicable thanks to careful definition of homogenous production zones. It has also introduced an interdisciplinary, on-farm research methodology that now enjoys wide legitimacy and it has produced research programs of greater relevance to farmers. The best production systems research and institutional capability has been developed in the Casamance with USAID support. The range of technologies from soil preparation and improved varieties, to improved planting, weeding, fertilizing, and rotations have been developed for rice and corn production systems that produce significant yield increases and provide handsome economic returns. (See Annex VII) "Inventory of Technologies Available to Senegalese Farmers".

ISRA has also produced millet and sorghum varieties that are drought resistant and better adapted to the shorter growing seasons characteristic of the last 20 years. A technical package including an improved, short cycle drought resistant variety of cowpeas has been developed. The applied economics research program has generated highly useful results, producing policy-relevant analysis based on empirical field research rather than recycled secondary data[15]. See Annex VII for a summary of technologies developed by the national research system and recommended for farmer adoption.

A review of cereals research programs concludes that while breeding and varietal screening should continue, the most important gains in the future are likely to come from improved agronomic practices. Research on these commodities is sufficiently advanced to specify well defined future research programs that offer reasonable prospects of successful technology development[16].

Manpower

One of ISRA's primary assets is its workforce. Given the size of the country and economy, the role of agriculture and its contribution to the GDP, and the level of development, ISRA enjoys a scientific staff that is relatively well trained and ample in number. Effective use of these assets has been somewhat constrained by organizational and management problems. Salary costs of this staff represent a major financial burden relative to available resources.

As of April, 1989, ISRA employed a total of 993 people working in 12 research centers (including the headquarters). This included 66 expatriates, mostly French; Senegalese staff totalled slightly over 900. Scientific research staff numbered 120 accounting for 13% of total staff; they were directly supported by a cadre of laboratory and field technicians representing another 35% of the workforce (Table 4). Administration support staff and laborers made up the other half of the staff, a heavy burden relative to those directly engaged in research.

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[15] Much of this discussion of research program results is based on the World Bank Staff Appraisal Report for the Second Agricultural Research Project.

[16] MSU, Cereals Advisory Team Commodity Research Reviews.

Table 4

ISRA Occupational Groups

Groups	Staff Number	%
Researchers	120	12.9
Laboratory technician	102	11.0
Field technician	231	24.9
Laborer	72	7.8
Technical support	276	29.8
Administrative support	126	13.6
TOTAL	927	100.0

Source: ISNAR, Human Resources of ISRA: Present Situation and Financial Implications of Alternative Salary Policies September, 1989.

Table 5 summarizes the educational level of ISRA's scientific staff. While relatively well trained in terms of degree level, the top of the pyramid representing the scientific leadership is rather weak - only 4% of the staff with the equivalent of a PhD[17]

Table 5

Educational Level of ISRA Scientific Staff

Degree Staff	%
Bachelors, Ing. Agr, Dr. Vet.	29
Masters, DEA	43
Dr. 3ème cycle, Dr. Ing. (ABD equivalent)	24
PhD, Dr. D'Etat	4

[17] ISNAR, ibid. p.7.

ISRA's staff is predominantly middle aged, over 80% between 30 and 49. This is largely a function of recruitment patterns. ISRA grew rapidly from 1973 to 1984, the period approximately coinciding with its creation and expansion as a Senegalese research institution. The average age of researchers ranges from 34 in the forestry department to 37 in the Crops Department. Recruitment has been strigently limited since 1987, due to budget limitations. Given recruitment constraints and the absence of young staff, this age structure poses some problems in the short run for retraining and restructuring scientific manpower to adjust to new priorities and in the long run for maintaining program and management continuity as this huge age cohort begins to retire.

Scientific staff is dispersed over a wide range of disciplines, 14 different centers and stations, plus various administrative, laboratory and research facilities in Dakar. They carry out over 60 research programs. Obviously this coverage - geographic, programmatic and disciplinary poses management problems in terms of administration, cohesion, critical mass, coordination and cooperation, etc. Table 6 summarizes research staff deployment by scientific discipline as of 1987.

Judgements about the quality of performance of staff is difficult given the lack of a personnel evaluation system. Presently advancement is based on seniority, limited to six levels. With AID financing, ISNAR is in the process of helping ISRA to develop such an evaluation system that will greatly enhance management's ability to provide performance-based rewards, to discriminate in training and promotion decisions and to serve as a tool for selecting out non-productive employees. In the meantime, one must rely on the assessment of knowledgeable observers who say there are some very good researchers, there are those who are marginal but potentially productive, given appropriate training, and there are those who ISRA needs to release because they are unproductive and unsalvageable. Eliminating those with little potential to contribute would give ISRA some flexibility to restructure its research staff to reflect research priorities which the ceiling on positions now prohibits.

The most serious of all personnel problems is the size of the wage bill relative to resources available from the national budget. (Donors do not finance employee salaries). In 1987, 406 employees were let go reducing the workforce by over a quarter to 900 plus. This was to have been associated with a restructuring that would have reorganized research personnel, reduced staff at various research stations and realized major salary savings. This opportunity was squandered; salaries of lower level personnel retained were increased, sometimes nearly double the amount permitted by the federal salary scale, and efficiencies were not realized from the reorganization that followed. Consequently, a second draconian reduction in force was mandated and largely completed in June, 1990. This reduction when completed will cut staffing levels from 885 to 560, a total of 325 positions representing 37% of the workforce. Most of these cuts were of support staff. Research staff were exempted and cuts of technical support staff minimized. ISRA estimates this reduction in force will save nearly CFA 350 million ($1.4 million) per year which is equivalent to 25% of the GOS's contribution in FY90. Research staff cuts will be made later when the decision can be based on systematic personnel evaluations. This awaits the implementation of reforms initiated with ISNAR's help. Painful and difficult as these cuts are, they are essential to ISRA's financial health and represent dramatic progress in its battle of the budget.

Table 6

Research Staffing Levels & Disciplines for ISRA Research Centers, 1987

Discipline	DG/DPRV/DRSAEA	CNRA	DJIBELOR	SAINT-LOUIS	KAOLACK	TAMBACOUNDA	CDH	LNERV	DAHRA	KOLDA	TOTAL
Agronomy											
General Agronomy	1	1	0	2	1	1	1	1			8
Plant Physiology	0	0	1	2	0	0	0				3
Plant Genetics	1	3	1	0	1	1	2				9
Plant Pathology	1	1	1	0	1	0	1				5
Entomology	2	1	1	1	1	1	1				8
Weed Science	0	0	1	1	0	0	0				2
Soil Science/Soil Chem.	1	5	3	1	2	0	0				12
Agricultural Engineering	0	1	1	1	0	0	0				3
Agro-bioclimatology	0	1	0	0	0	0	0				1
Sub-Total	6	13	9	8	6	3	5	1			51
Agricultural Economics & Social Science											
	3	0	2	3	2	0	1				11
Animal Science											
Animal/Range Science	1	1	1	0	1	0	1	5	1	2	12
Animal Nutrition								2	0	1	3
Genetics								0	1	0	1
Pathology/Virology								3	0	1	4
Parasitology/Hemotology								2	0	0	2
Microbiology								2	0	0	2
Sub-Total	1	1	1	0	1	0	0	14	2	4	24
Fisheries (at CRODT)											17
Forestry (at CNRF)											11
TOTAL	10	14	12	11	9	3	6	15	2	4	114

Not shown in this total are several administrative positions in Dakar which are currently filled by scientists.

Infrastructure

ISRA has an extensive network of research centers (7) and stations (7), plus various relatively unimproved sites where trials and demonstrations are carried out. This is an asset in terms of the broad range of ISRA's research mandate (crops, livestock, forestry, fisheries) and the great diversity in agroecological production zones, but recurrent costs of operation and management requirements are high. Recurrent costs associated with operation and amortization increased five fold between 1982 and 1987 due to rapid expansion of infrastructure financed by the World Bank.[18]

Recently, ISRA management has taken measures to curtail utility costs. The reforms which ISRA plans to present to its Board of Governors in the near future propose to consolidate management by transferring two research directorships (crops and agrarian systems) to research stations, thus reducing and simplifying the management structure. Station management itself is frequently weak. Increasingly, young, well-trained researchers are assigned to station directorships with little prior research management experience. At lower levels, there has been no training in station management skills. In sum, ISRA's physical infrastructure is an import asset but management reforms are necessary to curtail costs, improve management and possibly utilize excess capacity to generate revenue to defray the costs of the stations.

Financing

A serious financial crisis lies at the heart of ISRA's institutional problems. This crisis has corroded financial management and planning since resources are allocated to pay the most pressing bills and meet salaries rather than being allocated in accordance with budgets and formal research priorities. Research is compromised because field work and research supplies can't be financed on a secure basis. Although domestic funding sources are relatively generous (between .87% and 1.2% of agricultural GDP from 1986-1988) they have been inadequate to meet salary costs and pay for the maintenance and amortization of infrastructure and equipment. Consequently, stations and facilities are deteriorating steadily. Meanwhile, ISRA has incurred huge overdrafts in excess of its authorized budget[19]. Donors finance virtually all research program costs but do not pay salary and indirect costs.[20] This has two unfortunate consequences: 1) defacto, donors play a large role in setting research priorities by deciding which research programs get funded; and 2) ISRA has no flexibility to meet the urgent needs of financing indirect costs - utilities, management, amortization of facilities and equipment - because none of the donors will finance such costs.

Faced with this dilemna, ISRA's draconian reduction in its staff (37%) (the second in three years) will save an estimated CFA 346 million per year ($1.4 million). This represents a reduction in ISRA's wage bill of almost 25%.

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[18] Pronovost, Senegal Agricultural Research Project, Paper (draft), Annex G.3, Part II, p.1.

[19] Accumulated overdrafts totalling CFA 8.76 billion ($35 million) were written off by the Government in June, 1989. Subsequently, another CFA 690 million ($2.75 million) in unauthorized overdrafts was incurred as of August, 1990. ISRA is responsible for retiring this liability although this may prove difficult.

[20] The World Bank agreed to finance some indirect costs associated with the research programs it finances under its Second Agricultural Research Project. This project had not started disbursements as of the end of 1990.

Nevertheless, salary costs will continue to exceed GOS budget resources (the only available source of financing) by about CFA 160 million per year because only about CFA 900 million is available for personnel costs with the remaining CFA 500 million plus for equipment, etc[21]. Table 7 summarizes GOS short-term financing commitments to ISRA.

TABLE 7

GOS's Commitment to Finance ISRA's Budget

FISCAL YEAR	MILLIONS OF CFA		
	National Budget for Equipment	"Transfer" Budget	Total
1990/1991	500	913	1,413
1991/1992	536	940	1,476

Source: ISRA, Plan de Restructuration de l'ISRA, July, 1990.

A cursory review of ISRA's available financing (Table 8) and an illustrative budget of ISRA's principal cost components (Table 9) provide some interesting insights into the source and nature of ISRA's financing problems.

- The Government is by far the most important funding source providing double the amount of the next most important source, the World Bank.
- Government's funding at CFA 1.47 billion (about $6 million) is reasonably adequate, representing .9% of agricultural GDP[22].
- An appreciable portion (45%) of total resources come from domestic sources when revenue ISRA is expected to generate is included.
- Nearly 20% of the plan is unfinanced, representing a shortfall of nearly $3 million per year.
- Personnel costs are moderate, at less than 30% of the total budget. This represents a significant reduction in absolute terms and as a percent of the total budget, thanks to the reduction in force which was effected in mid-1990.
- Domestic resources are inadequate to finance personnel and indirect costs which most donors have not been willing to cover as a matter of principle. These items are estimated at CFA 1.92 billion ($7.7 million) whereas domestically generated resources are projected to total CFA 1.77 billion ($7.1 million) resulting in a financing gap of $600,000 per year. Due to the illustrative character of Table 8, this gap may actually be considerably larger.

[21] An exact definition of what the equipment budget is to finance is not available. Presumably it's intended to finance vehicles, equipment, utilities, and other operating expenses and amortization costs of facilities and equipment.

[22] This percentage is calculated based on the average of agricultural sector gross domestic product for a two-year period (1988 and 1989) to reduce excessive variability.

TABLE 8

Five Year Plan
Funding Sources and Annualized Amounts

Source	Billions CFA/Year	%
GOS Budget(a)	1.47	37
ISRA's Revenue	.30	8
World Bank	.75	18
French	.40	10
Other Donors & Research Contracts	.36	9
Residual to be financed (b)	.72	18
TOTAL	4.00 (c)	100

Source, World Bank Staff Appraisal Report, Senegal Agriculture Research Project, p. 14.

(a) Funding level for FY 90/91 and 91/92 in accordance with World Bank conditionality.

(b) Residual is simply the funding required to meet the Five Year Plan budget.

(c) Note that this is based on the Five Year Plan budget of FCFA 19.65 billion. The World Bank uses the figure of FCFA 18.5 billion ($6 million less) on the assumptions that employees' salaries in excess of the GOS salary schedule will be regularized and reduced. The analysis here uses the higher budget figure, believing that it is going to take a long time to realize this adjustment through savings from adjusting salaries, etc.

Table 9

FIVE YEAR PLAN
ILLUSTRATIVE BUDGET -- PRINCIPAL COST CATEGORIES[23]

ANNUALIZED BUDGET Category	ALLOCATION BY PRINCIPAL CATEGORY Billions CFA/Year	%
Personnel	1.12	28
Operations	1.42	36
Indirect	.80	20
Other	.66	16
TOTAL	4.00	100

The implications of this analysis are that ISRA must find additional ways to cut costs and improve efficiency. More than research program consolidation may be necessary to reduce costs to available resource levels. Issues of research program size and priorities need to be revisited. Greater flexibility

[23]This is an illustrative budget synthesized from available information. It reflects ISRA revised personnel costs following its mid-1990 reduction in force but it may exclude social costs and benefits associated with the wage bill. Operations are taken at the level when the total Five Year Plan was budgeted at CFA 23 billion rather than the CFA 19.65 billion used by the World Bank in its appraisal of its new project. Indirect costs are illustratively estimated at 20%. ISRA does not have a system for determining indirect cost, though in 1989, it budgeted 17% of total expenditures for this category. "Other" which would include investments and everything else, is a residual.

and discretion are needed in determining the things for which funding can be used. This includes the government's restrictions between personnel and "equipment" line items and donors' restrictions on financing indirect costs which are a significant and real part of total research program costs. And of course, financial management will have to be strengthened to insure whatever resources are available and priorities set, that the resources are allocated accordingly.

Management Issues

In 1990, ISRA launched its own reform initiative. This differed from the mid-'80s experience when the donors, under the leadership of the World Bank, demanded reorganization, a big staff reduction and management reforms. Results were disappointing. This time, ISRA leadership has taken the lead, establishing a participatory process involving institute-wide representation in the form of working committees charged with both diagnosis of problems and identification of reform options. A dialogue was established with key ministries, the Presidency and donors. A regional conference was also organized with participation from various representatives of other African national systems, ISNAR, International Research Centers, donors, and a domestic constituency representing extension, finance and development policy. All of this was undertaken to generate options for reform and build understanding for both the need and the process of reform. ISRA management will soon present proposed reforms to its Board of Governors (Conseil d'Administration) for approval; all approved reforms are to be implemented by the end of 1992.

Though covering a wide range of management, organizational and financial issues, the basic idea of the reforms finds its expression in the concept of a "noyau dur", or solid core program. ISRA aspires to define a core research program representing the highest priorities of the State, supported with secure funding from the GOS budget and executed by ISRA's best research staff. The reform proposal ISRA has formulated and the issues it is struggling with are intended to advance this goal. This reform agenda will/must address various personnel, research and financial management issues.

Personnel Management:

With ISNAR's help, ISRA is developing the tools required to establish a professional personnel evaluation system that will permit meritorious promotions, selection out and training decisions. A career ladder is also being developed which will afford upward mobility through various job ranks and which will open up a scientific track that allows senior personnel to advance as scientists rather than limiting senior promotions to management. In response to a morale problem, ISRA management asked for a review of its salary scale. ISNAR recommends a judicious set of salary adjustments (which are constrained for the moment by the budget). This is a potentially valuable tool in rewarding performance and improving morale. ISRA also requires a training system for identifying needs, specifying training plans and employing a variety of techniques (non-formal, long-term, "sandwich programs" which intersperse the components of a single training program with normal work schedules, etc.) to improve the efficiency of training programs. These matters bear directly on the efficiency with which ISRA utilizes its most value resource - its personnel.

Research Management: Reform issues include:

1. Research Priorities - In launching its reform initiative guided by the goal of creating a "noyau dur" (core program), ISRA has acknowledged the need to rethink its program in strategic terms, organizing resources around priorities which are financially feasible to support. Its research program consolidation, reorganization and deployment of research staff and financial retrenchment all require rethinking ISRA'strategic plan and research priorities.[24]

2. Rationalize the structure of ISRA to clarify roles, reduce redundancy and improve management. The dual management structure of research department directors and station directors has caused considerable ambiguity about authority and responsibilities while increasing the bureaucratic hierarchy and slowing management decisions. ISRA has tackled this issue by naming two research directors as station directors and moving the directorships out of Dakar. Research stations have been reassigned to different research departments, in order to reduce management burdens.

3. Research directors' roles are proposed to be exclusively scientific; they are to provide intellectual leadership in helping to formulate and evaluate research programs, advise on manuscripts and reports for publication. Administration (financial, personnel, etc) is to be handled by station directors dealing with central administration in Dakar operating under the purview of the Secretary General.

4. Research planning and budgeting suffers because there is not a well defined system for submitting research proposals and budgets, and the administrative process is unduly long and cumbersome due to multiple lays of administration.

Financial Management: The system suffers from:

1. The lack of experienced personnel. Senior staff has been hard to retain at ISRA's salary level.

2. The computerized accounting system is powerful but not user-friendly and few people can use it. Many records are kept manually. The equipment defeats the system it was intended to support.

3. There is no system for indirect costs accounting. In the absence of definitions and data, there is no credible way to estimate these costs and consequently no way of billing for them or managing reserves to amortize and replace facilities.

4. The system does not generate information and tools for senior management to use in decision making.

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[24] ISRA acknowledged that "established plans" will need to be revised since they don't coincide with the realities that are necessitating ISRA's self proposed reforms. ISRA, Plan de Restructuration de l'ISRA, July, 1989, p .10.

5. Budgets are not respected in making expenditure decisions.

6. Accountability for use of funds is very weak, both slow and imprecise.

External Linkages and Networks

ISRA maintains scientific contacts with a large number of international, regional and national research organizations and universities. It cooperates with 11 of the 13 International Agricultural Research Centers (IARCs) and participates in many networks including the one recently organized with French Support (CORAF) and as well as SAFGRAD. It maintains extensive relations with CIRAD, the French research service for international development, participates in three AID funded CRSP's (Collaborative Research Support Program) involving cowpeas, peanuts and sorghum/millet, and has worked closely with Michigan State University under A.I.D. financing since 1982.

Thus, ISRA has extensive contacts with the external research community, perhaps too many. The productivity of these relationships is variable across entities and time, but generally there is need to improve the quality and productivity of the most important ones.

WARDA's (West African Rice Development Association) irrigated rice research program is based in St. Louis and utilizes ISRA station facilities at Fanaye. Historically, ISRA has relied on WARDA to carry out a rice research program for the Senegal River Valley. ISRA has not developed its own irrigated rice programs; its work has been limited to farming systems research that includes rice, water management and fertilization research. Collaboration between WARDA and ISRA has been poor and, not surprisingly, results are minimal. In the last two years, WARDA has joined the CGIAR system, redefined and revitalized its rice research program and started to actively seek collaboration with ISRA. This is a potentially very significant linkage, given WARDA's renewed interest and resources and Senegal's interest in rice in the Fleuve. Nevertheless the impact of WARDA's program on rice production in the Fleuve will certainly depend on whether ISRA builds a viable national program.

ICRISAT (International Crop Research Institute for Semi-Arid and Tropical Agriculture) collaborated with ISRA from 1977 to 1985. Genetic material from ICRISAT and breeding work at Bambey produced two superior synthetic varieties of millet that have been widely adopted in the northern Peanut Basin. But relations were strained and for much of the 1980's the relationship was under-exploited relative to its potential usefulness to ISRA's millet and sorghum program. French participation in ICRISAT's West African network seems to be revitalizing this important link.

ISNAR (International Service for National Agriculture Research) has been working with ISRA under AID-financing since 1988 on improving human resource planning and management. IFPRI (The International Food Policy Research Institute) also with AID-financing, is participating with ISRA in a major agricultural price policy and household budget study which seeks to generate important policy recommendations and build institutional capacity for ISRA to continue a research program in these important areas. Linkages with IITA (International Institute for Tropical Agriculture) have not been very active and cooperation on cowpeas and alley cropping, to cite just two, has been less than desireable.

The French have recently set up a research and networking system for West Africa, CORAF. It supports a principal research station in the region for each of the main commodity systems. Senegal has three of the stations - peanut research at Bambey, irrigated corn research at St. Louis and horticultural research at Cambérène outside of Dakar. The concentration of research resources and network facilities is a potentially valuable complement to ISRA's national program.

In sum, important linkages with external research organizations already exist and improvements in the quality of selected linkages could pay big dividents.

Research-Extension Linkages

This vital link has been extremely weak in the past. It is the subject of the discussion that follows. It is worth noting that the World Bank's new $18.5 million agricultural research project addresses this issue in two ways:

1) It will finance facilities and operating costs to enhance ISRA's capacity to produce extension material; and

2) "Program contracts" with extension agencies to carry out adaptive research programs, jointly managed by ISRA and extension, will also be financed.

Conclusion

From the foregoing analysis, we may conclude that ISRA has the potential to become a viable, productive national agricultural research system. It possesses important assets that make this possible including: 1) a sufficiently large, diverse and well-trained scientific staff relative to its research mandate; 2) a well-established research program which addresses the principal commodities in the major ecological zones. In many cases, these programs are built on sound definitions of basic priorities and problems thanks to the growing acceptance of farming systems methodology; 3) the infrastructure is in place (though deteriorating) to deal with all major commodities in all major ecological zones.

In addition to these assets, ISRA is committed to essential institutional reforms thanks to enlightened leadership which has launched a participatory process engaging its own staff. It has also reached out to cultivate understanding and political support from its own ministry as well as representatives of other ministries (Finance and Planning) and the Presidency. Thus the politics of reform have been well engaged.

Notwithstanding these considerable institutional assets and political commitment to reform, ISRA faces significant challenges, the most urgent of which are: a financial crisis which destabilizes both the institute and its program and a set of financial, research and personnel management issues that must be addressed to make the institute viable, effective, productive and efficient. The feasibility of meeting these challenges with successful institutional reforms depends on the actions of not only ISRA but the government and ISRA's principal donors as well. From the government, ISRA requires stable, secure funding over the long run; current levels of approximately $6 million (FCFA 1.47 billion) per

year are adequate. From the donors, ISRA needs continued and stable financing consistent with ISRA's research priorities, continued technical assistance but increasingly programmed as short-term and intermittent rather than long-term, judicious technical assistance for its institutional reforms, and finally, increased flexibility on the part of donors regarding the financing of indirect costs and short-term contract staff.

With this kind of support, prospects for ISRA to evolve into a viable and productive national research system are good. It must be recognized that there are no realistic alternatives to ISRA for generating the technology required to increase agricultural productivity which lies at the core of Senegal's development challenge. The International Agricultural Research Centers and other external research institutions cannot conduct the adaptive research that must be done in Senegal. While they may be invaluable partners, providing genetic material, research findings and methodological assistance, they can only complement the national program. This principle has been widely validated throughout the world. Nor is the private sector a candidate to assume the burden of conducting Senegal's crop, forestry, fishery and livestock research. Several private voluntary organizations have demonstrated an interest and capacity to undertake useful but very finite research (e.g., on-farm seed storage, etc.). The commercial private sector which is engaged in input production is small and the market is extremely limited for fertilizer, seeds, pesticides and farm equipment. While the two principal companies engaged in production of these inputs do make modest investments in developing and validating their recommendations for seeds, fertilizer, etc., the scope for expansion is limited. More fundamentally, most of the priority research agenda involves agronomic research on cultural practices, resource management (agro-forestry, water harvesting, watershed management, etc.) and social and economic issues. This kind of research must be supported by the state because it does not afford the private sector the opportunity to develop marketable products. Finally, there is no potential for establishing a private research foundation (as has been done in Latin America and Asia). There is no constituency in Senegal to finance such a foundation either directly or through contract research. (Elsewhere associations representing large commercial farmers have financed meaningful research, though never the entire national system). Small, near-subsistence farmers cannot and will not bear the costs of research. The only other community of interest, the donors, is unlikely to be interested in this idea as it offers no advantages to direct support under the present circumstances. Thus, there are no plausible alternatives to building a viable national agricultural research system to deal with the central challenge of Senegalese agricultural development. However, the task is feasible if the challenge of continuity, coherence and stability is met.

Agricultural Extension

Overview

This section of the institutional analysis provides an overview of the extension institutions in Senegal, including governmental and non-governmental agencies, as well as extension linkages with research. Availability of appropriate technologies to extend are considered in Annex VII which contains an inventory of technologies available to Senegalese farmers. It is a fact that technologies exist in Senegal that could improve agricultural and animal production, but constraints arise in the availability of information at the farm level and in the evaluation of proposed technologies versus the dynamics of farmer adoption and risk assessment.

Agricultural extension in Senegal dates back to the 1940s at which time all extension activities were the sole responsibility of the Ministry of Rural Development. Currently the responsibilities for agricultural extension are divided among two ministries (Ministry of Rural Development and Hydraulics, and Ministry of Animal Resources), which include four Regional Development Agencies (Société Régionale de Développement Rural), and ten Regional Offices of Agriculture, Livestock, and Water and Forests. While the Ministry of Interior is not responsible per se for agricultural extension, many local level extension agents are located administratively within the Ministry of the Interior. This anomaly is a major obstacle in establishing an effective national extension service.

The activities of the 'traditional' governmental extension services (regional offices of agriculture, livestock, and forestry) are not well coordinated with the RDAs. RDAs are dependent upon donor financing, which in recent years has become increasingly scarce, leading to irregular and inconsistent extension activities. Dependent upon the meager resources of the government budget, the 'traditional' extension services are inoperative for most of the year. The extension agents of the Direction of Agriculture collect statistics and crop production data during the agricultural season, but due to lack of mobility, rarely work directly with farmers in most areas of Senegal. Livestock agents are active only during the months of the annual vaccination campaign (January-March/April), but like agricultural extension agents, lack mobility (vehicles/motorcycles and gas) for most of the year. Water and forestry agents have the mandate to police and control forests, and only recently have been given an extension role.[25]

Since 1987 the World Bank has been working with the Government of Senegal (GOS) to design and implement a program that will reform and reanimate the government extension services. The pilot project (Programme Pilote d'Amélioration des Services d'Appui aux Agriculteurs -- PAGRI) was followed by the Programme National De Vulgarisation Agricole (PNVA) which began implementation in July 1990.

In addition to the RDAs and the traditional extension services, many non-governmental organizations (NGOs), both Senegalese and international, work in agricultural extension and technology transfer. Farmer groups (GIE - Groupement d'Interêt Economique), NGOs as well as CERP (Centres d'Expansion Rurale

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[25] Morize, J., and Sergi, P., Diagnostic et Perspectives de la Vulgarisation Au Sénégal. FAO, Rome, April 1989.

Polyvalente[26]) and Maison Familiale Rurale are located administratively under the Ministry of the Interior.

Extension Institutions

Ministry of Rural Development and Hydraulique (MDRH) has overall responsibility for agricultural production in Senegal. Other ministries, notably Ministry of Animal Resources, and the Ministry of the Interior, have some responsibility for extension and rural development. The MDRH has four departments: (1) agriculture, (2) water and forests, hydraulics, and crop protection. The Minister also oversees four RDAs (SODEVA, SAED, SODEFITEX, SODAGRI); the peanut oil processing parastatal, SONACOS; the national agricultural research institute (Institut Sénégalais de Recherches Agricoles - ISRA); and several donor projects. MDRH is currently being reorganized with a proposal to create the position of Rural Development Manager in each of Senegal's ten administrative regions who would be responsible to the Minister for the MDRH activities in each region.

The Direction of Agriculture (DA) has five divisions: administration and finance; soils; horticulture, actions and programs; agricultural statistics; and seeds. DA has a total technical staff of approximately 470, including field staff. In the field, the DA is represented in each of the 10 regions by a regional officer, who operates under the direct authority of the Director of Agriculture. Each regional office is subdivided into sectors at the district level, and field level staff are located at the arrondissement and sometimes at the rural community level. It is worth noting here that a sizable number of local level agricultural extension agents (as well as water/forestry and livestock agents) are located within the CERPs (Centres d'Expansion Rurale Polyvalente). Although these agents remain agents of the Direction of Agriculture, they work under the supervision of the sous-préfet, and not the sector agricultural officer.[27]

Until recent years, graduates from the agricultural training schools were automatically absorbed into the civil service. Also until recently, many of the civil servants destined for the MDRH were seconded to the RDAs to work in specific development projects. However, this is no longer feasible as the RDAs have increasing financial difficulties as their scope and functions have been drastically reduced as part of the NPA.

Water and Forests. Traditionally, forestry agents have seen themselves protectors of the forest against the malicious actions of the population. Their duties included the issuance of permits for tree cutting, movement of wood and wood products, and issuance of hunting permits. Only in the past five to ten years have forestry agents begun to work with rural populations in forestry

[26] Center for Polyvalent Rural Expansion

[27] See further discussion of this anomaly under the section Ministry of the Interior.

management. Although some change has taken hold, overcoming entrenched institutional attitudes will take considerable time. It is possible, however, "that forestry extension services could shift from control and policing to a service with a development orientation"[28].

Recent reorganizacion of two GOS Ministries makes possible the eventual re-orientation required if forestry extension is to have an impact in Senegal. In March, 1990, two Ministries were entirely eliminated and the important functions assigned to two directions (for natural parks and the environment) were given to the new Ministry of Tourism and the Environment. A new direction was transferred to the new Ministry of Rural Development and Hydraulics. This direction entitled, Direction for Forestry, Fisheries and Wildlife, included the work previously assigned to the Direction for Reforestation and Soil Conservation. This reorganization may help eliminate three persistent problems faced by the Direction of Water and Forestry: i) the lack of coordination between technical services (In the Peanut Basin during the Agricultural Program of the 1960s and 1970s, agricultural extension agents insisted that farmers remove Acacia albida seedlings in their fields, while forestry agents were (and continue to be) charged with expanding the regeneration and protection of A.albida in farmers' fields.); ii) the lack of coordination among development projects; and iii) the failure of the administration to consider the needs of villagers in planning, administering and management of forestry projects. Numerous reforestation projects are recognizing the need for greater involvement of forestry agents and have included additional training and traditional extension functions in planning project interventions.

Of the estimated 900 total personnel in the Direction of Water and Forestry, there are approximately 450 agents (chef de brigade and chef de triage - Agent Technique des Eaux et Forets-level training). At the ten Regional Inspection Offices there are an additional total of 40 agents including some support staff and 30 Chef de secteur.

The Sociétés Régionales de Développement Rural (Regional Development Authorities - RDAs) are: a) SAED for irrigation development in the Senegal and Falémé River Valleys; b) SODEFITEX for cotton development in Eastern Senegal; c) SODEVA for agricultural development in the Peanut Basin; and d) SODAGRI for irrigation development in the Upper Casamance. In 1990, SOMIVAC, the RDA for regional development planning in the Lower Casamance, was dissolved and SOMIVAC's regional responsibilities were taken over by DERBAC, a project financed by the African Development Bank. RDAs, until the New Agricultural Policy (NPA) was announced in 1984, were responsible for a wide range of services in the agricultural sector, including input and credit supply, technical assistance, extension, and marketing. The mandate for each of the RDAs is defined in "Lettres de Mission" which sets forth terms of financial and managerial autonomy for the RDA. Most donor assistance in agricultural development has been through projects with the RDAs. During the 1970s, the RDAs grew with the influx of donor investments, resulting in staff that was relatively well paid and equipped, especially when compared to the tradition services. After the NPA, as GOS policies changed to remove input subsidies and to privatize many of the RDA activities, the unsustainability of the RDAs dependent on external financing became apparent. Only SODEFITEX generates some of its own resources through

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[28] Deneve-Steverlyck, 1982; and Catterson, 1984, as quoted in Senegal Natural Resources Management Assessment, Louis Berger International, Inc., 1990, p.132.

cotton exports, but these resources are likely to diminish as subsidies are removed and as markets are liberalized. The uncertain future of the RDAs and their personnel has led to extension services that are uncoordinated and disparate as training, transport, and incentives for extension agents become rare, and to extension personnel who are unmotivated.[29]

SAED was established in 1965 as a public enterprise to plan and manage irrigation development along the Senegal River Valley. Since 1981, SAED's role and functions has been defined in three-year performance contracts with the government (Lettre de Mission). Under the third 'Lettre de Mission' SAED will progressively abandon its auxiliary production activities and concentrate on irrigation infrastructure development and technical advice to farmers, including technical, management and literacy training. SAED also coordinates twelve separate donor projects. Because its mandate is irrigated agriculture, SAED's extension agents only advise farmers and farmers' groups involved in irrigated agriculture. Weaknesses of the SAED extension system are a) lack of well-trained technical specialists to link research and extension, give technical training to field agents, and monitor and evaluate extension packages; b) lack of infrastructure development and production packages that make irrigated agriculture along the Senegal River Valley economically viable; c) lack of coordination between SAED, donor projects and NGOs, between SAED and ISRA, and between SAED and the traditional extension services.

SODEVA was established in 1968 to provide extension services in the Peanut Basin. SODEVA once had the staff (2000 people) and financial capabilities to cover the entire Peanut Basin, but in recent years, its resources have been so reduced that it is practically non-functional. Compounding the institutional problems of SODEVA, changing agroclimatic conditions, soil degradation and deterioration of the world peanut market have had profound effects on this region of Senegal. SODEVA has benefitted from the availability of technical packages generated from the research conducted at ISRA-Bambey, but in recent years has lacked the technical and logistical capability to extend or to adapt these packages to the changing agroclimatic and soil conditions. The waning of SODEVA has allowed NGOs and donor projects to take the lead in agricultural extension activities in the Peanut Basin.

Farmers who work with SODEFITEX have benefited from an extension service that functions and produces results. The keys to this success have been the vertical control of the production and marketing of cotton, close ties to research, and motivated farmers' groups (Association de Base des Producteurs - ABP). SODEFITEX has approximately 150 extension agents (down from a high of 350) and their main responsibilities are to diffuse technical packages and to train producer groups (agricultural and literacy training). Some extension agents are trained under a contract with the Ecole des Agents Techniques d'Agriculture[30] in Ziguinchor. During the off-season, SODEFITEX also has a permanent system of training and upgrading the skills of its extension agents. Extension agents are supervised by highly trained section chiefs (ingenieur agronome). Drawbacks of the SODEFITEX system are a) only cotton farmers can

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[29] World Bank, Staff Appraisal Report, Senegal, Agricultural Services Project, February 1, 1990, pp. 4-6.

[30] The school for Agricultural Agents provides basic technical training for agricultural extension agents.

benefit from the extension services of SODEFITEX, which includes technical packages for all agricultural production in the region; and b) the future of the SODEFITEX system is dependent upon GOS cotton policies and the world market for cotton. Given the current depressed world market for cotton, SODEFITEX has had to reduce its personnel and activities.

SODAGRI's (Société de Développement Agricole de l'Anambé) area of intervention is limited to the Anambé basin in the Upper Casamance (Departments of Kolda and Velingara). SODAGRI concentrates its extension efforts on rice cultivation (both irrigated and rainfed) and rainfed cereals (millet, sorghum, corn). Approximately 30 persons are employed by SODAGRI, including 13 village extension agents.

The Casamance. SOMIVAC (Société Régionale de Mise en Valeur de la Casamance) was responsible for rural development in the Casamance until 1990 when the National Assembly voted SOMIVAC out of existence. While there is currently no RDA in the Casamance, projects (notably, DERBAC - Projet Autonome de Développement Rural de Basse Casamance, African Development Bank financing); and PRIMOCA (Promotion Rurale Intégrée en Moyenne Casamance, Italian financing) have assumed some of SOMIVAC's former responsibilities. DERBAC encompasses the Ziguinchor region (Departments of Oussouye, Bignona, and Ziguinchor) and PRIMOCA covers the department of Sedhiou. In recent years, a large number of local NGOs have been created which organize farmers. Association des Jeunes Agriculteurs de la Casamance (AJAC) consists of 600+ farmers' groups (approximately 100 members per group). While projects and NGOs are working directly with farmers, the ISRA/Djibélor researchers, facing their own budgetary and logistical constraints, are coordinating their efforts with projects and NGOs. In the Casamance as compared to other regions of Senegal, the linkages between research (ISRA) and those performing agricultural extension services are strong. Part of the credit for the strength of these linkages goes to the former USAID-financed Agricultural Research and Planning Project, which focused on research that addressed farm-level constraints.

The Niayes. No RDA exists for the Niayes zone, where horticulture is the major agricultural production. The Centre pour le Développement de l'Horticulture (CDH), which is part of ISRA, conducts research, promotes, and trains farmers and extension agents in horticultural techniques for the zone. Agricultural extension in the Niayes is conducted by the traditional services (Direction of Agriculture of MRDH and CERP), as well as numerous NGOs and projects active in the area. While most horticultural production in the Niayes is on very small plots (less than one hectare), a few private producers are cultivating and exporting vegetables from much larger areas (notably, Ranch FilFili and SEPROMA (Société d'Etude et de Promotion des Cultures Maraichères).

The sylvo-pastoral zone contains approximately 20% of the land mass of Senegal, but only 4% of the arable land and 6% of the population. Extensive livestock production systems (carrying capacity of one head per 6-7 hectares) provide a livelihood for the population. Extension services for herders has been provided by an RDA, the Direction de l'Elevage, and various donor projects. SODESP (Société de Développement de l'Elevage dans la Région Sylvo-Pastorale) was the RDA from 1985 until 1989 and provided extension services for herders in the sylvo-pastoral zone. SODESP focused its efforts solely on meat production, ignoring the importance of milk production in the livestock production system. In addition to SODESP, the Offices de l'Elevage have concentrated/limited their extension efforts to veterinary health (vaccination services and treatment of

disease) and not improved management of the livestock production systems. PDESO (Projet de Développement de l'Elevage au Sénégal Oriental), PARCE (Projet Aménagement et Reboisement du Centre-Est) and PICOGERNA (Programme Intégré de Gestion des Ressources Naturelles) are projects that concentrate on animal and/or agricultural production, natural resource management, and functional literacy. For an area as vast as the sylvo-pastoral zone, the extension personnel has been very limited. In 1988, SODESP had only 43 extension agents, of which 26 were trained to the minimum level (ATE) or higher (see below). PDESO had 54 extension agents, 38 of which were hired to teach functional literacy.

During the 1980s as the responsibilities of the RDAs expanded, the role of the Direction of Agriculture diminished in agricultural development and extension. While the Direction of Agriculture no longer had responsiblity for field-level implementation of agricultural projects and programs, it still retained field staff nationwide. Other government departments (Animal Resources, Forestry, Water Supply) retained, at the same time, considerable responsiblity for project execution.

Ministry of the Interior. At the local level, the Ministry of Interior regroups staff from various government departments into Polyvalent Rural Development Centers (Centres d'Expansion Rurale Polyvalente - CERPs). CERPs exist in all 90 districts of Senegal, but are essentially nonfunctional due to a lack of clearly defined objectives, technical competence, and operating funds. However, it is important to note that many of the village level extension agents (agriculture, livestock, forestry, health) work within the CERPs, which means that the local level extension agents work under the supervision of the Sous-Préfet and not of the Regional Officer. The extension agents "detached" from the Direction of Agriculture work with farmers (when transportation is available) and, during the growing season, collect agricultural statistics from the arrondissement. However, these same agents collect taxes and oversee voting during elections. The fact that farmers are wary and distrustful of extension agents is not surprising. Neither is the lack of motivation on the part of the agricultural extension agents to do extension.

The Ministry of Animal Resources (MRA) is responsible for animal health services and livestock development at the national level. The Minister oversees two departments (livestock and oceanography/fisheries), and various projects.

The Direction of Livestock (Direction de l'Elevage - DE) includes four technical divisions: studies and programming; economics and animal production; pastoral and extension; and animal health. In the field, the Direction of Livestock is represented in each region by a regional officer of livestock, who operates under the authority of the Director of Livestock. Each regional office is subdivided into 30 subsections, each having several veterinary posts. In Senegal there are 200 veterinary posts. The technical staff of the livestock department consists of 545 livestock officers, of which 101 are intermediate level staff (Ingenieur de Travaux d'Elevage - ITE) and 444 are technical agents of livestock (Agent Technique d'Elevage).

The DE's major activity is control of the major endemic cattle diseases (rinderpest and pleuropneumonia). Field staff are occupied for 2-3 months of the year during vaccination campaigns. Because of shortage of funds and thus mobility, and because of an orientation towards preventative animal health, visits to herders by field staff are limited.

In sum, a variety of extension institutions and trained agents exist in Senegal. The major drawback is that all of the governmental and parastatal institutions do not add up to an effective extension service. The general malaise that permeates Senegalese governmental agencies and parastatals (lack of operating budgets and thus, mobility; lack of motivation among the agents, etc.) effects the extension services, resulting in trained extension agents who are inactive for most of the year. The historical pattern of agricultural extension in Senegal has been very top-down in approach. Government development objectives and donor projects based on these objectives quite often do not meet the needs of the rural populations. Farm-level decisions have been made 'for' the farmer and not 'by' the farmer or even with farmer input. The problem of stagnate or declining agricultural production and part of the solution has to be found at the farm level.

Agricultural Education.[31] Under the Ministry of Work and Professional Training, Senegal has seven agricultural schools which offer three levels of training -- equivalent to secondary, junior college, and university training. Four agricultural schools (located in Ziguinchor (agriculture and forestry); in St. Louis (livestock); and in Dakar (horticulture)) train extension agents and lower level staff of ministries and other parastatals to the basic level (Agent Technique d'Agriculture-ATA; Agent Technique d'Elevage-ATE; Agent Technique d'Horticulture-ATH; and Agent Technique des Eaux et Forets-ATEF). These three schools are secondary schools, providing three years of training following lower secondary education. The Ecole Nationale Des Cadres Ruraux (ENCR) in Bambey trains middle level field officers to an intermediate level (Ingénieur des Travaux-ITA), representing post-secondary training (BAC plus three years). Technical assistance to the schools training lower and intermediate extension agents is provided by the Swiss government. A bilateral Senegalese-Swiss agreement also provides technical assistance for in-service training and recycling of extension agents through the Centres d'Appui pour le Recyclage des Agents Techniques (CARAT) et des Ingénieurs des Travaux (CARIT).

University level training is offered by INDR and EISMV. The Institut National de Développement (INDR) in Thiès trains professional agriculturalists, 'ingenieurs agronomes', (BAC plus five years). The Ecole Inter-Etats des Sciences et Médécines Vétérinaires (EISMV) in Dakar trains veterinarians.

A major weakness of agricultural training in Senegal has been that it is geared exclusively to train individuals for the government civil service. Enrollment in the agricultural training schools is set according to the projected needs of the civil service, which given the current budgetary constraints reduces the number of students and therefore under-utilizes the facilities of the schools. Another drawback to this system is that graduates are assured employment irrespective of performance.

While the traditional extension services are staffed with graduates of the agricultural training schools, the RDAs employ and train their own extension workers. Except where government agents from the traditional services have been seconded to a RDA, the level of training for the extension agents of the RDAs is below that of the ATA. Field extension workers for the RDAs have been

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[31] Kohli, D. and Ittah, J.D., Horizon 2000: Ressources Humaines pour le Développement Rural du Sénégal. Union Mondiale ORT, Geneva, May 1988.

recruited with primary or secondary school education and trained on-the-job[32]. SAED has its own training division to train agricultural advisors ('conseillers agricoles'), each of whom have responsibility for 500 hectares of irrigated perimeter and work under the directors of the irrigated perimeters in each of SAED's four operational zones. SODEVA, whose staff once numbered 2,000 in the late 1970s, now has a field staff of approximately 150, and of these 150 extension agents, preference has been to retain those agents with at least the educational level of the ATA. In 1968, SODEVA established its own training center, CETAD (Centre d'Entraide aux Techniques Agricoles de Développement). Since 1978, CETAD has served as a training center for the RDA personnel. CETAD has three divisions (Training/Studies/Advice, Audio-Visual, and Literacy) and one experimental field. Only SODEFITEX has a contract with the agricultural training school in Ziguinchor and trains some of its extension agents to the ATA level.

Linkages with Research. ISRA's role in agricultural extension is to diagnose farm-level constraints, to develop and validate technologies, and to deliver these extension recommendations to the extension services (including government and parastatal agencies, PVO/NGOs, private individuals). The extension services then transfer the technologies to farmers, and ISRA participates in farmer evaluation and feed-back. While ISRA has developed and tested varieties and/or cultural recommendations for the major cereals and vegetable crops in Senegal, most of these technologies do not reach farmers. Linkages between research and extension have been a major weakness in improving agricultural production in Senegal and the genesis of this weakness lies both within ISRA and between ISRA and farmers.

The sources and causes of the weak research-extension linkages are numerous, and some predate ISRA's birth as the Senegalese national agricultural research system. When ISRA was created in 1974, it inherited a research system originally established by the French (Institut de Recherches Agronomiques Tropicales et des Cultures Vivrières) to support peanut production for export. The legacy of crop research focussed on varietal improvement with purchased inputs, soil research focussed on typing soils and not the soil dynamics under crops, tree research focussed on testing exotics rather than local species, and reluctance to publish research results is traceable to ISRA's French origins. For example, as the crops research program expanded to include other crops besides peanuts, the emphasis for researchers (both French and Senegalese) has been to produce improved varieties that performed well on-station with purchased inputs. After varieties have proven themselves on-station, they are tested in multi-locational trials under controlled conditions.[33] In the past, once varieties performed well on-station and in PAPEMs, breeder seed was produced and turned over to the seed service (Direction of Agriculture) for multiplication and distribution. The fact that some of ISRA's varieties did not perform well on farmers' fields is not surprising because the varieties had not been tested and evaluated under farmer conditions.

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[32] Certain donor projects have worked to correct this problem by offering special technical training to RDA personnel in Senegal or elsewhere.

[33] ISRA has a system of PAPEMs (Pointe d'Appui pour Expérimentation Multilocale) or experimental test areas in several different locations around Senegal. Experiments conducted at PAPEMS is essentially on-station research, changing only climatic and soil conditions. ISRA tends to equate results from PAPEMS with on-farm trials, which is erroneous.

ISRA, with donor assistance[34], has rectified some of the shortcomings in research program priorities and execution. The creation of the Production Systems and Agricultural Economics Research Department in the early 1980s has contributed to a reorientation of research programs. Given that the farming systems approach to research at ISRA is recent and that the crop-specific research programs at ISRA are the oldest and most entrenched, a lack of coordination between crop-specific and farming systems research programs in the beginning was inevitable. Responding to criticism of crop-specific research results that did not address farm-level constraints identified by farming systems research, ISRA administration and researchers are working to improve this situation. With the current environment of limited research budgets, researchers are being forced to cross departmental lines and coordinate their research programs.

Also there is a growing demand for ISRA to produce extension recommendations that are 'farmer-ready', meaning tested under farmer conditions and presented in a form that is readily understandable and useable by technology transfer agents (both public and private). ISRA researchers have only recently been requested by donors and NGOs to translate research results into extension recommendations and publish them.[35] For publications ISRA possesses within UNIVAL[36] the capability and equipment to produce extension materials and informational bulletins on a large scale. Budgetary constraints and centralization of the publications unit limit UNIVAL's effectiveness. Once a researcher reaches the point of having extension recommendations to publish, obstacles arise that can delay the publication of the extension recommendations by a year or more.

Once extension recommendations are published or breeder seed grown, diffusion is the next hurdle. ISRA's mandate is to produce and evaluate the cultural recommendations, seed varieties, vaccines, etc., based on diagnosed problems at the farm-level. ISRA's connections with extensions entities (public or private), farmer groups and farmers is quite variable from region to region. At the highest levels, ISRA has a governmental consultative commission, composed of representatives from the Ministries of Rural Development and Hydraulics, and Animal Resources, the RDAs, and the regional offices of agriculture and livestock. This commission meets twice a year to discuss research priorities and coordination between research and extension. At the regional levels, ISRA, the RDAs and the regional offices of agriculture and livestock meet to discuss regional priorities and coordination. These meetings, while attempting to coordinate governmental actions, have little impact on farmers. While recognizing ISRA's problems in getting the extension recommendations out its door, once 'delivered' to the Directions of Agriculture and Livestock, and to the RDAs, their capacity to deploy the recommendations effectively is limited.

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[34] The AID-financed Agricultural Research and Planning Project and the World Bank's First Agricultural Research Project were instrumental in the creation and orientation of the Production Systems and Applied Economics Research Department.

[35] Morize, J., and Sergi, P., Diagnostic et Perspectives de la Vulgarisation Au Sénégal. FAO, Rome, April 1989.

[36] Unité de Valorisation.

There are encouraging signs that information is reaching farmers. ISRA researchers have been sought out by farmers, farmer groups and NGOs to provide training and advice on varying cultural and animal production techniques. Even with limited budgetary resources, individual researchers are seeking out cooperating farmers or farmer groups with whom to test and evaluate recommendations. Examples of this are a) the Peace Corps/Winrock On-Farm Seed Project/ISRA[37] effort that has conducted on-farm rice and millet trials in the Southern Peanut Basin and Casamance; b) the ISRA/CADEF[38] which builds on a relationship by the ISRA Productions Systems Research Team started during the AID-financed Agricultural Research and Planning and the Casamance Regional Development Projects; and c) the ISRA collaborative research program in the Thyssé-Kaymor watershed management area. All three are examples of participatory technology development: the farmers play the central role in the identification of constraints, testing of the proposed techniques, evaluation and diffusion (to other farmers in the area) of the results.

The World Bank-financed extension project (PNVA) defines ISRA's roles to execute on-farm trials, and to train subject matter specialists. (This project will be discussed later). The World Bank-financed Second Agricultural Research Project, which is being negotiated with the GOS, includes financing for other research costs as well as funds to publish extension documents and technical guidelines. Within PNVA one member of the Extension Management Unit, which coordinates project actions, was seconded from ISRA to coordinate research and extension linkages. PNVA is working to close the gap between farmers and sources of information, encouraging feed-back from the farmers through extension to research and vice versa.

As previously stated, research-extension linkages have been very weak. The information flow between ISRA and farmers (the intended users of the recommendations) has great potential for improvement because 'farmer-ready' technologies as well as the capacity to improve the flow of information already exists.

Non-Governmental Organizations and Private Voluntary Organizations. Annex VI lists fifty-five officially recognized Senegalese and international NGO/PVOs working in agriculture or natural resource management in Senegal. A growing movement of farmer organization also exists and is gaining momentum. A discussion of the farmer organizations will follow this section. The agricultural activities of the NGOs are as varied as the NGOs themselves, however some NGOs do work closely with government extension agents and ISRA in defining and implementing their programs. One notable example (as mentioned above) is the efforts of Winrock International's On-Farm Seed Project that works with the Peace Corps, World Vision and ISRA in executing on-farm verification trials for varieties and cultural techiques proposed by ISRA, as well as training for farmers in rainfed cereal (including peanuts) seed selection and storage.

Many local NGOs have only recently been created, therefore, judgements of institutional capacity and sustainability may be premature. Of the international

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[37] Osborn, T., Multi-Institutional Approaches to Participatory Technology Development: A Case Study from Senegal. Overseas Development Institute, London, June 1990.

[38] Comité d'Action pour le Développement du Fogny, a farmer group with members from 25 villages in arrondissement of Sindian, Bignona Department, Ziguinchor Region.

PVOs, some coordinate their efforts with the Direction of Agriculture/Livestock and ISRA, whereas others have discounted the effectiveness of the public extension services and focus their efforts on farmers and farmer groups.

PNVA -- Programme National de Vulgarisation

In 1987 the GOS began discussions with the World Bank concerning the issue of agricultural extension and in light of the waning RDAs, how to improve/reanimate the traditional GOS extension services[39]. The result of these discussions became PAGRI (Programme Pilote d'Amélioration des Services d'Appui aux Agriculteurs). While originally intended to reanimate the traditional extension services (Inspections Régionales de l'Agriculture et l'Elevage), the GOS decided that PAGRI would involve three RDAs (SAED, SODEVA, and SOMIVAC) to cover their different geographical zones. ISRA provided the technologies to extend. The 'training and visit' (T&V) extension methodology was chosen for use in Senegal. In the T&V extension methodology, constraints to agricultural (or livestock) production are diagnosed by researchers with input from farmers and extension agents, extension agents are trained in the appropriate techniques by subject-matter specialists, the appropriate techniques are proposed for testing on small plots by farmers, extension agents visit farmers on a regular schedule (weekly or biweekly) throughout the growing season, extension agents are trained/visited on a biweekly by their supervisors. In sum, farmers and extension agents are trained and in turn, farmers are visited. Monitoring of the T&V system is focused on adoption rates of technologies on test plots the first year and on finding out whether farmers continue using these technologies on a larger scale in subsequent years.

In December 1988/January 1989, PAGRI was evaluated by the Ministries of Rural Development and of Planning. The results of this evaluation were positive and thus, became the basis for the PNVA However, the evaluation of PAGRI was completed <u>before</u> all the results of the first two year's activities were available. Thus, the evaluation was based upon on-farm trials, reported as PAGRI results, but which are actually the results from the ISRA-Djibélor Production Systems Research that was conducted during the USAID-financed Agricultural Research and Planning and the PIDAC Projects. Nevertheless, the on-farm trial results were positive whether the T&V system was used or not. The SODEVA and SAED results in collaboration with ISRA-Bambey and St. Louis were not positive, and met institutional as well as methodological obstacles. Major recommendations by the evaluation report were: a) the necessity of clearly defined contractual relationships for the participating institutions with the management of PNVA; b) the urgent need for training of extension agents at all levels to understand extension methodology and the scientific basis for the proposed techniques to be extended; c) the need to adapt the work schedules of extension agents and supervisors to correspond with the different seasons; and d) the need for

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[39] Sources for this section are:

- MDR, "PAGRI: Alternatives de stratégies pour un programme national de vulgarisation agricole". MDR. October 1989.
- ____, "Programme National de Vulgarisation Agricole," Document de Projet, MDR, Dakar, Senegal, 20 Mars 1989.
- ____, "Rapport d'Evaluation du Programme Pilote d'Amélioration des Services d'Appui aux Agriculteurs (PAGRI)," MDR, Dakar, Senegal, March 1989.
- MDRH, PNVA, Programme Technique, MDRH, Dakar, August 1990.
- World Bank, Staff Appraisal Report, Senegal, Agricultural Services Project, February 1, 1990.

increased flexibility in the use of external funds that would allow for prefinancing of expenditures. Subsequent to the PAGRI evaluation, results of the 1988 PAGRI on-farm test plots versus controls were reported to show an average yield increase of 50% for millet and rice, and 25% for peanuts and cowpeas.

PNVA is the first four-year phase of a long-term program with the objective to improve agricultural extension services to farmers and herders. Total financing for PNVA is $20.2 million of which the World Bank provided a $17.1 million loan to the GOS and the GOS is to contribute $3.1 million. PNVA started officially on July 6, 1990. According to the World Bank project document (February,1990), PNVA

> would have one principal component, namely improvement of crop and livestock extension services, based on lessons learned during pilot operations undertaken for two years; systematic in-service training of extension staff at all levels, formal research/extension linkages, and careful implementation and effectiveness monitoring would be key ingredients to this component. The project would have two secondary components: (i) strengthening of producer organizations through training and (ii) short-term consultancies in policy formulation, project preparation and appraisal, and performance monitoring. The project would provide funding for vehicles, equipment and modest infrastructure, manpower development and training costs, and operating costs.[40]

The beneficiaries of PNVA will be farmers and herders (60% of the rural population) who will be reached by improved crop and livestock extension services. The main benefits of PNVA are expected to be:

> a) increase crop and livestock output; b) increased autonomy and self-reliance of farmers' and herders' organizations due to functional literacy and management training; c) more effective identification, testing and documentation of new techniques due to the training of large numbers of staff in communications and management skills as well as technical matters; and d) institutional strengthening by building up the capacity of the Agriculture and Livestock Departments to provide extension services, and enhancing MDR's analytical capacity.[41]

While the first World Bank project documents make the case for reanimating the Agriculture and Livestock Departments, the GOS has continued to include RDAs as part of PNVA. The World Bank and the GOS agreed that limited RDAs (SAED and SODEVA) will be included during the first phase of PNVA and their involvement will be evaluated before continuing. The World Bank Staff Appraisal Report (Feb. 1990) and the PNVA technical program for 1990/91 (dated August 1990) states the following objectives for PNVA:

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[40] World Bank, Staff Appraisal Report, Senegal, Agricultural Services Project, February 1, 1990, p. iv.

[41] ibid.

- to reinforce the national capacities in the areas of planning, programming, coordination, monitoring and evaluation of agricultural extension;
- to reinforce the Agriculture and Livestock Departments so that they can progressively take charge of agricultural extension functions;
- to improve the extension activities of the RDAs;
- to reinforce farmer organizations; and
- to create a policy analysis unit within the MDRH.

National management of PNVA or the "Extension Management Unit" consists of five professional staff: a director, a research/extension specialist, a training specialist, a person responsible for farmer organizations, and a monitoring/evaluation specialist. Three of the five members of the current extension management unit, including the national director, were formerly SODEVA staff. The national director is supervised by the MDRH Director du Cabinet.

The field extension staff is organized in four levels: the field extension agents (conseiller agricole); field supervisors; regional coordinators; and subject matter specialists (SMS). Principles of the T&V system are to be closely adhered to and include: a) establishing and adopting a time-bound and supervised work program at all levels; b) regular and continuous training of staff at all levels; and c) strengthening the linkages between research and extension. PNVA utilizes existing extension and research staff, creating only the extension management unit to manage the program. To more efficiently use existing extension agents, PNVA will also train extension agents to be polyvalent, which means that livestock agents will be trained to give advice on crop production and vice-versa. Extension agents will also teach functional literacy to farmers. Subject matter specialists from Direction of Agriculture will provide support for the field level staff of the DE, and DE will provide backstopping for Direction of Agriculture. Farmers will work with one extension agent for their farming system. By the end of year four, PNVA will cover approximately 50% of Senegal's geographic area which includes 60% of the rural population. Table 10 summarizes the geographic areas of intervention and Table 11 summarizes the PNVA extension staff for 1990/91.

PNVA will provide field extension agents and their supervisors from Direction of Agriculture and DE with motorcycles and monthly allowances for the operation and maintenance of their motorcycles based on their workloads. Each regional inspection of agriculture and livestock will be provided a pick-up truck. During the first four-years of PNVA, approximately 500 motorcycles, 13 trucks, 6 cars and 2 four-wheel drive vehicles will be purchased. PNVA will also finance the renovation of regional offices of agriculture and livestock, and the purchase of office furniture. Commodities for the participating RDAs are not mentioned in the PNVA project document.

In conclusion, PNVA has a string of difficult tasks ahead of it: reanimating a lifeless public extension service; improving technical and communication skills of extension agents; improving communication among the different technology transfer agents and farmers; formalizing research-extension linkages; and strengthening of producer organisations by direct training of their leaders and through adult literacy training. As PNVA is just beginning,

it is difficult to predict its prospects for significant improvement of the current extension situation. The sustainability of an extension service that is donor-driven can be questioned, however the World Bank is making a concerted effort to strengthen the institutional basis for an extension service that is, and will remain, part of the government structure. PNVA is trying to correct the administrative anomaly of the local level extension agents being responsible to the Ministry of the Interior, insisting that these agents be detached from the CERPs, and work under the supervision of the sector agriculture, livestock, or water-forestry officer. Also it is too early to assess the effectiveness and the potential for success of the 'training and visit' extension methodology in Senegal. Nevertheless, the case of Senegal shows that the lack of an effective extension service is a key limiting factor in improving Senegalese agricultural production. PNVA at least provides the potential for improvement through investment of significant resources, a clearer mandate for the extension service, and channels for improved communication with research and farmers.

Table 10

PNVA Geographic Coverage
(Source: PNVA. Programme Technique 1990/91, August 1990)

Regions	Departments	Extension Agencies
Dakar	Rufisque	Direction de l'Agriculture(DA) Direction de l'Elevage (DE)
Diourbel	Diourbel	DA
Thiès	Thiès Mbour, Tivaouane	SODEVA DA
St. Louis	Dagana, Podor, Matam St. Louis	SAED DA
Kolda	Kolda, Vélingara, Sédhiou	DA
Tambacounda	Tambacounda Bakel	DA SAED
Ziguinchor	Ziguinchor, Bignona, Oussouye	DA
Kaolack	Kaolack, Nioro, Kaffrine	DA
Fatick	Foundiougne, Fatick, Gossas	DA
Louga	Louga Linguère, Kébémer	DA DE

Table 11

PNVA EXTENSION STAFF 1990/91
(Source: PNVA, Programme Technique 1990/91, August 1990)

	Nat'l Coord.	Reg. Coord.	Trng. Spec.	Super-visors	SMS *	Ext. Agents	Other	TOTAL
Dir. de l'Agric.	5							5
IRA/Dakar		1			2	10	1	14
IRA/Thiès		1		3	2	17		23
IRA/St.Louis		1			2	6	2	11
IRA/Tamba		1		7		25		33
IRA/Kaolack		1	1	3	1	23	1	30
IRA/Fatick		1	1	3	5	22		32
IRA/Diourbel		1		1	1	8		11
IRA/Kolda		1		3		7	2	23
IRA/Ziguinchor		1	1	3		19	1	25
DA Total	5	9	3	23	13	147	7	207
Dir de l'Elevage	4							4
IRE/Dakar		1		1	2	10		14
IRE/Louga		1		2	2	25		30
DE Total	4	2		3	4	35		48
SAED	5				3			8
Dagana		1		5		26		32
Matam		1		2		16		19
Podor		1		5		28		34
Bakel		1		1		6		8
SAED Total	5	4		13	3	76		101
SODEVA	4							4
Thiès		1		3		22		26
SODEVA Total	4	1		3		22		30
TOTAL PNVA STAFF	18	16	3	42	20	280	7	386

* SMS = Subject Matter Specialists

Other Donor Extension Efforts

In 1989, when the GOS and the World Bank decided that PNVA was necessary to revitalize agricultural extension in Senegal, some of the other donors, notably the French Caisse Centrale, voiced concerns about the extension methodology ("training and visit") and about the organization and focus of PNVA. In July 1989, the MDR published the report "Organisation des Appuis aux Producteurs: Répartition des Fonctions entre les Différents Partenaires du Développement dans le Milieu Rural Sénégalais", which was prepared with Caisse Centrale financing. This report identified three major conditions in rural areas that had been largely ignored by PNVA. These are: a) the degradation of natural resources with concurrent impoverishment of many farms; b) the emergence of a growing dynamism of farmer organizations, independent from the state; and c) the confusion of the different ministries and agencies that have a role in rural areas. The major recommendation of the report was to create the Programme National d'Appui aux Producteurs (PNAP) to oversee and coordinate all activities in rural areas with

the objectives to reinforce farmer organizations and to improve the public services provided by the GOS in the regions and in villages. PNAP in effect recommended the creation of a "super-ministry" to coordinate all rural activities, including PNVA.

In response to these criticisms, the final PNVA project document was modified to address some of the concerns, most notably, strengthening of farmer organizations and their involvement in agricultural extension. Criticisms of the lack of natural resource management emphasis in PNVA are also addressed in the final PNVA document as well as in the World Bank-CCCE-financed project, PICOGERNA.

The current status of PNAP is on hold at present. The GOS and the Caisse Centrale have proposed a study to test the feasibility of PNAP.

Conclusions

Most Senegalese farmers do not currently benefit from agricultural extension services. Nevertheless, there is a long history of extension efforts supported in a piecemeal fashion by a succession of bilateral and multilateral donors. Research-extension linkages have been notoriously weak. Input from farmers in defining research priorities via extension is just now gaining deserved recognition. Recent GOS reforms have realigned the traditional services and RDA extension roles, forced reforms, and allowed the emergence of NGO-based programs at the village level. World Bank support to PNVA, as amended by criticisms from other donors, will do much to 'regularize' delivery of extension services. Nonetheless, without motivation, adequate training, and financial incentives, traditional extension services will not contribute a great deal. PNVA is building institutional capacity, providing a clearer mandate, mobility and in-service training to existing extension agents, and offering potential for improvement. Elsewhere, farmers' groups, and local NGOs, some with external financing and some without, are forging new linkages with research and alternative technology transfer agents.

Recognizing the importance of extension, PNVA will cover 50% of Senegal (60% of the rural population) in four years, and will be supplemented with efforts by NGO/PVOs as well as other donors, leaving a very limited role for further bilateral investment in extension services in specific areas, such as, translation of research results into 'farmer ready' extension materials and their publication and dissemination, and degree training in extension.

Farmer Organizations

Overview

Efforts to develop farmer organizations span nearly a century. The state, donors and farmers themselves have viewed such organizations as potentially important vehicles for advancing their causes and as a necessary requirement for working with a dispersed, diverse, illiterate and impoverished peasantry. Four distinct organizational forms have evolved since Independence -- cooperatives, state-sponsored producer groups, "Groupements d'Intérêt Economique" (rural business associations) and peasant-based associations.

The discussion that follows explores the history of each of these important initiatives, examining their organizational form, mandates, functions and performance. Efforts to mobilize farmers through special organizations in pursuit of developmental objectives has proven difficult and the results frequently disappointing. An underlying theme throughout the analysis of this institutional experimentation is the issue of legitimacy, i.e., the extent to which these organizational forms faithfully represent members' interests and the impact which legitimacy has had on the viability and performance of the organization.

Cooperatives

From its inception, the post-colonial cooperative movement has been employed as an instrument of the state, created, supported and directed to advance public development objectives. It followed over fifty years of colonial experience which contributed durable legacies to the post-Independence Senegalese cooperative movement: state-sponsored cooperatives were intended to protect the peasantry from exploitative capitalism and to serve as a vehicle for the state to organize and mobilize an illiterate peasantry[42]. Organized in 1960 and reformed in 1983 as part of the New Agricultural Policy, the modern history of cooperatives is intimately linked to the peanut sector which is the foundation of the rural economy. As such, cooperatives have served as vehicles for agricultural credit, input distribution and marketing agricultural production and more broadly for taxing agriculture and rendering patronage to the powerful and influential.

The cooperative movement was founded at Independence as an expression of political and philosophical interests. Cooperatives were formed to assert control over the peanut industry which was dominated by traders and foreign-owned oil mills, both of which represented the menace of exploitative capitalism. This initiative reflected both nationalism and socialism. It sought to replace or reduce French and Lebanese interests by placing this key sector in Senegalese hands and it sought to establish state control over what was at the time the "basic industry."

Between Independence (1960) and 1984, cooperatives played a significant though subservient role to parastatals in input marketing, credit and output marketing[43]:

- They assumed an important role in buying, assembling, and marketing peanuts. In 1965/66 cooperatives were given a monopoly on all peanut marketing.

- Cooperatives served as the primary vehicle for agricultural lending. During the "Programme Agricole" (1969-1978), over 400,000 pieces of

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[42] Robert Tignor, "Senegal's Cooperative Experience, 1907-1960" in the Political Economy of Risk and Choice in Senegal, edited by John Waterbury and Marz Gersovitz, Princeton University, 1987.

[43] From 1966 to 1980, OWCAD (the National Office of Cooperation & Development Assistance) assumed direct responsibility for most input distribution and credit delivery, utilizing cooperatives which were under its jurisdiction to assist with these functions. Sheldon Gellar, "Circular 32 revisited: Prospects for Revitalizing the Senegalese Cooperative Movement in the 1980's", in the Political Economy of Risk and Choice in Senegal, edited by John Waterbury and Mark Gersovitz, Princeton University, 1987.

agricultural equipment and 35,000 teams of draft animals were acquired by farmers on credit extended through their cooperatives.

Inputs (fertilizer, seed, etc.) were distributed by ONCAD. Cooperatives "retailed" the distribution of these inputs to its members and served as the legal borrowers of the credit used to finance these inputs.

By the early 1980s, the cooperative movement was in shambles. Rural indebtedness reached CFA 38 billion, of which CFA 30 billion was overdue. Repayment rates for the decade of the 1970s averaged around 60%. The cooperatives' problems were both internal and external. Cooperatives were treated as development instruments of the state; there was no serious effort to strengthen the cooperatives themselves through training and technical assistance. Credit, marketing and input supply functions were assigned to the cooperatives irrespective of their interests and capabilities. The scale and complexity of these functions completely overwhelmed whatever nascent capacity existed[44]. Beyond these internal, institutional problems lay external issues. The mandates assigned to the cooperatives exceeded their financial resources. The normal risks of Sahelian agriculture, exacerbated by severe and periodic droughts, exposed the cooperatives to enormous financial risks. The Government's response to these hardships -- debt forgiveness -- undermined the moral authority of the cooperatives to command financial responsibility of their membership. In this environment (natural and institutional), the cooperatives' viability was clearly problematic.

In view of these failures, the Government decided to reform and rehabilitate the cooperative movement as a part of the New Agricultural Policy. This watershed reform, promoted by the donors and embraced by the Government in 1984, was ostensibly a radical break with the past. Its formal objectives were to redefine the role of the state (from socialist manager of the economy to the guarantor of the conditions of Western-style, development capitalism) and to restructure and liberalize the highly regulated and protected economy. More specifically, the New Agricultural Policy sought to reduce the role of the state in the agricultural sector by redefining the role of the regional development authorities from commercial functions to supporting farmers and farmer organizations. As a corollary, farmer organizations and particularly rural cooperatives were to assume a primary role in input supply, marketing and processing.

Legislation in 1983 provided for the reorganization of the cooperative movement to enable it to assume these reform-mandated functions. A six-tier hierarchical structure was created with 4,500 "sections villageoises" at the base representing the 13,000 villages in Senegal; a national federation, (the "Union Nationale de Coopératives Agricoles - UNCA") at the top; and four intermediary levels corresponding to the administrative units of region, department, "arrondissement," and "communauté rurale." The "sections villageoises" are characterized by: 1) geographic organization -- each "section villageoise" represents one or more villages depending on the size of the population; 2) membership -- which consists of all village residents irrespective of gender or ethnicity; 3) function -- the cooperative is multifunctional (credit, input distribution, marketing); and 4) a multisectoral organization, i.e., "sections villageoises" may have units engaged in agriculture, livestock,

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[44] Ministry of Rural Development, GOS, Organisation des Appuis aux Producteurs, Volume II, July, 1989.

forestry, fishing or artisanal crafts. With the collapse of ONCAD in 1980, responsibility for cooperative development and support was transferred to the Ministry of Rural Development and a new Directorate of Cooperative Action was established.

These reforms failed to revitalize the cooperative movement. Although their new mandate and structure were national in scope, the cooperatives have remained primarily focused on the Peanut Basin and the peanut industry. The cooperative movement has not fared well under the New Agricultural Policy and certainly has not become a viable, grass roots development institution. With the withdrawal of state subsidies and special privileges, the cooperatives' functions have diminished to inconsequential levels except for peanut marketing. Briefly, cooperatives' functions may be characterized as follows:

Credit: The National Cooperative Union has a special relationship with the agricultural bank, CNCAS. It owns 10,000 shares and has a representative on the bank's board of directors. "Sections villageoises" are eligible clients who may secure credit for purchasing peanut seed, fertilizer and pesticides. Repayment rates have been poor and CNCAS has responded by tightening lending conditions (peanut seed financing limited to 65% and fertilizer to 85% of purchase costs) and cutting off cooperatives with unpaid arrears. Lending for fertilizer was entirely cut off in the Peanut Basin in 1989 following extremely low repayment rates the previous year. Cooperatives received CNCAS financing for about 9,000 tons of peanut seed in 1990, representing 70% of purchased seed[45].

Fertilizer: The National Union of Cooperatives' role in fertilizer marketing and finance has diminished sharply despite its mandate and efforts. In 1984/85, it managed over CFA one billion generated by the old scheme of retaining earnings from members' peanut sales the previous year. This financed about 11,000 tons of fertilizer (30% of the total for the year). Over the last five years (1986-1990), the coops never marketed more than 3,000 tons of fertilizer per year and averaged slightly over 800 tons annually representing 4% of the annual retail trade, a mere shadow of its former position in the market.

Peanut Seed: Covered by donor conditionality and committed by its own New Agricultural Policy, the state progressively divested itself of the responsibility to supply farmers with peanut seed each year. While farmers were encouraged to save their seed and renew genetic material through purchases every forth year, cooperatives attempted to step in to fill this void. The cooperatives used their own resources to finance peanut sales to members: 11,000 MT in 1984/85, 5,000 MT in 1986/87. Repayment rates were low (apparently reflecting members' belief that the Government would absorb the loss) and the National Cooperative Union was saddled with FCFA 580 million of debt by 1986/87. Weakened by these losses, the National Cooperative Union's role was reduced; in 1989 and 1990, it facilitated members' access to CNCAS credit by loaning them the 35% up-front financing

[45] The annual national peanut seed requirements average around 100,000 tons. Prior to the New Agricultural Policy (NAP), farmers were encouraged to replace all of their peanut seed each year and were supplied by ONCAD through the cooperatives. With a quarter of the national crop to be planted with purchased seed in accordance with the NAP, these quantities represented roughly a third of the quantity of seed that needs to be renewed each year for technical reasons and less than 10% of the total seed stock used each year.

required by the bank. This allowed them to purchase 7,700 MT and 9,000 MT in 1989 and 1990 respectively representing 77% and 69% of purchased seed in those years.

Agricultural Marketing Campaigns: The cooperatives assembled and marketed 38%, 67% and 63% of total peanut sales to the oil mills in 1986, 1987 and 1988 respectively. In 1989 they handled only 42% of the marketing while licensed traders accounted for most of the remaining market. This function provides a principal source of revenue for the cooperatives who make FCFA 1,000 per ton marketed. The earnings, however, were all retained by the national organization, leaving nothing for the local "sections villageoises."

Conclusions: After more than 80 years, the state-sponsored cooperative movement is moribund, marginalized and discredited. At Independence, Senegal launched a bold reform to transform the troubled colonial cooperatives into a significant economic force intended to assert national control over the key peanut sector and mobilize the peasants in the process of post-Independence economic development. Despite twenty years of effort and significant resources and political commitment, the initiative failed. The cooperative movement was deeply in debt and disfunctional by 1980, plagued by many of the same problems of its colonial predecessors, i.e., the cooperatives were hierarchical, autocratic and financially unstable. The "reform" of the cooperative movement in 1983 inspired by the New Agricultural Policy changed few of the fundamentals and consequently the results were disappointing. Once again cooperatives were treated as an instrument of the state intended to advance "developmental" and political objectives. The "reformed" movement was mandated from above, organized around administrative units of the state (village, communauté rurale, arrondissement, etc.) and assigned multiple functions (largely associated with the peanut industry). Membership was open to everyone in the geographic area of organization irrespective of gender, ethnicity, allegiances or other interests. In short, they were an artificial creation with no integrity of their own. The cooperatives were unrepresentative and autocratic and thus failed to mobilize allegiance and local resources. Thus fatally flawed, they were doomed as well in that their assigned functions exceeded their managerial and financial resources. No real effort was devoted to developing the institution from the bottom up -- i.e., training, technical assistance, a legal and political environment conducive to the development of autonomous and viable grassroots organizations. Implicitly acknowledging the demise of the state-sponsored cooperative movement, the Directorate of Cooperative Action in MDRH was abolished as a part of a major reorganization and consolidation of the national government in April, 1990. As a part of an IMF-sponsored program to reduce public sector payrolls, 88 cooperative development agents resigned from the service as of 1990, significantly reducing the personnel of this service. The state appears to be withdrawing from its role of sponsoring cooperative development.

State-Sponsored Producer Groups

Outside the Peanut Basin, an alternative form of farmers' organization took shape in the 1970's and 80's, sponsored by the regional development authorities and large, donor-funded regional projects. As we have seen, notwithstanding its national mandate, the state's cooperative development efforts were concentrated largely on the peanut sector and the Peanut Basin. In tacit acknowledgement of the marginal relevance and

capacity of the cooperative structure outside the Peanut Basin, the parastatals and donors sponsored their own farmer organizations, frequently charging them with the same kind of functions that were assigned to cooperatives -- input distribution, credit, commodity marketing, extension, etc. SAED organized Producer Croups (Groupements des Producteurs) around rice production; SODEFITEX sponsored grassroots, producer associations (Association de Base des Producteurs) to promote first cotton and later corn production and marketing (1800 ADP's had been organized by 1988) and AID and the French financed regional development projects in the Lower and Middle Casamance which sponsored their own farmer organizations to facilitate the execution of project-financed activities.

These efforts at farmer organization challenged the cooperative movement by effectively usurping its members and functions, but accepted the basic paradigm. To some extent, these efforts were more successful, at least for a time. They enjoyed a coherence in purpose, geographic focus and often a "captive market" for a specific commodity that made it easier to both organize and "tax" their membership (e.g., collect payment for inputs and services). SODEFITEX is the most durable and viable of the examples. Its "Associations de Base des Producteurs" continue to distribute inputs, facilitate access to credit from CNCAS, provide a marketing structure for cotton and offer the most effective extension services in the country. It also has moved to strengthen the associations themselves through literacy training and assistance with organizational and management functions and skills. Thanks to continuing subsidies on inputs and services (productive and social) SODEFITEX's associations remain functional and reasonably effective and its members sufficiently solvent to meet their obligations.

Like their cooperative rivals, these producer groups have tended to be paternalistic. They are top-down structures organized to carry out the sponsor's development agenda. Farmers were generally given little voice in how the organizations were run, a modus operandi for which SAED was notorious. SODEFITEX has been most progressive in these matters, devoting efforts and resources to developing the associations themselves. All of these groups functioned best when resources were available from their sponsor to support the organization, as SODEFITEX's operations illustrate. But generally these associations have been heavily dependent on their sponsor for financial and organizational resources and have withered as these resources were withdrawn (e.g., SAED, the AID project sponsored "Groupement de PIDAC in the Lower Casamance", etc.) Thus the producer groups, like the cooperatives, have generally failed to develop viable, sustainable grassroots development organizations. Their sponsors, the regional development authorities, viewed them as vehicles for achieving production objectives, too often autocratically assigning them goals, priorities and technological production packages.

Groupements d'Intérêt Economique

GIEs (Economic Interest Groups) are an institutional innovation born of the New Agricultural Policy (NPA) in 1984. The GIEs were established to complement the "reformed" cooperatives and to serve as a vehicle for advancing some of the policy's major objectives: the withdrawal of the state from commercial functions, the "responsabilisation" of farmers (which philosophically seemed to mean "empowering" the peasantry to take control over their economic and social development), and privatization of state owned enterprises. GIEs

offer a form of organization which relies on participants' initiative and involves minimal state intervention.

GIEs may be formed by two or more people or organizations. They are a legal entity which may incur debt and may be capitalized at the discretion of their membership. They are not subject to income tax (although members are liable for taxes on personal income received from their GIE) and profits are distributed to the membership and not retained by the GIE. There are four types of GIEs: those representing farmers exclusively; those representing an extended family network; "mixed" GIEs consisting of technicians and farmers (found principally in the Fleuve); and "neo-rural" GIEs formed by technicians and unemployed urban people who have "returned to the land."

GIEs have proliferated rapidly; nearly 5,000 were registered as of mid-1990. The incentives for organizing and joining a GIE appear linked to the impact of the New Agricultural Policy. With the restructuring of the parastatals and their withdrawal from commercial and credit functions an institutional vacuum was created. The failure of the 1983 reforms to revitalize the cooperative movement exacerbated farmers' problems with access to credit and inputs. This implosion of parastatal institutions had its most dramatic impact in the Fleuve where high input, intensive agriculture is most widely practiced. Over a third of all GIEs are located in the Fleuve. See Table 12 for a summary of the regional distribution of GIEs. The principal reasons given by respondents in a survey for joining a GIE are:[46]

1.	Improve access to credit	25%
2.	The difficulties of operating individually rather than as a group	25%
3.	The unavailability of salaried employment, thus encouraging autogenerated sources of income	25%

Table 12

Number of GIEs by Region

REGIONS	NUMBER OF GIE	% OF TOTAL
ST. LOUIS	1618	34
LOUGA	748	16
DIOURBEL	471	10
THIES	168	3
DAKAR	458	10
KAOLACK & FATICK	592	12
ZIGUINCHOR & KOLDA	546	12
TAMBACOUNDA	144	3
TOTAL	4745	100

Source: Labat-Anderson, Inc., "Senegal, "Groupements d'Intérêt Economique", 1990.

[46] Labat-Anderson, Inc., "Senegal - Groupements d'Intérêt Economique", The Senegal NAP's study, 1990.

Fully 75% of respondants' reasons for joining a GIE are linked to the new economic and institutional environment associated with the liberalization reforms and the contraction of the state and associated salaried employment.

GIEs themselves are generally not fashioned out of whole cloth, over 75% were created from pre-existent associations organized by the regional development authorities and the Ministries of Rural Development, Social Development and Animal Resources as well as by non-governmental organizations. Since there is no structure preventing individuals or organizations from simultaneously participating in a GIE, many GIEs complement rather than replace alternative organizational forms.

Other salient features of GIEs indicative of their potential role and significance include:

- Over 80% of GIEs are rural and thus positioned to pursue agricultural and rural development agendas of their membership.

- 25% of GIEs are women-only organizations; most of these GIEs are transformed "Groupement de Promotion Féminine", which were organized by the Ministry of Social Development.

- Generally GIEs are smaller (two-thirds have less than 50 members) than cooperatives and other types of farmer organizations. This offers some potential advantages of cohesion while minimizing management requirements.

The virtues of GIEs are considerable. They are independent, relatively free from government regulations, and organized by local initiative. They are frequently built on a preexisting organizational structures so that initial organizational problems are lessened, and they are smaller and more "manageable" than traditional structures. However, GIEs are not without their liabilities. They tend to be "informal" in character, lacking management capacity, accounting systems, and the capacity to plan and invest. These characteristics reflect their memberships' liabilities. Most of the membership of "agricultural" GIEs is illiterate and without experience and preparation to play an active role in an enterprise engaged in agribusiness functions. Many GIEs remain weak and vulnerable to the same kinds of failures that other rural organizations have suffered - indebtedness, squandered investments, disillusioned members and discredited reputations. GIEs will require appreciable time and assistance to become viable, grassroots organizations. This will likely require literacy and numeracy training of the membership, assistance and training in organization and management skills, basic accounting capabilities, and the ability to identify and elaborate investment plans. Notwithstanding these weaknesses, the movement has demonstrated impressive vitality and growth and is already serving members' needs no longer addressed by the state.

Associations

Another distinctive and increasingly significant form of peasant organization is represented by the "mouvement associatif" consisting of village-based organizations, which have formed multi-village associations; these associations have in turn federated themselves to become the National Federation of Non-Governmental Organizations of Senegal (FONGS). The "mouvement associatif" is a grassroots phenomenon organized and directed by villagers and their leaders. While some village organizations and many multi-village associations have

received assistance from external sources, they reflect indigenous initiatives and are not the creation of an external force (i.e., the state, donors, etc.)

This movement was born in the 1970s and expanded rapidly in the 1980's following the introduction of the NPA and a correspondant cutting back of GOS services. It includes a variety of associations -- ASESCAW in the Fleuve; Intre-Entente de Bamba Thialène and GADEC in Tambacounda; Entente de Kabiline, CADEF and AJAC in the Casamance; ADAK and ADAF in Kaolack and Fatick. The national level organization, FONGS, was registered as a recognized legal entity in 1978. Although FONGS membership is basically rural, the associations have broad, multi-purpose objectives; as such they might better be thought of as community development organizations than farmer organizations. Today FONGS consists of 24 multi-village associations located throughout Senegal and representing 100,000 members.

Although there is a great diversity of experience among this large, heterogenous, bottom-up movement, the general pattern of institutional evolution is clear. Frequently village organizations were formed with the energetic leadership of someone with more advanced training and/or extensive experience beyond the village itself. Village organizations have formed very slowly following extensive community debate and reflection. Normally, the first explicit step in forming an organization has been a diagnosis by the village itself of its problems and aspirations. External forces such as drought or food scarcity have sometimes triggered such a diagnosis. Typically village associations' initial agenda have been oriented towards community development and social services (health, village water projects, etc.) and only later been directed to deal with more complex agricultural objectives -- production, marketing, processing, credit, etc.

FONGS represents its constituent associations; it does not have its own independent agenda. It provides a number of services to its members including:

- Credit: It has organized an experimental system of savings and credit and linked it to CNCAS. Capital raised through membership savings and donor grants allowed the membership of various multi-village associations access to credit. Through its purchase of CNCAS shares, FONGS has also gained a seat on CNCAS's board of directors thereby forging an important institutional foundation for the development of a rural credit system. Repayment rates by member borrowers were good initially (1987) but deteriorated significantly in 1989 indicative of the endemic problems of rural credit and the inevitably long and arduous task ahead in building a viable rural credit system.

- Training: Since 1985, FONGS has provided various kinds of training-of-trainers to its associations: management, program planning, for community development agents and literacy training. The purpose of this training has been basic institutional strengthening with no specific functional objective in mind (i.e., credit, extension, etc.). The effectiveness of this training, supported by several donors, has been uneven. The most progress has been made in management skills whereas associations' planning and programming capacities remain very weak.

The size, diversity and vitality of the indigenous "mouvement associatif" is impressive, and it represents an institutional asset with significant potential to contribute to rural and agricultural development. However, the

larger history of farmer organizations suggests various lessons about both methodology and potential for mobilizing these resources in the cause of development. These lessons include:

- It is crucial to respect the essential character of these organizations which are based on local (internal) initiative and resources. What makes them both unique and a potentially valuable asset is their grassroots nature; it is their agenda, commitment and resources.

- Genuine community-based organizations cannot be created solely from above. Local initiative is important and those organizations that spawn their own leadership afford the most viable foundation for institutional development.

- It takes a long time for genuine local organization to form and evolve.

- Such organizations typically have multiple objectives and particularly at the onset are inclined to pursue social rather than production objectives.

- The diversity of member associations demonstrates that the "mouvement associatif" is capable of performing a range of functions important to grassroots development and increased agricultural production. Although most associations have had little direct contact with agricultural research or extension agencies, CADEF through their associations in Bignona department, Ziguinchor Region, has demonstrated that farmers can work directly with agricultural researchers, define priorities, collaborate in the research and diffuse the results. Promising starts have been made on village-based savings and loan associations in several regions, both under a local organization, CONACAP, working with village women's groups and by the French aide agency (FAC).

- These associations may contribute to agricultural development over the long run. They need time and assistance to mature. Assistance must focus on strengthening the institution rather than exclusively on utilizing the organization as an instrument to carry out assigned functions. Associations have the potential to play important roles in credit and extension, <u>if</u> associations are selected which have these functions as their objective and if they are not overwhelmed with too many resources and responsibilities too quickly.

Selective, measured efforts in areas of self-defined interest by associations offer the potential for gradually laying the base for significant development initiatives, particularly in the areas of credit and extension.

Conclusions

Efforts by the state to pursue development objectives which utilize farmer organizations as a vehicle for carrying on commercial functions have largely failed as have similar top-down efforts by NGOs. Both state-sponsored cooperatives and producer associations suffered from paternalism which dictated goals, functions and even production technologies. These institutions were organized from the top down; they never developed a legitimate constituency. Farmer participation was a function of the benefits derived from association membership. These benefits were unreliable and frequently marginal. The farmer organizations were typically assigned functions that frequently exceeded their managerial and

financial capacity. The organizations themselves were never provided the means to grow and mature. The creation of GIEs acknowledged the detrimental consequences of paternalistic development models by reducing state control and direction. This institutional innovation has flourished, springing up from existing institutions, attracted by the potential benefits of access to credit. However, it suffers from some of the same liabilities of existing and early forms of peasant organizations: membership is illiterate, lacks skills and experience in organizational and business management, and there are no resources available for strengthening the GIEs. Nevertheless, GIEs have proven to be an important institutional innovation with potential to play a useful role in providing agribusiness services to producers. In the Senegal River Valley, intensive irrigated agriculture combined with the withdrawal of SAED from various commercial functions has stimulated rapid growth of GIEs which are assuming functions previously monopolized by the state. In the last decade, peasants have increasingly taken matters into their own hands, organizing their own associations, continuously asserting their independence from the government and establishing their own agendas. These associations also have considerable potential. It will take time for them to develop the capacity to undertake more complex functions. Resources are needed for training memberships and officers and strengthening the organization themselves. Selective and measured support of some of these associations might enable them to play important roles in extension and rural savings and loan functions. Finally, the two movements may complement each other. Associations may register as GIEs and enjoy the privileges this legal status conveys.

CHAPTER VI
STRATEGIC IMPLICATIONS

The Focus is on Crop-Based Agriculture and Agro-Forestry

The preceding analysis reviewed Senegal's agricultural sector with the primary focus on agro-forestry and crop-based production systems. The analysis explicitly excluded three of the four sub-sectors defined as part of Senegal's primary sector: industrial forestry, fishing, and livestock. There are several reasons why this orientation has been selected:

- these sectors are already supported by other donors (specifically the Germans, the Japanese, the Canadians and the World Bank);
- it is consistent with conditions of the DFA in that a majority of the rural population depends on crop-based agriculture as the primary source of food and income (and this is unlikely to change in the foreseeable future); and
- given the resources available (financial and other), the Mission does not believe it has a comparative advantage in these sectors.

Given this focus, the purpose of the analysis has been to outline the cause-effect-consequences sequence for the existing system and, then, to identify opportunities and potentials for strengthening economic growth in Senegal's rural economy. This focus is not intended to diminish the importance of the other three sectors, nor is it intended to suggest that they lack development potential imbedded within them (although at the present, on the basis of contribution to real GDP, forestry and fishing account for only a total of 5% of GDP, while crops and livestock account for about 15%). It is also fully recognized that in many ways, these sectors are interdependent: in some parts of Senegal crops and livestock are complimentary to production, and certainly supplementary to family income; the same is true of artisnal fishing in some parts of the country; and forestry (meaning specifically industrial forestry - such as the charcoal industry) is complimentary in the sense that it clears land that may be used for agriculture and grazing (not necessarily a good effect) and it is clearly competitive in that it removes vast amounts of woodfuel from local communities. These factors are not ignored by the analysis, but they are not pursued to develop explicit consequences within or among the forestry, fishing and livestock sub-sectors.

Improved Resource Productivity: the Key to Growth at the National and Rural Levels

The primary sector, while diminishing in overall importance in the macro statistics, remains the main source of employment and one of the main generators of national income. This is especially true for the portion of GDP originating outside Dakar (Dakar accounts for about 55% of total real GDP, which in turn is dominated by the services sector and government administration and, thus, donor financing).

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GDP, especially GDP originating in the primary sector, is highly variable largely (but not totally) because of weather variation. Real growth in the primary sector has been positive, but the growth rate has also tended to decline over time. Part of the reduction in the rate of growth can be attributed to world prices and weather, but part can also be attributed to declining productivity. This is especially evident when the sector is divided into the agriculture (crops), livestock, fisheries, and forestry sub-sectors.

The agriculture sub-sector has essentially stagnated. In 1989, real GDP in this sub-sector was only slightly above the level in 1977. This stagnation has been accompanied by a shift in relative importance from crops to livestock and fisheries. Yet, two-thirds of Senegal's active population is rural and 60 percent of the rural population lists agriculture (in the broad sense) as their profession. Clearly, the sector has some basic constraints yet to be resolved.

Information provided in this analysis shows that there has been a general decline in productivity in both food and cash crops and that increasing demands have and will continue to be made on limited natural resources and a land base which does not permit area expansion as a general "solution" in large parts of the nation. Resource productivity is a major issue.

The present GOS investment program has been targeted to support policies established by the 1984 New Agricultural Policy, the 1986 Cereals Policy and four World Bank Structural Adjustment Loans. Since existing policy is skewed toward irrigated agriculture, the investment program is similarly skewed:

- in the primary sector investment plan "agriculture" (essentially irrigation system development) accounts for almost 50% of the total;
- nearly 40% of the "agriculture" sub-sector investment plan is aimed at the St. Louis Region, which, with 26% of total primary sector investment, has the largest regional share of investment;
- donors supply 82 percent of expected investment in the primary sector, and as a group their programs are all at least 50 percent in the agricultural (essentially irrigation) sub-sector; and
- given the above, it is not surprising that a small portion of the planned investment is aimed at improving and protecting the soil. Only 8.7 percent of the total is in the forestry/natural resources sub-sector and only 8.6 percent of all primary sector investment is expected to be in the groundnut basin, where soil problems are the worst.
- The analysis shows that investment priorities must be adjusted to emphasize more efficient and broader based natural resource management.

Balancing Population and Resource Productivity - the Long-Term Solution

Between 1976 and 1988, the nation's population grew at 2.7 percent per year (2.1% for the rural population and 3.8% for the urban population). About 40 percent of the total population is urban and by the year 2000 the urban population will account for 44 percent of the total. There is no expectation that Senegal can achieve food self-sufficiency, unless immediate steps are taken,

the day is rapidly approaching when Senegal's resources will not be able to support its rural population, even in good years. The portion of the country with the majority of the rural population has little room for cropland expansion and highly variable rainfall and, thus, highly variable production. Virtually all of this land is extremely susceptible to erosion, with little actual investment targeted to resource management. This, combined with the high rate of population growth, has a number of negative impacts:

- a steady decline in the area cultivated per agricultural worker;
- extension of farming to marginal land;
- a shift from cash to food crop cultivation; and
- an increasing food production deficit.

For all intents and purposes Senegal has abandoned (at least in terms of investment) its most intensely cultivated and most densely populated rural area - the Groundnut Basin, and the development program has ignored basic problems in most of the potentially productive regions of the Casamance and Tambacounda. The soil resource has been "mined" to such a degree that it is incapable of producing enough food to feed the nation (often not enough to feed even the rural population). As the result of stagnant production, the real value of agricultural output has stagnated over the last 14 years, and the real, gross value of marketed output (cash income from crops) has declined at 2.5 percent per year. A rural population growth rate of 2.1% means real per capita cash income has declined by 4.6% per year. In the absence of a significant and sustained effort to improve efficiency and productivity, there is little prospect that Senegal's rural population can hope for a better life.

Policy and Institutional Contributions to a Growth Environment

Untangling the political, social, environmental/resource and economic interdependence and ascribing cause and effect to arrive at solutions is not a simple task. But, in a broad context, certain facts are evident: the more the elements of a system are controlled and protected, the less controllable and more complicated the system. The policy to expand local rice production at any cost is a good example. This analysis has shown that under current pricing and marketing policies, without massive subsidies, farmers in the Senegal River Valley cannot possibly produce and market rice competitively. Yet, the majority of Senegal's investment in agriculture and the majority of its agricultural credit is focused on irrigated rice in the Senegal River Valley. Rice is the "wage good" in Senegal and is, thus, firmly attached to political and welfare issues. Rice represents over half of urban cereal consumption, and while it represents about 29 percent of the rural diet, its importance has been increasing. Nationwide, rice is the most important cereal in the diet. It is worth noting that the suggested geographic region produces as much rice as the River Valley, at much lower cost.

On the surface, there would seem to be three possible solutions: increased urban employment and incomes; production of cash crops with which to purchase more food and to contribute to growth in agro-processing and agribusiness; and

increased production and consumption of local cereals - which also creates income and business opportunities.

The most recent policy statements (SAL IV) and the ongoing Agricultural Sector Adjustment dialogue will reorient the system to some degree. These programs are aimed at extending the disengagement begun by the NAP, particularly the privatization of SONACOS, SEPFA, and SAED rice mills. They are also aimed at a more liberal and more flexible pricing system (completely liberalized local rice pricing system, and more flexible cotton and groundnut prices) and at completing the elimination of input subsidies (SODEFITEX). All of these measures, some already negotiated (SAL IV) and some still under discussion (PASA), are aimed at reorienting the regulatory and economic environment and the investment program toward where the rural population lives and toward developing a more stable and a more flexible rural economy controlled by rural people.

These programs also push for better resource management with more local and personal control over resources. Resource tenure, especially for products from trees planted by individuals, and assurance that individuals will retain control of land on which they make improvements (irrigation structures as well as natural resource related improvements) are especially important. The "tree tenure" question should be view as a priority issue because it relates directly to agro-forestry. Fortunately, it is also the most easily resolved. A new forestry code is being prepared which will establish appropriate "rights". What is important is that the regulatory aspects of the code establish clear and simple procedures for production and/or sale of home produced tree products. The land tenure question is much more complicated and unlikely to be resolved in the near-term. Customary land rights, so long as they are clearly understood and under local control, provide a reasonable amount of security for land holders (the exception is the Senegal River Valley, where large investments are at stake). In all cases, there are also intra-family resource allocation and control questions (land/labor, young/old, male/female) none of which are being addressed in any detail by the present discussions. The resolution of these issues would have to be classified as long-term and unlikely to be resolved until the rural economy has achieved basic security. These issues are, however, extremely important because they are the fundamental determinants of how land and labor are allocated at the farm level. Any program which begins to implement a development strategy - particularly the kind of strategy being suggested here - will have to deal with these issues. Increasing population pressure, especially in the regions where land is already scarce, will bring these problems forward, perhaps faster than the existing system is ready to deal with them unless local institutions are strengthened.

A Resource Focused Strategy

The combination of a limited and fragile resource base and high and increasing population densities means that Senegal could face a future in which it is constantly at the edge of disaster. While on the average farmers have managed to maintain yields at stable levels (even increasing slightly in the southern parts of the country), the larger part of the land resource base has generally been ignored. Even though average yields have been somewhat stable, the year-to-year variation has been increasing, so that each year there is greater risk that the rural population will not be able to feed itself. And, this has been accompanied by a steady decline in the amount of land dedicated

to cash crops with steady (2.5% per year) declines in real cash revenues. Over time, the opening of new land and the introduction of higher technologies (essentially improved seeds and animal traction) have managed to compensate for an annual productivity decline which has been estimated at between three and five percent per year. These were introduced under highly subsidized programs which the GOS was not, and is not now, capable of supporting financially, so it is reasonable to expect yields to begin to decline, along with a considerable increase in soil lost to erosion. Farming, as practiced in much of the country, contributes by removing virtually all crop material from the soil. The organic matter content of Senegal's soils drops rapidly once the vegetative cover is removed, which means reduced productive capacity, less water retention, lower responses to inputs such as fertilizer and increased vulnerability to even marginal changes in the weather. While in some regions (especially the Groundnut Basin) the productivity loss may have stabilized (it is as bad as it can get), any newly opened land risks a similar fate and most of the land now in use is classified as extremely susceptible to erosion.

The decline in soil productivity has been compensated, to some degree, by the use of improved seeds etc., but there is clearly a limit at which this will reach the point of diminishing returns. (Malten, for example, suggests that for millet there are no real genetic advances to be made.) This doesn't mean however that there are no possibilities for increased productivity. The technology review has shown that soil and water management techniques can add between 30 and 180 percent to millet and sorghum yields, as well as contributing to stability and even increased productivity of most other crops. Crops, especially in areas which have the "new land" potential and enough rainfall, can be more productive. With the proper input technologies, yields of rainfed rice, maize and sorghum can be increased 50-100% and acacia albidia (because of the soil nutrients it pulls from the deep soil and increased organic matter) is reported to increase groundnut yields as much as 40% and millet yields 50% to 150%.

Thus, a strategy to focus on arresting the decline in resource productivity is both desirable and feasible. Indeed, this analysis shows that it is critical for Senegal's progress in the 21st century.

A Geographic Focus

Senegal does have some agricultural potential and numerous areas where the existing system can be made more productive. The Senegal River Valley is one such area. Vegetable production in the Niayes is another (although a problem is developing between degradation of basic water sources and area expansion), and there is considerable unused, moderate potential land in that part of the country which lies south of the 400mm usable rainfall isohyet[1]. Since there is about 1.7 million hectares of additional exploitable land in the regions south of the 400mm usable rainfall isohyet, and since there are already several large donors active in the Senegal River Valley, the conclusion of this analysis is that a USAID development strategy should concentrate on the southern part of Senegal. A large potential exists in this region, but it must be developed with

[1]The 400mm reliable rainfall isohyet and the related geographic area was defined in Chapter III. Briefly, it is the region which receives 400mm of well distributed rainfall 80% of the time over a 90 day period (a minimum for sustainable rainfed agriculture). This area includes almost all of Kaolack, all of Fatick, Ziguinchor and Kolda and most of Tambacounda.

a view to maintaining the resource base, otherwise there is virtually not hope for sustainable real economic growth in the rural economy.

That portion of the country which is south of the critical rainfall level has the greatest potential for expanded rainfed agriculture and is the least density populated, especially the Casamance and Tambacounda. It contains over 50 percent of the national rural population and itself is over 80 percent rural. This area possesses a wide range of development alternatives, but has, as well, some marketing/transportation and land/population management constraints. While this area contains some of the "best" land (Senegal has no land that would be classified as "good") a large portion of this land is also susceptible to erosion, once the vegetative cover is removed. This region also has the largest forested area, but pressure from "mining" newly cleared land for crop production and to provide woodfuel (woodfuel provides 69% of the nation's energy) continues to place more and more land at risk. Exploitation for woodfuel alone can be expected to account for vast clearing (Senegal's national fuelwood sustainable density is well below 20 people/km^2 but the population density is already 35/km^2). Regeneration and natural forestry management are the best options for the rural communities where woodfuel provides virtually all of the energy and where women and children are spending increasing amounts of time collecting wood. Agro-forestry is important because of its link to livestock (as a major source of feed during the dry season), its contribution to soil organic and mineral content, and as an anti-erosion agent. The advantages of integrating resource focused agro-forestry in the farming system cannot be denied (this is especially relevant for the northern parts of Senegal outside the suggested geographic area, and in the northern parts the suggested focus region).

Senegal also has a comparative advantage for the production of crops suitable to these regions (millet, maize, cotton, and groundnuts). These land resources will clearly have to be brought into production, and probably relatively soon. The advantage to Senegal is that these lands are located in a zone which has sufficient rainfall for most cereal crops. The disadvantage is that most of these soils are extremely susceptible to erosion once the vegetative cover is removed and most of the area is some distance from the major urban centers.

This geographic focus concentrates investments in the areas with the greatest potential and increases the efficiency of this investment. It has the added advantage of initiating appropriate resource management before the resources become severely degraded.

Programmatic Options

This analysis was not intended to develop a specific strategy or a specific set of interventions for the USAID Mission, but it is evident that if the Mission is to have an agricultural strategy, then it needs to address (or select among) several distinct issues: the first is population management, which though necessary for the long-term cannot produce an appreciable impact over the current strategy time frame; the second is an appropriate policy and program environment, which is now being discussed with the GOS; the third is producer resource control, especially the right to manage the harvest and sale of farmer produced tree products - now being discussed under the new forestry code; the fourth the development of appropriate and more productive technology; the fifth is training

and access related to resource and productivity management practices; and a sixth is the eventual development of a grain storage, marketing and processing system (very important if appropriate productivity enhancing measures are widely accepted). There are also clear program and non-program support issues.

Non-Project Support and Food Aid

The nature of the strategy suggested by this analysis will require a wide range of participation: individual, family, village, rural community, local and regional authorities, institutional, and an explicit national commitment. There is an important function for non-project assistance (including food aid) at each level. Since the strategy is resource oriented, and since, finally, it is the individuals (perhaps, but not necessarily, defined as a family unit) who must decide to act, it is critical that they have both the incentive and the flexibility to do so. Focused policy and appropriate regulation must create the appropriate environment (which will mean more deregulation, revision of licensing procedures, continued state disengagement, establishing pricing systems which reflect resource costs and values, reorientation of investment priorities and programs, and especially clear and widely understood individual and community rights to use and control their own resources). None of these elements is without immediate as well as continuing cost. In addition, the state, as it disengages from the sector, leaves substantial debts - they will need to be cleared before the private sector can be expected to show much enthusiasm. Some of the major policy issues are:

- establishing farm pricing systems for rice, groundnuts and cotton which are more flexible and more closely tied to world market prices;
- complete elimination of the input subsidies now paid by SODEFITEX to cotton producers;
- privatization of the state owned rice mills and liberalization of the local the local rice marketing and processing system;
- elimination of the inter-regional transport subsidy on imported rice - this should accompany the rice sector privatization initiative;
- reduce the role and function of CPSP (government rice import and distribution agency) to facilitate private sector entry into rice importing (broken grain rice, the intermediate and wholegrain portions are already open, but they need to be encouraged as well);
- privatization of the edible groundnut sector (already agreed but still to be implemented);
- complete privatization of the agricultural credit bank (CNCAS); and
- passage and implementation of the new forestry code;

Given the appropriate policy and regulatory environment, it is possible to imagine a scenario covering the next ten years under which Senegal develops, protects, and to some degree regenerates its basic land and forestry resource base, to achieve a productivity gain of 4 percent per year. If the rural

population continues to grow at about 2 percent per year, this would mean a 2 percent per year gain in the per-capita value of farm output (at constant costs and prices) and a substantial improvement in rural fuelwood supplies. The region suggested as the geographic focus would produce a 42 percent surplus over its own food needs - enough to meet the deficit in the rest of the rural Senegal. Nationwide, Senegal would still have to import between 25 and 30 percent of it food needs (and this assumes that the population would shift from imported rice to locally produced cereals). Imbedded within this scenario are two risks that Senegal's food aid needs would be higher than they are today. In the near-term, while such a strategy is being put in place, land might be taken out of production, thus increasing the short-term need for food imports. In the longer term, farmers may shift from food to cash crops once they have met their own food needs. In the latter case, farm incomes would increase substantially, but this would mean a considerable increase in the need for imported food for the urban population. While it is possible for Senegal to improve its overall food (and rural income) status, it is difficult to imagine a situation under which Senegal will not require assistance either directly in terms of food, or financing with which to purchase food and definitely to support any investment.

Project Assistance

The solution to the problems outlined above requires a commitment to both parts of the "carrying capacity" dilemma: reduced rate of population growth and better resource management. The solutions do not necessarily mean higher cash expenditures by farmers, but it does imply an intense effort to communicate benefits and consequences of good or bad resource management to farmers (as well as administrators). There are also some labor implications. In the Casamance, for example, rice is grown by the women and there may be some question about how much control they have over land and land use decisions. It varies by region, but women are generally the major food producers while men are the main cash crop producers. Thus, any program would have to account for differing goals (food vs cash) and different levels of decision power and resource control. The "compound" or family group social system may also have implications. Since an individual may not know from year-to-year what land he or she will be allocated by the compound head, there may be less incentive to adopt or continue conservation measures. That is, given the land tenure system in Senegal, soil and water conservation measures probably will have to be focused on the compound rather than on the individual farmer.

An appreciable number of technologies have been developed in Senegal or elsewhere, and, possibly subject to verification in the Senegalese context, are available for dissemination. The main agricultural research institution (ISRA), which has been relatively effective in developing technologies, could be improved and could help to support a natural resource focused strategy through further technology research and testing. The analysis has also demonstrated that there is a fairly large number of farmer and Non-Governmental Organizations which could be mobilized to assist in implementing such a strategy. These institutions would need to be strengthened and care would have to be taken in selecting groups and NGO's which have resource related agendas.

A weakness does exist - the extension system. The World Bank is now engaged in strengthening the extension system (PNVA), but USAID cannot expect, in the near term, that it will be an effective vehicle for technology transfer and farmer training. Finally, while the largest agribusiness firms have engaged

in developing seed, equipment, and chemical input demonstration plots, they cannot be expected to show much interest in the kinds of interventions which appear to be needed. In time, agribusiness would benefit, because a resource based strategy would set the stage for the kind of agriculture which could eventually respond to the kind of technologies they sell. The information available demonstrates that these "instruments" exist (the research system has already investigated many farm based techniques and technologies and food processing technologies are available). The one remaining and crucial issue is the incentive and the capability of the institutional system to deliver these tools to the user - project and non-project assistance may be appropriate in both cases.

All of this suggest some specific kinds of project assistance to support the strategy. At the administrative level (both national and local) there may be a need for assistance in developing and disseminating appropriate resource and forestry related management skills (this would include understanding and application of regulations, training in resource management, development and use of information systems, and possible development of marketing systems for farm produced wood products). Particular attention will have to be placed on involving local communities and rural associations. This will be important from the point of view of common lands and resource protection, reforestation, and erosion and water control. That is, there are some interventions which will explicitly require contact with individuals, some with families, and some with community groups.

The foregoing suggests some specific kinds of project assistance that would be appropriate. Adaptive research and technology, validation of crop-based farming systems focused on improved resource management (soil, water and vegetative cover, especially trees) will be necessary to produce a stream of farmer ready technology. ISRA will need to be strengthened, particularly its research and financial management. Collaboration with PVO's and farmer organizations can be expanded to improve the quality of research and farmers' access to the results. Various technologies and techniques are ready or near ready which can increase watershed management practices, erosion control, improved, integrated livestock-crop production systems, agro-forestry, regeneration of vegetative cover; and natural forestry management. Grassroots organizations have considerable potential for transferring these kinds of technologies to farmers through training and demonstration, but their organizational, managerial and technical capacities will have to be strengthened. USAID's new PVO project represents one vehicle for launching such an initiative. Improved resource management will also require stronger local institutions. "Communités Rurales", village associations and other kinds of organizations can be strengthened to play a stronger role in maintaining community control over forests and grasslands and to mobilize participation in investments requiring community-level cooperation. The private sector can be stimulated through improved efficiency in semi-industrial scale processing and development of new products (especially for corn). Market development for forestry products also offers opportunities to supplement real incomes and increase incentives for improved forestry management. Improved technology, and strengthened institutions operating in an environment offering greater producer incentives are essential elements of a strategy to address Senegal's rural development challenge.

In addition to the PVO Project, the Mission has several other projects which also fall within the "window" defined by the kind of strategy suggested. Southern Zone Water Management fits perfectly in that it addresses both water

management, land reclamation and land resource protection and it is located in the suggest geographic area. The Senegal Reforestation Project has already acquired considerable experience with local community groups (and individuals) and a combined agro-forestry soil- productivity enhancement program could build on this experience. The Mission has a long experience with Senegal's main agricultural research institute (ISRA) and is well situated to help it improve both its own operations and its ability to conduct appropriate and related technology testing and its ability to (if necessary) help train appropriate groups. Finally, the Mission has considerable experience in family planning in Senegal. Even though it is unlikely that such a project will have appreciable impact over the period of the new strategy, population control is absolutely essential, otherwise the expected gains will evaporate shortly after they have been achieved. It is fundamental, if Senegal's resources continue to be subjected to the kinds of abuse they now suffer, development is quite frankly impossible, and social, economic and political upheaval is a certainty.

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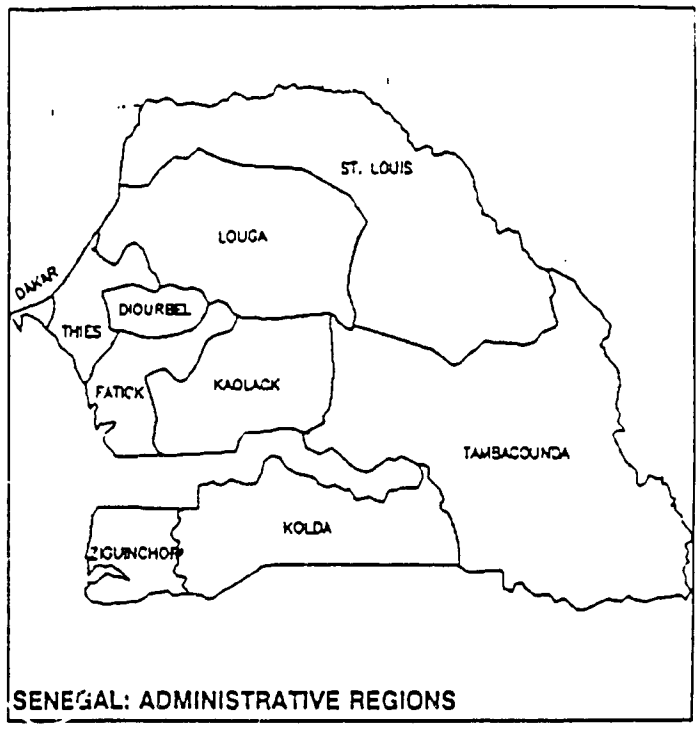
SENEGAL AGRICULTURAL SECTOR ANALYSIS

STATISTICAL ANNEX



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USAID/SENEGAL/ADO January 1991.

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Annex I

Macroeconomic Data

TABLE 1. REAL GROSS DOMESTIC PRODUCT BY SECTOR (BILLIONS 1977 CONSTANT CFA)

YEAR	PRIMARY SECTOR					SECONDARY SECTOR TOTAL	TERTIARY SECTOR TOTAL	SALARIES			TOTAL GDP	IMPORT GOODS AND SERVICE	EXPORT GOODS AND SERVICES	RESOUR GAP	POPULATION (000'S) 1.030	GDP PER CAPITA (FCFA)	YEAR
	AGRI-CULTURE	LIVE-STOCK	FISH-ING	FOREST	TOTAL			ADMIN.	DOMESTIC	TOTAL							
1959					78.8	50.9	130.7	39.3	3.5	42.8	303.2	189.2	170.1	-19.1	3,041	99,704	1959
1960					85.0	52.7	127.3	41.2	3.3	44.5	309.5	173.3	158.4	-14.9	3,131	98,844	1960
1961					73.6	56.0	149.2	41.1	3.5	44.6	323.4	161.3	150.0	-11.3	3,224	100,303	1961
1962					92.7	59.1	136.5	42.0	3.6	45.6	333.9	180.4	145.0	-35.4	3,320	100,582	1962
1963					94.7	61.0	145.2	42.3	3.8	46.1	347.0	179.3	133.3	-46.0	3,418	101,517	1963
1964					95.0	65.2	145.9	45.7	3.8	49.5	355.6	174.3	131.8	-42.5	3,520	101,036	1964
1965					105.7	67.4	147.4	46.0	4.0	50.0	370.5	169.1	132.0	-37.1	3,624	102,237	1965
1966					94.5	68.8	167.0	47.0	3.8	50.8	381.1	179.1	147.0	-32.1	3,731	102,133	1966
1967					103.0	71.9	148.8	48.8	4.0	52.8	376.5	187.5	140.1	-47.4	3,842	97,994	1967
1968					103.5	74.6	176.1	42.2	3.8	46.0	400.2	176.4	147.6	-28.8	3,956	101,162	1968
1969					105.5	76.3	153.7	34.8	3.6	38.4	373.9	160.2	145.4	-14.8	4,073	91,791	1969
1970					111.6	82.9	163.7	44.0	3.8	47.8	406.0	178.5	158.8	-19.7	4,194	96,800	1970
1971					93.2	85.0	177.1	46.5	3.6	50.1	405.4	172.9	140.6	-32.3	4,319	93,873	1971
1972					115.4	86.7	178.5	46.9	3.8	50.7	431.3	172.7	160.2	-12.5	4,447	96,994	1972
1973					96.8	85.0	175.3	46.5	3.6	50.1	407.2	171.5	140.2	-31.3	4,579	88,936	1973
1974					119.2	94.7	162.5	45.1	2.8	47.9	424.3	174.8	149.6	-25.2	4,714	90,001	1974
1975					124.2	97.1	184.9	47.1	3.0	50.1	456.3	195.3	168.5	-26.8	4,854	94,001	1975
1976					142.3	107.6	187.6	56.0	3.5	59.5	497.0	217.8	195.9	-21.9	4,998	99,436	1976
1977	74.1	32.3	18.1	8.[illegible]	132.5	113.1	177.0	57.0	4.0	61.0	483.6	251.7	209.2	-42.5	5,133	94,211	1977
1978	44.9	30.2	17.9	8.2	101.2	102.9	191,7	64.6	4.1	68.7	464.5	206.6	137.6	-69.0	5,272	88,110	1978
1979	75.8	31.1	13.4	8.4	128.7	114.3	187.3	61.5	5.3	66.8	497.1	218.9	166.8	-52.1	5,414	91,814	1979
1980	51.8	30.5	14.1	8.8	105.2	110.9	192.9	65.7	6.0	71.7	480.7	208.9	142.5	-66.4	5,560	86,450	1980
1981	45.9	31.1	13.6	8.7	99.3	117.2	184.8	69.2	6.5	75.7	477.0	228.1	141.9	-86.2	5,711	83,528	1981
1982	68.3	32.0	14.8	8.8	123.9	134.8	211.1	73.3	6.5	79.8	549.6	220.3	196.9	-23.4	5,865	93,710	1982
1983	72.6	33.0	15.6	8.7	129.9	137.8	212.7	76.7	6.5	83.2	563.6	231.2	197.1	-34.1	6,023	93,570	1983
1984	42.0	38.4	18.0	8.7	107.1	135.3	207.4	81.2	6.5	87.7	537.5	242.2	197.6	-44.6	6,186	86,890	1984
1985	46.3	41.5	19.0	8.8	115.6	138.0	211.5	84.0	8.8	92.8	557.9	228.3	166.3	-62.0	6,353	87,816	1985
1986	55.6	43.1	19.7	9.0	127.4	144.6	230.2	72.1	8.8	80.9	583.1	242.8	191.4	-51.4	6,525	89,369	1986
1987	54.8	45.6	21.1	9.4	130.9	156.0	235.7	74.8	9.0	83.8	606.4	245.4	194.2	-51.2	6,701	90,495	1987
1988	62.7	48.0	20.8	9.9	141.4	168.6	242.8	74.9	9.3	84.2	637.0	247.6	203.9	-43.7	6,882	92,562	1988
1989	52.3	49.4	20.9	10.2	132.9	165.9	243.5	77.2	9.6	86.8	629.1	249.1	211.6	-37.5	7,068	89,010	1989
1990	60.7	51.4	21.7	10.5	144.3	171.9	250.8	78.4	9.9	88.2	655.2	244.1	209.1	-35.0	7,259	90,264	1990

SOURCE: MEF/DIRECTION DE LA PREVISION. Note: in 1990 the constant value GDP was changed to a 1987 base. The data above (1988-1990) were revised according the % change. (mac)

Table 2. Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
1. Investment programming	Optimize allocation of available resources within a macroeconomic and sectoral framework. Place greater emphasis on directly productive and priority rehabilitation activities.	Adopt an appropriate public investment program for each year in the context of a three-year rolling public investment program.	June 1989, June 1990, and June 1991.
	Evaluate financing requirements, recurrent cost, and debt service implications of projects.	Rationalize budget preparation and ensure close coordination of ministries involved.	1989/90, 1990/91, and 1991/92.
	Strengthen capabilities of technical ministries to undertake project identification, feasibility studies, and monitoring.	Transfer responsibilities for project identification and preparation to certain technical ministries.	1989/90, 1990/91, and 1991/92.
		Adopt and periodically review sector investment strategies.	1989/90, 1990/91, and 1991/92.
		Adopt uniform approach to project preparation and appraisal.	1989/90.
	Improve overall control and monitoring of public investment expenditure.	Consolidate the investment outlays financed by foreign grants and loans with the regular budget monitoring and expenditure control processes.	1989/90.
		Improve the monitoring of projects.	1989/90, 1990/91, and 1991/92.
2. Agricultural policy reform	Expand and diversify production; increase net contribution to public finances; narrow price distortions.	Pursue and develop the reform process envisaged in the New Agricultural Policy, including gradual elimination of price distortions and subsidies and disengagement of Government from productive and commercial activities.	1989/90, 1990/91, and 1991/92.
		Finalize an Agricultural Development Policy statement (LPDA).	1989.
a. Cereals sector	Promote substitution of domestic coarse grains for imported rice.	Test suitable technologies at different scales of production.	1989/90, 1990/91, and 1991/92.
		Set criteria for adjusting price of rice to provide an adequate degree of protection for local cereals.	1989.

TABLE 1.A. REAL GROSS DOMESTIC PRODUCT BY SECTOR (Annual Percent Change, BILLIONS 1977 CONSTANT CFA)

YEAR	PRIMARY SECTOR					SECONDARY SECTOR TOTAL	TERTIARY SECTO TOTAL	SALARIES			TOTAL GDP	IMPORT GOODS AND SERVICE	EXPORT GOODS AND SERVICES	RESOUR GAP	POPULATION (000'S) 1.030	GDP PER CAPITA (FCFA)	YEAR
	AGRI-CULTURE	LIVE-STOCK	FISH-ING	FOREST	TOTAL			ADMIN.	DOMESIC	TOTAL							
1959																	1959
1960					7.9%	3.5%	-2.6%	4.8%	-5.7%	4.0%	2.1%	-8.4%	-6.9%	-22.0%	3.0%	-0.9%	1960
1961					-13.4%	6.3%	17.2%	-0.2%	6.1%	0.2%	4.5%	-6.9%	-5.3%	-24.2%	3.0%	1.5%	1961
1962					26.0%	5.5%	-8.5%	2.2%	2.9%	2.2%	3.2%	11.8%	-3.3%	213.3%	3.0%	0.3%	1962
1963					2.2%	3.2%	6.4%	0.7%	5.6%	1.1%	3.9%	-0.6%	-8.1%	29.9%	3.0%	0.9%	1963
1964					0.3%	6.9%	0.5%	8.0%	0.0%	7.4%	2.5%	-2.8%	-1.1%	-7.6%	3.0%	-0.5%	1964
1965					11.3%	3.4%	1.0%	0.7%	5.3%	1.0%	4.2%	-3.0%	0.2%	-12.7%	3.0%	1.2%	1965
1966					-10.6%	2.1%	13.3%	2.2%	-5.0%	1.6%	2.9%	5.9%	11.4%	-13.5%	3.0%	-0.1%	1966
1967					9.0%	4.5%	-10.9%	3.8%	5.3%	3.9%	-1.2%	4.7%	-4.7%	47.7%	3.0%	-4.1%	1967
1968					0.5%	3.8%	18.3%	-13.5%	-5.0%	-12.9%	6.3%	-5.9%	5.4%	-39.2%	3.0%	3.2%	1968
1969					1.9%	2.3%	-12.7%	-17.5%	-5.3%	-16.5%	-6.6%	-9.2%	-1.5%	-48.6%	3.0%	-9.3%	1969
1970					5.8%	8.7%	6.5%	26.4%	5.6%	24.5%	8.6%	11.4%	9.2%	33.1%	3.0%	5.5%	1970
1971					-16.5%	2.5%	8.2%	5.7%	-5.3%	4.8%	-0.1%	-3.1%	-11.5%	64.0%	3.0%	-3.0%	1971
1972					23.8%	2.0%	0.8%	0.9%	5.6%	1.2%	6.4%	-0.1%	13.9%	-61.3%	3.0%	3.3%	1972
1973					-16.1%	-2.0%	-1.8%	-0.9%	-5.3%	-1.2%	-5.6%	-0.7%	-12.5%	150.4%	3.0%	-8.3%	1973
1974					23.1%	11.4%	-7.3%	-3.0%	-22.2%	-4.4%	4.2%	1.9%	6.7%	-19.5%	3.0%	1.2%	1974
1975					4.2%	2.5%	13.8%	4.4%	7.1%	4.6%	7.5%	11.7%	12.6%	6.3%	3.0%	4.4%	1975
1976					14.6%	10.8%	1.5%	18.9%	16.7%	18.8%	8.9%	11.5%	16.3%	-18.3%	3.0%	5.8%	1976
1977					-6.9%	5.1%	-5.7%	1.8%	14.3%	2.5%	-2.7%	15.6%	6.8%	94.1%	2.7%	-5.3%	1977
1978	-39.4%	-6.5%	-1.1%	2.5%	-23.6%	-9.0%	8.3%	13.3%	2.5%	12.6%	-3.9%	-17.9%	-34.2%	62.4%	2.7%	-6.5%	1978
1979	68.8%	3.0%	-25.1%	2.4%	27.2%	11.1%	-2.3%	-4.8%	29.3%	-2.8%	7.0%	6.0%	21.2%	-24.5%	2.7%	4.2%	1979
1980	-31.7%	-1.9%	5.2%	4.8%	-18.3%	-3.0%	3.0%	6.8%	13.2%	7.3%	-3.3%	-4.6%	-14.6%	27.4%	2.7%	-5.8%	1980
1981	-11.4%	2.0%	-3.5%	-1.1%	-5.6%	5.7%	-4.2%	5.3%	8.3%	5.6%	-0.8%	9.2%	-0.4%	29.8%	2.7%	-3.4%	1981
1982	48.8%	2.9%	8.8%	1.1%	24.8%	15.0%	14.2%	5.9%	0.0%	5.4%	15.2%	-3.4%	38.8%	-72.9%	2.7%	12.2%	1982
1983	6.3%	3.1%	5.4%	-1.1%	4.8%	2.2%	0.8%	4.6%	0.0%	4.3%	2.5%	4.9%	0.1%	45.7%	2.7%	-0.1%	1983
1984	-42.1%	16.4%	15.4%	0.0%	-17.6%	-1.8%	-2.5%	5.9%	0.0%	5.4%	-4.6%	4.5%	0.3%	30.8%	2.7%	-7.1%	1984
1985	10.2%	8.1%	5.6%	1.1%	7.9%	2.0%	2.0%	3.4%	35.4%	5.8%	3.8%	-5.7%	-15.8%	39.0%	2.7%	1.1%	1985
1986	20.1%	3.9%	3.7%	2.3%	10.2%	4.8%	8.8%	-14.2%	0.0%	-12.8%	4.5%	6.4%	15.1%	-17.1%	2.7%	1.8%	1986
1987	-1.4%	5.8%	7.1%	4.4%	2.7%	7.9%	2.4%	3.7%	2.3%	3.6%	4.0%	1.1%	1.5%	-0.4%	2.7%	1.3%	1987
1988	14.4%	5.3%	-1.4%	5.3%	8.0%	8.1%	3.0%	0.1%	3.3%	0.5%	5.0%	0.9%	5.0%	-14.6%	2.7%	2.3%	1988
1989	-16.6%	2.9%	0.5%	3.0%	-6.0%	-1.6%	0.3%	3.1%	3.2%	3.1%	-1.2%	0.6%	3.8%	-14.2%	2.7%	-3.8%	1989
1990	16.1%	4.0%	3.8%	2.9%	8.6%	3.6%	3.0%	1.6%	3.1%	1.6%	4.1%	-2.0%	-1.2%	-6.7%	2.7%	1.4%	1990

SOURCE: MEF/DIRECTION DE LA PREVISION. Note: in 1990 the constant value GDP was changed to a 1987 base. The data above (1988-1990) were revised according the % change. (mac)

Table 2 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
		Rationalize domestic pricing of rice.	1989/90, 1990/91, and 1991/92.
		Develop capacity in the Ministry of Rural Development (MDR) to use and improve agricultural pricing model.	1989/90.
	Move toward less costly and more sustainable policy for irrigation.	Implement third Lettre de Mission of SAED 2/ relating to phased disengagement from productive and commercial activities, full-cost pricing of water for farmers benefiting from double cropping, and autonomy and privatization of rice milling activities.	1989/90, 1990/91, and 1991/92.
b. Groundnut sector	Reduce financial deficit of groundnut sector.	Rationalize SONACOS' groundnut processing capacity. 2/	1989/90.
		Adopt a flexible system for the determination of producer prices in line with world market conditions.	1989/90, 1990/91, and 1991/92.
		Carry out technical and financial study of SONACOS and institute regular independent audits.	1989/90.
		Revise protocol between SONACOS and the Government.	December 1989.
		Strengthen the guarantee fund for groundnuts to monitor the financial performance of SONACOS and associated enterprises.	1989.
		Privatize the commercialization of confectionery groundnut.	1991.
c. Cotton sector	Reduce cost to public finances.	Prepare recovery program for SODEFITEX 2/ to include technical performance, internal economy measures, and progressive reduction of subsidy on inputs.	1989.
d. Sugar sector	Reduce cost of producing sugar.	Prepare plan of action to further increase productivity of CSS. 2/	1989/90.
		Renegotiate the agreement on the determination of domestic sugar prices.	1989/90 and 1990/91.
	Reduce cost to the CSS.	Link reference price for local industrial users to world market prices.	1989.

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Table 2 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
e. Rural credit	Increase sustainability of rural credit system.	Draw up plan for the reform of the agricultural credit system.	1989.
		Open the capital of the CNCAS to private participation and increase its commercial autonomy. 2/	1989.
		Prepare program for recovery of overdue loans and advances; set up analytical accounting system, and institute annual external audit for the CNCAS.	1989/90.
f. Diversification and export promotion	Develop cash crops for domestic consumption and export. Stimulate domestic and foreign investment for the development of high-yield crops.	Prepare plan of action to promote diversification, including steps to facilitate marketing and export of fruits and vegetables.	1989/90.
g. Land tenure	Improve the land tenure system and reduce administrative obstacles to the productive use of land.	Define and introduce an initial series of studies, consultations, and specific measures designed to improve the land tenure system.	1989/90.
		Review regulations and administrative system governing the allocation of irrigated land in the Fleuve to foster more intensive land use.	1989/90.
		Prepare and introduce a rural code.	1989/90.
h. Natural resource conservation and management	Develop national and region-specific approaches to the productive management and conservation of natural resources.	Set up an administrative framework for implementing and evaluating pilot natural resource conservation and management activities.	1989/90.
i. Fisheries policies	Preserve contributions of fisheries to national income and to public finance.	Finalize a study of fishery prospects in Senegal and develop an action plan for the sector.	1989/90.
j. Strengthening of the Ministry of Rural Development	Strengthen policymaking capacity.	Establish small strategy unit within the MDR to program and implement agricultural policies. 2/	1989/90.
3. Industrial policy reform	Develop the industrial sector by alleviating the existing rigidities in the labor market, production costs, and administrative regulations.	Assess the impact of the measures taken during the first phase of implementation of the New Industrial Policy and adopt appropriate actions.	1989/90.
a. Protection system	Rationalize the system of protection to enhance competitiveness and improve export and revenue performance.	Continue review of the system of reference prices.	1989/90 and 1990/91.

Table 2 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
		Implement recommendations of studies on special agreements for SAR, CSS, and SOCOCIM. 2/	1989/90.
b. Provision of investment incentives	Foster private sector development.	Review the level and composition of corporate taxation, and identify possible reductions in corporate tax burden, and ways to simplify its administration.	1989/90.
c. Simplification of labor laws and other regulations	Foster employment and labor mobility.	Introduce a two-tier labor market under which labor and wage legislation will be substantially relaxed for new and small- and medium-scale enterprises, as well as companies in the free zone or in the process of being restructured.	1989/90.
		Start the process of comprehensive review of labor legislation and freeze minimum wages for a period of three years. Introduce greater flexibility in nominal wage.	1989/90.
	Eliminate administrative constraints on the trade of industrial products.	Review the regulatory environment and implement a program of rationalization of various institutions involved in quality control, economic control, investment, and export promotion (including the free trade zone).	1989/90.
4. Energy policy	Develop local sources of supply, maximize efficiency (both of energy consumption and of its production/distribution), and raise revenues for the public sector.	Implement new energy pricing and taxation system to improve efficiency and transparency in the operations of the petroleum refinery.	1989/90.
		Begin deregulating distribution and retailing of petroleum products.	1990/91.
		Reduce, in a phased manner, energy prices for industrial users.	1990/91, and 1991/92.
5. Parapublic sector reform	Promote the efficiency of the parapublic sector, through rationalizing financial relations between the Government and the enterprises.	Reduce substantially direct subsidies from the 1988/89 levels.	1989/90, 1990/91, and 1991/92.
		Eliminate government guarantee and interest subsidies of parapublic borrowing.	1989/90.

Table 2 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
		Limit overdrafts to the level of end-June 1989 and eliminate the Central Accounting Office by restructuring the public enterprises into autonomous public establishments or state corporations.	1989/90.
		Update the accounting of the end-1988 stock of verified cross-arrears and continue their settlement.	1989/90, 1990/91, and 1991/92.
		Ensure harmonization of financial commitments in performance contracts with budgetary allocation; monitor and enforce compliance with contractual obligations.	1989/90 and 1990/91.
		Conclude performance contracts with eight public enterprises and initiate negotiations for other enterprises.	1989/90.
	Reduce the scope of the parapublic sector through liquidation and privatization of nonstrategic enterprises.	Engage firms qualified to assist in the privatization process.	1989/90.
		Privatize 35 enterprises and liquidate at least 10.	1989/90, and 1990/91.
		Prepare and implement rehabilitation programs for public enterprises.	1989/90, 1990/91, and 1991/92.
		Prepare and implement a plan of action to accelerate the privatization process.	1989/90, 1990/91, and 1991/92.
		Examine feasibility of creating a secondary market in shares and implement action plan.	1989/90.
	Streamline and reform the Government's institutional setting for overseeing parapublic enterprises.	Develop an information system to improve monitoring of economic and financial performance of the parapublic sector.	1989/90.
		Improve the system of administrative supervision over public enterprises.	1989/90.
6. Fiscal policy	Continue to improve the Government's fiscal operations.	Improve revenue performance and pursue a prudent spending policy.	1989/90, 1990/91, and 1991/92.
a. Revenue	Improve revenue performance and reduce reliance on exceptional resources by shifting to a more stable revenue base.	Improve customs administration.	1989/90, 1990/91, and 1991/92.

Table 2 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

Objectives	Strategies and Measures	Timing 1/
	Reduce the higher rate value-added tax from 50 percent to 30 percent and expand its coverage.	September 1989.
	Raise the customs duty rate from 10 percent to 15 percent.	September 1989.
	Reduce the underinvoicing of imports by introducing a minimum duty on underinvoiced items.	September 1989.
Increase tax yields.	Reinforce the mechanism for recovery of tax arrears.	1989/90, 1990/91, and 1991/92.
	Introduce a global income tax to replace the current schedular system.	January 1990.
	Introduce a separate corporate profit tax.	1989/90.
	Introduce withholding taxes on nonwage incomes, to be credited against the global income tax liabilities.	1989/90.
	Complete the modernization of the customs services, especially the valuation section, and the computerization of customs clearance procedures to reduce fraud.	September 1989.
	Maximize the surplus of the CPSP by implementing a system of wheat purchases through international competitive bidding.	November 1989.
	Introduce a more transparent pricing and taxation system for petroleum products, and mobilize the prospective surpluses of the oil sector in support of the budget.	1989/90.
Widen the tax base.	Develop gradually the taxation of the informal sector and other selective measures, such as the refo[illegible] of the advance cash payments on account of "patente," the presumptive tax on commercial and industrial benefits, and the selective and gradual application of the value-added tax (VAT).	1989/90, 1990/91, and 1991/92.
	Re-examine the special tax agreements with enterprises with a view to reducing exemptions.	1989/90, 1990/91, and 1991/92.

Table 3 (continued). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
		Extend the application of the value-added tax to the commerce and service sectors and eliminate the present tax on services.	January 1990.
		Introduce a revised tax on urban property on the basis of a fiscal cadastre.	1990/91 and 1991/92.
		Implement the reform of the taxation of foreign-financed projects.	1989/90, 1990/91, and 1991/92.
b. Expenditure	Maintain tight limits on current government outlays.	Control the wage bill by compressing the incentives, while keeping the wage drift to a minimum.	1989/90.
		Reduce the wage bill to CFAF 125 billion on the basis of the recommendations of the studies to be completed in September 1989.	1990/91 and 1991/92.
		Make adequate provisions for materials, supplies, maintenance, and the provision of essential social services, as well as for the redeployment fund.	1989/90, 1990/91, and 1991/92.
		Progressively reduce budgetary subsidies.	1989/90, 1990/91, and 1991/92.
	Rationalize administrative structures.	Define a training and redeployment program for civil servants.	1989/90.
c. Fiscal discipline	Strengthen the allocation of available resources.	Improve the monitoring of the Treasury's special and correspondent accounts on the basis of the recommendations made by a Fund technical assistance mission.	1989/90, 1990/91, and 1991/92.
		Take steps to integrate the recording and monitoring of all external grant and loan assistance within the budgetary process.	1989/90, 1990/91, and 1991/92.
d. Domestic arrears	Eliminate all currently verified domestic arrears of the Government and public agencies.	Allocate adequate resources to liquidate such arrears.	1989/90.
7. Credit policy	Conduct a prudent credit policy consistent with the growth, inflation, and balance of payments targets.	Keep the growth of domestic liquidity below that of nominal GDP to curb aggregate demand.	1989/90, 1990/91, and 1991/92.
	Improve the financial position of the banking system.	Implement the reform of the banking system involving, inter alia, a reduction in government shareholdings to below 25 percent. Undertake removal or provisioning of bad debts, and consolidation by the BCEAO.	1989/90.

Table 2 (concluded). Senegal: Summary and Time Frame for Macroeconomic and Structural Adjustment Policies, 1989/90-1991/92

	Objectives	Strategies and Measures	Timing 1/
		Restructure, rehabilitate, and/or liquidate the banks facing difficulties.	1989/90.
		Strengthen supervision of deposit money banks by the Central Bank (BCEAO), the Ministry of Economy and Finance, and the Banking Control Commission.	1989/90, 1990/91, and 1991/92.
	Mobilize domestic savings and improve resource allocation.	Follow a flexible interest rate policy.	1989/90, 1990/91, and 1991/92.
E. External debt management	Limit external debt service burden to manageable proportions.	Keep new external borrowing on nonconcessional terms to a strict minimum, while intensifying efforts to mobilize resources in the form of grants.	1989/90, 1990/91, and 1991/92.
		Make adequate provisions for the settlement of debt service obligations so as to avoid any external payments arrears.	1989/90, 1990/91, and 1991/92.
	Strengthen debt management.	Extend computerization system to monitor medium- and long-term debt as well as grants.	1989/90, 1990/91, and 1991/92.
9. Social impact	Minimize short-term adverse income distribution and social cost impact of various adjustment measures.	Review experience with employment fund with a view to expanding it.	1989/90.
		Prepare a standard-of-living survey;	1989/90 and 1990/91.
		Initiate socioeconomic studies aimed at identifying projects and programs for the most vulnerable groups.	1989/90, 1990/91, and 1991/92.
		Explore alternative means to enable the poor to have access to training and credit.	1989/90, 1990/91, and 1991/92.
		Sponsor public works program for employment creation.	1989/90.
10. Environment	Arrest degradation of environment.	Research appropriate farming techniques to reverse soil degradation and encourage their implementation.	1989/90, 1990/91, and 1991/92.
		Adopt new forestry code and take measures to arrest loss of forest cover.	1989/90, 1990/91, and 1991/92.
		Improve urban waste disposal.	1989/90, 1990/91, and 1991/92.

1/ Where a single date is indicated, it means that the measure(s) will be in effect no later than that date; where one year or several years are noted, it means that action will be taken in each year.

2/ SAED, Senegal's river valley development agency; SONACOS, groundnut oil processing company; SEPTA, confectionery groundnut company; SODEFITEX, textile development agency; CNCAS, agricultural credit company; MDR, Ministry of Rural Development; SAR, Senegal's petroleum refinery; CSS, Senegal's sugar company; SOCOCIM, cement company; CPSF, price equalization and stabilization fund.

Table 3 Senegal Total Population with Projections to 2010

YE	SENEGAL	DAKAR	ZIGUINCH	DIOURB	ST. LOUI	TAMBA	KAOLAC	THIES	LOUGA	FATIK	KOLD
	2.70%	3.97%	2.63%	3.18%	1.98%	2.44%	2.52%	2.77%	1.29%	1.81%	2.5
1976	4,998,085	940,920	291,632	423,038	514,735	287,313	597,502	675,440	419,59	408,857	439,0
1977	5,133,093	978,232	299,292	436,506	524,922	294,315	612,558	694,143	425,024	416,243	450,1
1978	5,271,748	1,017,024	307,153	450,403	535,311	301,488	627,994	713,363	430,518	423,762	461,6
1979	5,414,148	1,057,354	315,221	464,742	545,905	308,836	643,819	733,116	436,084	431,417	473,3
1980	5,560,395	1,099,284	323,501	479,538	556,709	316,363	660,042	753,416	441,722	439,210	485,3
1981	5,710,592	1,142,876	331,998	494,805	567,727	324,073	676,675	774,278	447,433	447,144	497,6
1982	5,864,846	1,188,197	340,718	510,558	578,963	331,972	693,726	795,717	453,217	455,222	510,3
1983	6,023,267	1,235,315	349,668	526,812	590,422	340,062	711,207	817,750	459,077	463,445	523,2
1984	6,185,967	1,284,301	358,852	543,584	602,107	348,350	729,129	840,393	465,012	471,817	536,5
1985	6,353,062	1,335,231	368,278	560,890	614,023	356,840	747,502	863,664	471,023	480,340	550,2
1986	6,524,670	1,388,179	377,951	578,747	626,175	365,537	766,339	887,578	477,113	489,017	564,18
1987	6,700,914	1,443,228	387,879	597,172	638,568	374,446	785,649	912,155	483,281	497,851	578,50
1988	6,881,919	1,500,459	398,067	616,184	651,206	383,572	805,447	937,412	489,529	50[illegible]844	593,19
1989	7,067,813	1,559,960	408,523	635,801	664,094	392,920	825,743	963,369	495,858	5[illegible]0	608,2[illegible]
1990	7,258,728	1,621,820	419,253	656,043	677,237	402,497	846,551	990,044	502,268	5[illegible]	623,7[illegible]
1991	7,454,801	1,686,134	430,265	676,929	690,641	412,306	867,883	1,017,458	508,762	5[illegible]1	639,5[illegible]
1992	7,656,169	1,752,997	441,567	698,480	704,309	422,355	889,773	1,045,631	515,339	5[illegible]2	655,78
1993	7,862,977	1,822,513	453,165	720,717	718,248	432,648	912,174	1,074,584	522,001	5[illegible]37	672,4[illegible]
1994	8,075,372	1,894,785	465,068	743,663	732,463	443,193	935,160	1,104,339	528,750	5[illegible]20	689,5[illegible]
1995	8,293,503	1,969,922	477,284	767,338	746,959	453,994	958,725	1,134,918	535,586	5[illegible]14	707,0[illegible]
1996	8,517,527	2,048,040	489,820	791,768	761,743	465,059	982,883	1,166,343	542,510	584,893	724,9[illegible]
1997	8,747,602	2,129,255	502,686	816,975	776,818	476,393	1,007,651	1,198,639	549,524	595,458	743,3[illegible]
1998	8,983,891	2,213,691	515,890	842,985	792,192	488,004	1,033,043	1,231,829	556,628	606,215	762,2[illegible]
1999	9,226,564	2,301,475	529,440	869,822	807,871	499,897	1,059,074	1,265,937	563,824	617,166	781,6[illegible]
2000	9,475,791	2,392,740	543,347	897,514	823,859	512,081	1,085,762	1,300,991	571,113	628,315	801,4[illegible]
2001	9,731,751	2,487,625	557,619	926,088	840,164	524,561	1,113,122	1,337,015	578,497	639,665	821,8[illegible]
2002	9,994,624	2,586,272	572,265	955,572	856,792	537,346	1,141,171	1,374,036	585,976	651,220	842,6[illegible]
2003	10,264,598	2,688,830	587,297	985,994	873,749	550,442	1,169,928	1,412,083	593,551	662,984	864,0[illegible]
2004	10,541,865	2,795,456	602,723	1,017,385	891,042	563,857	1,199,408	1,451,183	601,225	674,960	886,0[illegible]
2005	10,826,621	2,906,310	618,554	1,049,775	908,676	577,599	1,229,632	1,491,366	608,998	687,153	908,5[illegible]
2006	11,119,069	3,021,560	634,801	1,083,196	926,660	591,677	1,260,618	1,532,661	616,871	699,566	931,6[illegible]
2007	11,419,417	3,141,381	651,475	1,117,681	945,000	606,097	1,292,384	1,575,100	624,846	712,203	955,2[illegible]
2008	11,727,878	3,265,952	668,587	1,153,264	963,702	620,868	1,324,950	1,618,714	632,924	725,069	979,[illegible]
2009	12,044,670	3,395,464	686,148	1,189,980	982,775	636,000	1,358,338	1,663,535	641,107	738,167	1,004,3[illegible]
2010	12,370,020	3,530,112	704,171	1,227,865	1,002,225	651,501	1,392,566	1,709,598	649,395	751,501	1,029,8[illegible]

Source: Senegal 1988 Population Census. Projections by USAID/ADO.

Table 4. Senegal: Urban Population with Projections to 2010

YE	SENEGAL	DAKAR	ZIGUINCH	DIOURB	ST. LOUI	TAMBA	KAOLAC	THIES	LOUGA	FATIK	KOLDA
	3.80%	3.98%	4.70%	3.44%	3.72%	3.30%	3.21%	4.19%	1.88%	3.01%	3.8
1976	1,789,927	906,033	86,635	88,979	115,445	163,544	123,518	178,827	53,124	36,784	37,03
1977	1,857,975	942,115	90,709	92,037	119,736	168,941	127,479	186,326	54,123	37,891	38,44
1978	1,928,610	979,633	94,974	95,200	124,186	174,517	131,568	194,140	55,141	39,031	39,90
1979	2,001,930	1,018,646	99,440	98,472	128,802	180,276	135,787	202,282	56,178	40,205	41,41
1980	2,078,036	1,059,212	104,115	101,856	133,589	186,226	140,142	210,765	57,235	41,415	42,99
1981	2,157,039	1,101,394	109,011	105,356	138,554	192,372	144,637	219,604	58,311	42,661	44,62
1982	2,239,044	1,145,256	114,137	108,977	143,704	198,721	149,275	228,813	59,408	43,945	46,31
1983	2,324,166	1,190,865	119,504	112,722	149,045	205,279	154,063	238,409	60,525	45,267	48,07
1984	2,412,524	1,238,289	125,123	116,596	154,585	212,054	159,004	248,407	61,664	46,629	49,89
1985	2,504,242	1,287,603	131,006	120,603	160,330	219,052	164,103	258,824	62,823	48,032	51,79
1986	2,599,446	1,338,880	137,166	124,747	166,289	226,282	169,366	269,678	64,005	49,478	53,75
1987	2,698,269	1,392,199	143,616	129,035	172,470	233,750	174,798	280,987	65,209	50,966	55,79
1988	2,800,850	1,447,642	150,369	133,469	178,880	241,464	180,404	292,771	66,435	52,500	57,91
1989	2,907,330	1,505,293	157,440	138,056	185,529	249,433	186,190	305,049	67,684	54,080	60,11
1990	3,017,859	1,565,520	163,425	143,304	192,582	258,916	193,268	316,646	70,258	56,136	62,40
1991	3,132,589	1,621,922	169,638	148,752	199,903	268,759	200,616	328,684	72,929	58,270	64,77
1992	3,251,682	1,683,583	176,087	154,408	207,503	278,976	208,243	341,180	75,701	60,485	67,23
1993	3,375,301	1,747,588	182,781	160,278	215,392	289,582	216,159	354,150	78,579	62,785	69,79
1994	3,503,621	1,814,027	189,730	166,371	223,580	300,591	224,377	367,614	81,567	65,171	72,44
1995	3,636,819	1,882,991	196,943	172,696	232,080	312,019	232,907	381,590	84,667	67,649	75,19
1996	3,775,080	1,954,577	204,430	179,261	240,903	323,881	241,762	396,097	87,886	70,221	78,07
1997	3,918,598	2,028,884	212,202	186,076	250,062	336,194	250,953	411,155	91,227	72,890	81,02
1998	4,067,572	2,106,017	220,270	193,150	259,568	348,975	260,493	426,786	94,696	75,662	84,10
1999	4,222,210	2,186,082	228,644	200,493	269,436	362,242	270,397	443,011	98,296	78,538	87,34
2000	4,382,727	2,269,190	237,336	208,116	279,680	376,014	280,676	459,853	102,033	81,524	90,62
2001	4,549,346	2,355,459	246,359	216,028	290,312	390,309	291,347	477,336	105,912	84,623	94,06
2002	4,722,299	2,445,006	255,725	224,240	301,349	405,147	302,423	495,483	109,938	87,840	97,64
2003	4,901,827	2,537,959	265,447	232,765	312,805	420,550	313,920	514,319	114,118	91,180	101,35
2004	5,088,161	2,634,445	275,538	241,614	324,697	436,538	325,855	533,872	118,456	94,646	105,20
2005	5,281,619	2,734,599	286,013	250,800	337,042	453,134	338,243	554,169	122,959	98,244	109,2
2006	5,482,412	2,838,561	296,887	260,335	349,855	470,361	351,102	575,237	127,634	101,979	113,3
2007	5,690,838	2,946,475	308,174	270,232	363,155	488,243	364,450	597,106	132,486	105,856	117,6
2008	5,907,187	3,058,492	319,890	280,505	376,962	506,804	378,305	619,806	137,523	109,881	122,1
2009	6,131,762	3,174,767	332,051	291,169	391,293	526,071	392,687	643,369	142,751	114,058	126,78
2010	6,364,874	3,295,462	344,674	302,239	406,168	546,071	407,616	667,828	148,178	118,394	131,6

Source: Senegal 1988 Population Census. Projections by USAID/ADO.

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Table 5. Senegal: Rural Population with Projections to 2010

YE	SENEGAL	DAKAR	ZIGUINCH	DIOURB	ST. LOUI	TAMBA	KAOLAC	THIES	LOUGA	FATIK	KOLI
	2.03%	3.52%	1.59%	3.12%	1.41%	1.16%	2.33%	2.20%	1.20%	1.68%	2.4
1976	3,208,158	34,887	204,997	334,059	399,290	123,769	473,984	496,613	366,475	372,073	402,0
1977	3,275,118	36,118	208,583	344,469	405,186	125,374	485,079	507,816	370,901	378,352	411,7
1978	3,343,138	37,391	212,130	355,203	411,125	126,971	496,426	519,223	375,377	384,731	421,7
1979	3,412,218	38,708	215,782	366,271	417,104	128,560	508,032	530,834	379,906	391,212	431,9
1980	3,482,357	40,071	219,385	377,682	423,120	130,137	519,900	542,651	384,487	397,795	442,38
1981	3,553,552	41,482	222,987	389,449	429,173	131,701	532,038	554,674	389,122	404,483	453,0
1982	3,625,802	42,941	226,582	401,581	435,259	133,251	544,451	566,904	393,809	411,277	464,02
1983	3,699,101	44,450	230,164	414,090	441,377	134,783	557,145	579,342	398,551	418,178	475,2
1984	3,773,443	46,012	233,730	426,988	447,522	136,296	570,125	591,987	403,348	425,187	486,68
1985	3,848,820	47,628	237,272	440,287	453,693	137,788	583,399	604,840	408,200	432,307	498,4
1986	3,925,225	49,299	240,785	453,999	459,886	139,256	596,972	617,900	413,108	439,539	510,4
1987	4,002,645	51,028	244,263	468,138	466,098	140,696	610,851	631,167	418,072	446,884	522,7
1988	4,081,069	52,817	247,698	482,715	472,326	142,108	625,043	644,641	423,094	454,344	535,2
1989	4,160,483	54,667	251,083	497,745	478,566	143,487	639,554	658,320	428,173	461,920	548,1
1990	4,240,869	59,301	255,828	512,739	484,655	143,581	653,283	673,398	432,011	469,185	561,3
1991	4,322,211	64,211	260,628	528,177	490,737	143,547	667,268	688,774	435,833	476,541	574,7
1992	4,404,488	69,414	265,480	544,073	496,806	143,378	681,511	704,451	439,638	483,987	588,5
1993	4,487,676	74,924	270,384	560,440	502,857	143,066	696,015	720,434	443,422	491,523	602,6
1994	4,571,751	80,758	275,338	577,292	508,883	142,601	710,783	736,725	447,184	499,149	617,0
1995	4,656,694	86,932	280,341	594,642	514,879	141,975	725,817	753,328	450,918	506,865	631,8
1996	4,742,446	93,463	285,390	612,506	520,839	141,178	741,122	770,247	454,624	514,672	646,9
1997	4,829,003	100,371	290,484	630,899	526,757	140,199	756,698	787,484	458,296	522,568	662,3
1998	4,916,319	107,674	295,620	649,834	532,624	139,028	772,549	805,043	461,932	530,553	678,1
1999	5,004,354	115,393	300,797	669,329	538,434	137,655	788,678	822,926	465,529	538,628	694,3
2000	5,093,064	123,550	305,011	689,399	544,180	136,067	805,085	841,138	469,081	546,791	710,8
2001	5,182,405	132,166	311,260	710,061	549,852	134,252	821,775	859,679	472,585	555,042	727,7
2002	5,272,325	141,265	316,540	731,331	555,443	132,198	838,748	878,554	476,038	563,380	745,0
2003	5,362,771	150,872	321,850	753,228	560,944	129,892	856,007	897,763	479,434	571,804	762,7
2004	5,453,684	161,012	327,184	775,770	566,344	127,319	873,554	917,311	482,769	580,314	780,8
2005	5,545,002	171,711	332,541	798,975	571,635	124,465	891,389	937,197	486,038	588,909	799,3
2006	5,636,658	183,000	337,914	822,861	576,805	121,316	909,516	957,424	489,237	597,587	818,2
2007	5,728,579	194,906	343,301	847,449	581,844	117,854	927,934	977,994	492,360	606,347	837,5
2008	5,820,690	207,461	348,697	872,759	586,741	114,064	946,645	998,908	495,401	615,188	857,3
2009	5,912,908	220,697	354,037	898,811	591,482	109,929	965,651	1,020,166	498,356	624,109	877,6
2010	6,005,146	234,649	359,496	925,626	596,057	105,429	984,950	1,041,770	501,217	633,107	898,2

Source: Senegal 1988 Population Census Projections by USAID/ADO.

Table 6. Senegal Export Volume, Value and Unit Export Price (1980-1988)

	1980	1981	1982	1983	1984	1985	1986	1987	1988
Volume (1000 tons)									
Groundnuts	175.4	58.0	351.8	402.8	203.4	114.8	206.6	257.4	391.8
Raw Oil	62.6	21.6	151.5	157.9	85.5	40.0	80.4	104.3	133.0
Refined Oil	11.2	0.6	0.8	5.8	7.0	1.9	0.3	0.6	1.0
Meal	98.9	31.9	194.9	214.4	94.8	72.7	124.8	151.7	256.8
Grain	2.7	3.9	4.6	24.7	16.1	0.2	1.1	0.8	1.0
Cotton	5.6	4.2	10.1	13.6	9.1	10.0	7.0	6.5	12.1
Fruit & Veg.		10.5	14.7	16.0	16.8	16.1	13.6	8.0	
Fish	71.4	69.1	69.1	72.9	88.7	91.5	97.0	75.2	78.2
Fresh	59.8	53.9	53.7	53.3	64.3	66.5	70.0	56.7	59.8
Canned	11.6	15.2	15.4	19.6	24.4	25.0	27.0	18.5	18.4
Fertilizer	136.0	146.9	138.0	173.6	131.6	0.0	30.9	43.4	44.0
Sub-Total	388.4	288.7	583.7	679.0	449.6	232.4	355.1	390.5	526.1
Other Exports	4,224	3,858	1,995	2,221	2,591	2,707	2,418	1,881	
Total Exports	4,613	4,146	2,579	2,900	3,040	2,939	2,773	2,271	
Value (billion FCFA)									
Groundnuts	17.6	9.2	42.1	55.5	54.5	23.7	22.6	21.0	34.9
Raw Oil	11.3	6.2	31.1	36.3	39.3	18.4	16.7	15.1	22.0
Refined Oil	1.6	0.2	0.3	1.5	3.3	1.0	0.1	0.2	0.3
Meal	4.2	1.9	10.1	13.6	7.7	4.2	5.6	5.6	12.4
Grain	0.5	0.9	0.6	4.1	4.2	0.1	0.2	0.1	0.2
Cotton	2.1	2.0	4.8	8.1	6.9	7.1	2.5	2.7	5.4
Fruit & Veg.		1.1	1.5	1.5	3.5	4.6	4.5	3.1	
Fish	21.2	27.9	30.2	37.3	49.5	54.0	56.6	49.0	51.5
Fresh	13.9	17.3	18.5	21.1	28.3	31.0	33.0	33.9	36.5
Canned	7.3	10.6	11.7	16.2	21.2	23.0	23.6	15.1	15.0
Fertilizer	2.4	4.4	2.2	4.1	2.7	0.0	0.8	1.3	1.4
Sub-Total	43.3	44.6	80.8	106.5	117.1	89.4	87.0	77.1	93.2
Other Exports	57.5	91.2	99.2	100.5	126.4	108.0	105.2	104.8	116.4
Total Exports	100.8	135.8	180.0	207.0	243.5	197.4	192.2	181.9	209.6
Price (FCFA/kg)									
Groundnuts	100.3	158.6	119.8	137.8	267.9	206.6	109.4	81.6	89.1
Raw Oil	180.5	287.0	205.3	229.9	459.6	460.0	207.7	144.8	165.4
Refined Oil	142.9	333.3	375.0	258.6	471.4	526.3	333.3	333.3	300.0
Meal	42.5	59.6	51.8	63.4	81.2	57.8	44.9	36.9	48.3
Grain	185.2	230.8	138.9	166.0	260.9	585.0	181.8	125.0	200.0
Cotton	375.0	476.2	475.2	595.6	758.2	710.0	357.1	415.4	446.3
Fruit & Veg.		108.5	99.1	96.0	206.9	285.5	333.8	383.0	
Fish	296.9	403.8	436.9	511.4	558.3	590.2	583.5	651.6	653.6
Fresh	232.4	321.0	344.5	395.9	440.1	466.2	471.4	597.9	610.4
Canned	629.3	697.4	758.8	824.7	870.4	920.0	874.1	816.2	815.2
Fertilizer	17.6	30.0	15.9	23.6	20.5	na	25.9	30.2	31.8
Sub-Total	111.5	154.6	138.4	156.9	260.4	384.7	245.1	197.4	177.2
Other Exports	13.6	23.6	49.7	45.2	48.8	39.9	43.5	55.7	
Total Exports	125.1	178.3	188.1	202.2	309.2	424.6	288.6	253.1	

Source: [MDRH, November 1989] (exports)

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Annex II

Crop Production
Farm Prices
Fertilizer Use

Table 1 Senegal: Area Planted by Crop (1000 HA)

Crop / Year	Millet Sorghum	Maize	Rice	Cowpeas	Manioc	Groundnuts		Cotton	Total
						Oil	Table		
1960 / 61	761	31	68	45	35	974	--	--	1,912
1961 / 62	839	32	73	56	36	1,021	--	--	2,057
1962 / 63	863	31	71	49	39	1,010	--	--	2,064
1963 / 64	959	33	74	47	28	1,079	--	--	2,220
1964 / 65	1,010	37	80	56	32	1,051	--	--	2,266
1965 / 66	1,068	44	81	53	38	1,108	--	1	2,395
1966 / 67	996	44	87	86	68	1,110	--	2	2,393
1967 / 68	1,154	72	101	99	67	1,159	--	4	2,655
1968 / 69	1,053	36	77	68	65	1,188	--	7	2,494
1969 / 70	1,036	55	103	71	44	961	--	10	2,280
1970 / 71	964	51	93	63	42	1,046	8	14	2,281
1971 / 72	969	49	84	71	33	1,055	11	18	2,291
1972 / 73	936	32	53	86	45	1,069	15	20	2,257
1973 / 74	1,102	39	65	53	29	1,023	19	28	2,358
1974 / 75	1,143	49	85	59	34	1,050	22	38	2,480
1975 / 76	962	49	94	62	29	1,310	24	39	2,569
1976 / 77	948	48	89	63	27	1,293	17	44	2,529
1977 / 78	942	54	63	57	20	1,161	24	47	2,368
1978 / 79	1,054	56	91	63	23	1,153	24	48	2,514
1979 / 80	967	68	79	55	8	1,047	21	31	2,276
1980 / 81	1,115	78	67	54	8	1,064	9	30	2,425
1981 / 82	1,190	78	73	68	8	1,009	8	32	2,465
1982 / 83	990	86	68	48	9	1,142	18	42	2,403
1983 / 84	828	70	51	42	6	1,080	29	33	2,140
1984 / 85	1,003	84	66	51	7	858	15	46	2,130
1985 / 86	1,338	102	78	128	8	594	10	39	2,297
1986 / 87	992	96	71	117	20	789	18	25	2,130
1987 / 88	1,073	102	74	71	14	830	14	29	2,207
1988 / 89	1,022	112	79	69	19	885	17	39	2,242
1989 / 90	1,084	96	79	65	18	763	19	24	2,148
1990 / 91	1,037	116	71	45	12	886	28	36	2,233

Source: GOS/MDRH/DS

Table 2 Senegal: Crop Production (1000 MT)

Crop Year	Millet Sorghum	Maize	Rice	Cowpeas	Manioc	Groundnuts		Cotton	Total	Groundnuts Marketed
						Oil	Table			
1960 / 61	392	27	81	11	159	889	--	--	1,560	786
1961 / 62	406	21	83	15	137	992	--	--	1,654	859
1962 / 63	423	27	90	13	151	892	--	--	1,595	765
1963 / 64	478	27	105	13	146	949	--	--	1,718	806
1964 / 65	531	32	108	17	155	1,017	--	--	1,860	867
1965 / 66	555	36	122	14	149	1,120	--	1	1,996	993
1966 / 67	423	36	125	18	237	855	--	2	1,697	772
1967 / 68	654	57	134	30	234	1,002	--	4	2,115	949
1968 / 69	448	25	61	17	226	819	--	10	1,607	707
1969 / 70	556	49	140	22	177	787	--	11	1,742	698
1970 / 71	383	33	95	18	161	581	8	12	1,291	500
1971 / 72	582	38	109	26	137	981	13	21	1,907	870
1972 / 73	322	20	39	11	150	570	17	23	1,153	498
1973 / 74	509	34	67	15	120	656	17	33	1,450	570
1974 / 75	799	43	117	22	120	980	18	41	2,140	882
1975 / 76	615	44	130	24	108	1,432	24	31	2,408	1178
1976 / 77	507	43	126	16	66	1,186	13	45	2,002	1125
1977 / 78	410	33	64	12	74	509	11	37	1,151	464
1978 / 79	752	54	146	22	81	1,050	10	34	2,149	912
1979 / 80	521	46	97	19	25	673	3	27	1,410	417
1980 / 81	544	57	65	17	25	520	2	21	1,251	191
1981 / 82	742	95	127	29	32	866	5	41	1,935	686
1982 / 83	585	82	108	13	32	1,139	5	47	2,011	899
1983 / 84	355	61	101	10	17	570	10	37	1,161	355
1984 / 85	471	103	136	16	19	669	13	59	1,487	236
1985 / 86	949	151	147	80	31	590	11	38	1,997	350
1986 / 87	633	112	143	55	75	821	19	25	1,883	590
1987 / 88	801	119	133	29	52	946	17	35	2,131	608
1988 / 89	594	129	146	17	54	717	20	45	1,722	461
1989 / 90	763	132	169	25	58	819	25	29	2,020	590

Source: GOS/MDRH/DS

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Table 3 Senegal: Crop Yields (kg/ha)

Crop Year	Millet Sorghum	Maize	Rice	Cowpeas	Manioc	Groundnuts		Cotton	Total
						Oil	Table		
1960 / 61	515	891	1,201	247	4,561	913	--	--	816
1961 / 62	484	646	1,138	268	3,764	972	--	--	804
1962 / 63	491	847	1,258	267	3,878	883	--	--	773
1963 / 64	499	817	1,417	273	5,182	880	--	--	774
1964 / 65	526	850	1,347	298	4,920	968	--	--	821
1965 / 66	519	811	1,496	257	3,927	1,010	--	473	833
1966 / 67	425	824	1,428	211	3,507	770	--	888	709
1967 / 68	567	793	1,327	305	3,499	864	--	1,054	797
1968 / 69	426	696	797	253	3,464	689	--	1,459	644
1969 / 70	537	881	1,350	317	4,023	819	--	1,172	764
1970 / 71	397	653	1,017	281	3,794	556	1,064	852	566
1971 / 72	601	770	1,301	363	4,152	930	1,164	1,155	833
1972 / 73	344	625	738	125	3,361	533	1,104	1,145	511
1973 / 74	462	864	1,030	287	4,139	642	892	1,159	615
1974 / 75	699	890	1,377	375	3,528	933	827	1,070	863
1975 / 76	639	890	1,390	396	3,765	1,093	980	783	937
1976 / 77	535	898	1,418	255	2,461	917	743	1,031	792
1977 / 78	435	617	1,018	205	3,722	439	470	789	486
1978 / 79	713	958	1,604	344	3,475	910	432	700	855
1979 / 80	538	684	1,227	340	3,109	642	148	881	619
1980 / 81	488	727	963	315	3,271	489	181	701	516
1981 / 82	623	1,219	1,739	420	4,162	858	589	1,282	785
1982 / 83	591	953	1,582	276	3,722	997	293	1,120	837
1983 / 84	429	860	1,975	234	2,742	528	349	1,108	543
1984 / 85	470	1,223	2,055	309	2,958	780	880	1,284	698
1985 / 86	710	1,478	1,881	621	4,035	993	1,078	969	869
1986 / 87	638	1,165	1,998	466	3,788	1,041	1,077	970	884
1987 / 88	746	1,167	1,803	400	3,861	1,139	1,175	1,219	966
1988 / 89	581	1,147	1,858	250	2,904	810	1,133	1,167	768
1989 / 90	704	1,375	2,131	391	3,258	1,072	1,263	1,212	940

Source: Calculated.

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Table 4 Senegal: Producer Prices (FCFA/kg)

Crop Year	Millet/ Sorghum	Maize	Rice	Cowpeas	Groundnuts		Cotton		Average per kg	GDP Deflator
					Oil	Table	st Ch.	2nd Ch.		
1960 / 61	15.0	12.0	18.0	20.0	22.5	--	--	--	17.9	41.2
1961 / 62	16.0	13.0	18.0	20.0	22.5	--	--	--	18.7	42.2
1962 / 63	16.0	13.0	20.0	20.0	21.5	--	--	--	17.8	42.3
1963 / 64	15.0	14.0	20.0	20.0	21.5	--	28.0	28.0	17.6	43.7
1964 / 65	17.0	14.0	21.0	20.0	21.5	--	28.0	28.0	18.3	44.2
1965 / 66	17.0	15.0	21.0	20.0	21.5	--	28.0	28.0	18.5	44.5
1966 / 67	17.0	15.0	21.0	25.0	20.5	--	28.0	28.0	16.7	45.0
1967 / 68	17.0	15.0	21.0	25.0	18.0	--	28.0	28.0	15.9	44.9
1968 / 69	20.0	18.0	21.0	25.0	18.0	--	28.0	28.0	16.3	48.0
1969 / 70	20.0	18.0	21.0	25.0	18.5	--	28.0	28.0	17.4	49.0
1970 / 71	17.0	18.0	21.0	25.0	19.5	29.0	28.0	28.0	16.6	50.6
1971 / 72	17.0	18.0	21.0	25.0	23.1	28.9	31.0	16.0	19.4	52.7
1972 / 73	17.5	19.0	25.0	25.0	23.0	28.1	30.0	15.0	18.5	56.8
1973 / 74	25.0	25.0	22.0	30.0	29.5	29.6	34.0	19.0	25.0	66.4
1974 / 75	30.0	35.0	41.5	30.0	41.5	51.1	47.0	22.0	34.6	74.3
1975 / 76	30.0	35.0	41.5	28.0	41.5	51.9	47.0	22.0	36.5	81.2
1976 / 77	35.0	35.0	41.5	28.0	41.5	51.6	49.0	25.0	38.2	87.1
1977 / 78	35.0	37.0	41.5	30.0	41.5	54.7	49.0	25.0	36.3	93.2
1978 / 79	40.0	37.0	41.5	30.0	41.5	52.1	49.0	25.0	39.2	100.0
1979 / 80	40.0	37.0	41.5	30.0	45.5	54.4	55.0	50.0	42.1	109.5
1980 / 81	40.0	37.0	41.5	33.0	44.0	54.5	60.0	55.0	41.0	119.8
1981 / 82	50.0	47.0	51.5	43.0	60.0	80.0	68.0	62.0	53.9	131.2
1982 / 83	50.0	47.0	51.5	43.0	50.0	80.0	70.0	62.0	49.6	142.2
1983 / 84	55.0	50.0	60.0	43.0	50.0	80.0	70.0	62.0	52.4	161.0
1984 / 85	60.0	60.0	66.0	60.0	60.0	90.0	70.0	62.0	60.3	175.9
1985 / 86	70.0	70.0	85.0	70.0	90.0	95.0	100.0	90.0	76.5	189.1
1986 / 87	70.0	70.0	85.0	70.0	90.0	95.0	100.0	90.0	77.7	202.3
1987 / 88	70.0	70.0	85.0	70.0	90.0	95.0	100.0	90.0	78.7	214.4
1988 / 89	75.0	75.0	85.0	89.0	70.0	95.0	100.0	90.0	72.3	225.1
1989 / 90	71.0	71.0	85.0	75.0	70.0	95.0	100.0	90.0	70.4	226.4

Source: GOS/MDRH/DS, CSA.

Note: Price for oil groundnuts excludes 10 FCFA in 1981 and 20 FCFA in 1982/83-1985/86 (witheld to cover bad debit, seeds and fertilizer)

The average per kg is gross value of output/total output.

Table 5 Gross Value of Output by Crop (billion FCFA)

Crop Year	Millet Sorghum	Maize	Rice	Cowpeas	Groundnuts Oil	Groundnuts Table	Cotton	Total Gross	GDP Deflator	Total Real
1960 / 61	5.878	0.326	1.463	0.223	20.003	--	--	27.893	41.2	67.7
1961 / 62	6.497	0.269	1.502	0.302	22.312	--	--	30.882	42.2	73.2
1962 / 63	6.776	0.345	1.798	0.262	19.168	--	--	28.350	42.3	67.0
1963 / 64	7.175	0.373	2.107	0.257	20.409	--	--	30.321	43.7	69.4
1964 / 65	9.024	0.442	2.274	0.334	21.875	--	--	33.949	44.2	76.8
1965 / 66	9.432	0.539	2.559	0.273	24.073	--	--	36.876	44.5	82.9
1966 / 67	7.196	0.541	2.618	0.451	17.533	--	0.057	28.396	45.0	63.1
1967 / 68	11.126	0.852	2.809	0.753	18.029	--	0.119	33.689	44.9	75.0
1968 / 69	8.966	0.455	1.285	0.429	14.740	--	0.273	26.149	48.0	54.5
1969 / 70	11.119	0.879	2.931	0.561	14.556	--	0.322	30.367	49.0	62.0
1970 / 71	6.512	0.595	1.994	0.441	11.330	0.238	0.325	21.435	50.6	42.4
1971 / 72	9.902	0.677	2.298	0.641	22.668	0.365	0.497	37.048	52.7	70.3
1972 / 73	5.635	0.384	0.984	0.271	13.112	0.476	0.524	21.385	56.8	37.6
1973 / 74	12.721	0.847	1.470	0.455	19.364	0.490	0.864	36.209	66.4	54.5
1974 / 75	23.960	1.513	4.866	0.668	40.654	0.944	1.401	74.006	74.3	99.6
1975 / 76	18.455	1.536	5.393	0.684	59.437	1.235	1.059	87.798	81.2	108.1
1976 / 77	17.731	1.499	5.219	0.451	49.232	0.653	1.672	76.458	87.1	87.8
1977 / 78	14.348	1.224	2.675	0.350	21.144	0.611	1.375	41.727	93.2	44.8
1978 / 79	30.066	2.000	6.075	0.650	43.559	0.544	1.251	84.146	100.0	84.1
1979 / 80	20.821	1.713	4.008	0.565	30.601	0.171	1.430	59.309	109.5	54.2
1980 / 81	21.773	2.101	2.683	0.563	22.890	0.088	1.206	51.303	119.8	42.8
1981 / 82	37.085	4.448	6.543	1.235	51.944	0.369	2.665	104.290	131.2	79.5
1982 / 83	29.228	3.861	5.555	0.568	56.935	0.426	3.107	99.680	142.2	70.1
1983 / 84	19.514	3.028	6.09[illegible]	0.419	28.516	0.813	2.441	60.821	161.0	37.8
1984 / 85	28.283	6.201	8.964	0.947	40.139	1.187	3.927	89.647	175.9	51.0
1985 / 86	66.460	10.537	12.495	5.575	53.141	1.043	3.576	152.826	189.1	80.8
1986 / 87	44.327	7.854	12.132	3.816	73.928	1.835	2.342	146.235	202.3	72.3
1987 / 88	56.051	8.322	11.279	1.998	85.107	1.582	3.344	167.683	214.4	78.2
1988 / 89	44.534	9.666	12.444	1.537	50.159	1.856	4.275	124.471	225.1	55.3
1989 / 90	54.146	9.354	14.370	1.893	57.307	2.335	2.785	142.190	226.4	62.8

Source: Calculated

crop_sum

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Table 6 Estimated Value of Marketed Output by Crop (billion FCFA)

Crop Year	Millet Sorghum	Maize	Rice	Cowpeas	Groundnuts Oil	Groundnuts Table	Cotton	Total Gross	GDP Deflator	Total Real
1960 / 61	0.588	0.033	0.439	0.022	17.685	--	--	18.767	41.2	45.550
1961 / 62	0.650	0.027	0.451	0.030	19.328	--	--	20.485	42.2	48.542
1962 / 63	0.678	0.035	0.539	0.026	16.448	--	--	17.725	42.3	41.904
1963 / 64	0.718	0.037	0.632	0.026	17.329	--	--	18.742	43.7	42.887
1964 / 65	0.902	0.044	0.682	0.033	18.641	--	--	20.303	44.2	45.934
1965 / 66	0.943	0.054	0.768	0.027	21.350	--	--	23.142	44.5	52.004
1966 / 67	0.720	0.054	0.785	0.045	15.826	--	0.057	17.487	45.0	38.860
1967 / 68	1.113	0.085	0.843	0.075	17.082	--	0.119	19.317	44.9	43.023
1968 / 69	0.897	0.046	0.386	0.043	12.726	--	0.273	14.370	48.0	29.937
1969 / 70	1.112	0.088	0.879	0.056	12.913	--	0.322	15.370	49.0	31.368
1970 / 71	0.651	0.060	0.598	0.044	9.750	0.119	0.325	11.547	50.6	22.820
1971 / 72	0.990	0.068	0.689	0.064	20.097	0.183	0.497	22.588	52.7	42.862
1972 / 73	0.563	0.038	0.295	0.027	11.454	0.238	0.524	13.140	56.8	23.134
1973 / 74	1.272	0.085	0.441	0.045	16.315	0.245	0.864	19.767	66.4	29.769
1974 / 75	2.396	0.151	1.460	0.067	36.603	0.472	1.401	42.549	74.3	57.267
1975 / 76	1.846	0.154	1.618	0.068	48.887	0.617	1.059	54.249	81.2	66.809
1976 / 77	1.773	0.150	1.566	0.045	46.688	0.327	1.672	52.220	87.1	59.954
1977 / 78	1.435	0.122	0.803	0.035	19.756	0.305	1.375	23.331	93.2	25.033
1978 / 79	3.007	0.200	1.823	0.065	37.848	0.272	1.251	44.465	100.0	44.465
1979 / 80	2.082	0.171	1.202	0.057	18.974	0.085	1.430	24.001	109.5	21.918
1980 / 81	2.177	0.210	0.805	0.056	8.404	0.044	1.206	12.903	119.8	10.770
1981 / 82	3.708	0.445	1.963	0.124	41.160	0.184	2.665	50.250	131.2	38.300
1982 / 83	2.923	0.386	1.666	0.057	44.950	0.213	3.107	53.302	142.2	37.484
1983 / 84	1.951	0.303	1.827	0.042	17.750	0.407	2.441	24.721	161.0	15.354
1984 / 85	2.828	0.620	2.689	0.095	14.160	0.593	3.927	24.913	175.9	14.163
1985 / 86	6.640	1.054	3.748	0.557	31.500	0.521	3.576	47.603	189.1	25.173
1986 / 87	4.433	0.785	3.640	0.382	53.100	0.918	2.342	65.599	202.3	32.427
1987 / 88	5.605	0.832	3.384	0.200	54.720	0.791	3.344	68.876	214.4	32.125
1988 / 89	4.453	0.967	3.733	0.154	32.270	0.928	4.275	46.779	225.1	20.782
1989 / 90	5.415	0.935	4.311	0.189	41.319	1.168	2.785	56.123	226.4	24.787
% Mkted	0.1	0.1	0.3	0.1	0.7	0.5	1			

Source: Calculated

Table 7. Rice Supply and Utilization (000 tons) and Per Capita Consumption (kg/year)

Year	Supply											Use		
	Area 000 ha	Prod. 000 MT	Milled 000 MT	Yield kg/ha	Stock Change 000 MT	Aid Imports 000 MT	CPSP Imports 000 MT	Private Imports 000 MT	Total Imports 000 MT	Exports 000 MT	Total Avail. 000 MT	Non-Food Use 000 MT	Consump-tion 000 MT	Per capita Consumptio kg
1976	88.7	125.8	83.8	1,418	50	0.0	244.5	0.0	244.5	0	281.0	12.0	269.0	53.8
1977	93.5	129.9	86.5	1,390	-10	0.3	217.7	0.0	218.0	0	311.8	13.0	298.8	58.2
1978	88.7	125.8	83.8	1,418	-40	3.6	234.2	0.0	237.8	0	364.3	12.0	352.3	66.8
1979	63.3	64.5	42.9	1,018	50	7.8	322.1	0.0	329.9	0	363.7	14.0	349.7	64.6
1980	91.3	146.4	97.5	1,604	50	7.0	255.5	143.7	406.2	0	399.1	9.0	390.1	70.2
1981	78.7	96.6	64.3	1,227	-25	36.7	297.0	-11.9	321.8	0	444.3	13.0	431.3	75.5
1982	67.2	64.7	43.1	963	25	22.2	329.7	6.7	358.6	0	397.9	11.0	386.9	66.0
1983	73.0	127.1	84.6	1,739	-50	28.1	376.1	-65.5	338.7	0	451.8	8.0	423.8	70.4
1984	68.2	107.9	71.8	1,582	-10	35.8	347.8	-19.2	364.4	0	459.0	11.0	448.0	72.4
1985	51.4	101.5	67.6	1,975	4	5.2	325.6	5.2	336.0	0	403.8	11.0	392.8	61.8
1986	66.1	135.8	90.5	2,055	21	49.4	310.7	18.2	378.3	0	424.9	11.0	413.9	63.4
1987	78.2	147.0	97.9	1,881	-39	39.6	166.8	100.3	306.7	0	436.2	13.0	423.2	63.1
1988	71.4	142.7	95.1	1,998	8	64.6	262.9	32.5	360.0	0	449.9	14.0	435.9	63.3
1989	73.6	132.7	88.4	1,803	15	37.6	382.9	-10.5	410.0	0	490.1	14.0	476.1	67.4
1990	79.0	160.0	106.6	2,025	10	30	340.0	15.0	385.0	0	463.4	8.0	455.4	62.7

Source: USAID Database, CPSP, MDRH/DAS

(sd.a)

Note: Production in crop year beginning with indicated year, largely for consumption in the following year.

- Import privatization experiment.

Milling	0.666	Seed rate in tons paddy/ha	0.1
Waste	0.06	Seed rate in tons rice/ha	0.0666

Table 8. Wheat Supply and Utilization (000 tons) and Per Capita Consumption (kg/year)

Year	Supply (000 tons)						Use (000 tons)		Per Capita (kg)
	Stock Change	Aid Imports	Private Imports	Total Imports	Exports	Total Avail.	Non-Food	Consumption	
1976	5	1.6	121.6	123.2	0.7	118.2	2.4	115.8	23.2
1977	5	14.0	121.4	135.4	8.3	130.4	2.6	127.8	24.9
1978	0	54.5	100.7	155.2	28.8	155.2	3.1	152.1	28.8
1979	5	10.3	117.8	128.1	11.5	123.1	2.5	120.6	22.3
1980	-15	14.1	94.5	108.6	0.0	123.6	2.5	121.1	21.8
1981	5	33.2	97.4	130.6	0.3	125.6	2.5	123.1	21.6
1982	0	24.1	98.0	122.1	0.0	122.1	2.4	119.6	20.4
1983	5	37.5	104.6	142.1	0.0	137.1	2.7	134.4	22.3
1984	-5	42.1	85.4	127.5	0.0	132.5	2.7	129.9	21.0
1985	-6	35.7	90.5	126.2	0.0	132.2	2.6	129.6	20.4
1986	15	17.7	115.0	132.7	0.0	117.7	2.4	115.3	17.7
1987	-6	25.2	86.5	111.7	0.0	117.7	2.4	115.3	17.2
1988	7	18.6	118.7	137.3	0.0	130.3	2.6	127.7	18.6
1989	0	6.8	133.2	140.0	0.0	140.0	2.8	137.2	19.4
1990	0	16.4	133.0	149.4	0.0	149.4	3.0	146.4	20.2

Source: USAID Database, CPSP, MDRH/DAS (s&u)

Feed % 0

Waste 0.02

Table 9. Millet and Sorghum Supply and Utilization (000 tons) and Per Capita Consumption (kg/year)

	Supply										Use		
Year	Area 1000 ha	Prod. 000 MT	Milled 000 MT	Yield kg/ha	Stock Change 000 MT	Aid Imports 000 MT	Other Imports 000 MT	Total Imports 000 MT	Exports 000 MT	Total Avail. 000 MT	Non-Food 000 MT	Consump-tion 000 MT	Per Capita kg
1976	1,143	799		535	0.0	3.9	44.0	47.9	0.0	663.9	71.4	592.5	118.5
1977	962	615		639	-25.0	29.4	15.6	45.0	0.0	868.7	84.3	784.3	152.8
1978	948	507		535	-75.0	46.0	23.5	69.5	0.0	759.7	71.3	688.4	130.6
1979	942	410		435	100.0	2.2	7.8	10.0	0.0	416.6	67.1	349.5	64.6
1980	1,054	752		713	-50.0	19.1	9.8	28.9	0.0	488.8	57.7	431.1	77.5
1981	967	521		538	-50.0	5.8	25.1	30.9	0.0	832.6	86.1	746.5	130.7
1982	1,115	544		488	75.0	3.1	6.8	9.9	0.0	455.4	72.1	383.3	65.4
1983	1,190	742		623	0.0	26.1	52.9	79.0	0.0	623.3	67.8	555.5	92.2
1984	990	585		591	-45.0	155.0	11.0	166.0	0.0	952.7	76.7	876.0	141.6
1985	828	355		429	-30.0	46.0	0.4	46.4	0.0	661.0	71.0	590.0	92.9
1986	1,003	471		470	100.0	15.0	0.0	15.0	0.0	269.8	65.0	204.8	31.4
1987	1,338	949		710	-75.0	7.0	(0.3)	6.7	0.0	553.1	62.8	490.3	73.2
1988	992	633		638	40.0	7.0	0.0	7.0	0.0	916.4	98.6	817.8	118.8
1989	1,073	801		746	-55.0	5.5	29.5	35.0	0.0	723.2	74.3	648.9	91.8
1990	1,000	760		760	45.0		0.0			755.7	56.1	699.7	96.4

Source: USAID Database, CPSP, MDRH/DAS (s&u)

Seeding 30 kg/ha
Waste 6.0%
Feed % 1.0%

Table 10. Corn Supply and Utilization (000 tons) and Per Capita Consumption (kg/year)

	Supply										Use		
Year	Area 1000 ha	Prod. 000 MT	Milled 000 MT	Yield kg/ha	Stock Change 000 MT	Aid Imports 000 MT	Other Imports 000 MT	Total Imports 000 MT	Exports 000 MT	Total Avail. 000 MT	Non-Food 000 MT	Consump-tion 000 MT	Per Capita kg
1976	48.6	43.2		890	0.0	2.8	12.3	15.1	0.0	59.1	6.6	52.5	10.5
1977	49.3	43.9		890	5.0	0.3	20.7	21.0	0.0	64.6	6.4	58.2	11.3
1978	47.7	42.8		898	-5.0	0.9	11.1	12.0	0.0	53.9	6.5	47.4	9.0
1979	53.6	33.1		617	0.0	0.0	3.2	3.2	0.0	36.3	6.0	30.3	5.6
1980	56.4	54.0		958	0.0	13.8	6.2	20.0	0.0	60.2	6.9	53.3	9.6
1981	67.7	46.3		684	0.0	9.7	0.0	9.7	0.0	46.3	8.0	38.3	6.7
1982	78.1	56.8		727	0.0	0.0	5.8	5.8	0.0	62.6	8.1	54.4	9.3
1983	77.7	94.6		1,219	10.0	0.0	8.4	8.4	0.0	103.0	11.2	91.8	15.2
1984	86.2	82.2		953	-10.0	15.0	5.0	20.0	0.0	87.2	12.4	74.8	12.1
1985	70.4	60.6		860	7.0	0.8	13.9	14.7	0.0	74.5	10.7	63.8	10.0
1986	84.5	103.4		1,223	16.0	0.0	10.0	10.0	0.0	113.4	12.4	101.0	15.5
1987	101.9	150.5		1,478	-21.0	0.0	6.0	6.0	0.0	156.5	17.6	138.9	20.7
1988	96.3	112.2		1,165	-1.0	6.8	0.0	6.8	0.0	112.2	18.3	93.9	13.6
1989	101.8	118.9		1,167	0.0	2.0	8.0	10.0	0.0	126.9	16.3	110.6	15.7
1990	96.0	132.0		1,375	0.0	1.0	5.0	6.0	0.0	137.0	15.1	121.9	16.8

Source: USAID Database, CPSP, MDRH/DAS (s&u)

Seed rat 25 kg/ha

Feed % 6.0%

Waste 0.06

Table 11 Senegal: Millet/Sorghum Area Planted (1000 hectares)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	77.5	109.3	126.5	79.1	-	-	244.4	-	-	72.4	51.5	760.6
1961	62	109.7	113.8	128.0	89.2	-	-	265.5	-	-	80.6	52.1	838.9
1962	63	113.8	89.6	127.0	131.4	-	-	270.1	-	-	77.8	53.3	863.0
1963	64	110.6	157.2	132.1	132.8	-	-	291.5	-	-	86.4	53.1	958.6
1964	65	125.0	150.0	139.0	135.0	-	-	298.5	-	-	102.9	59.5	1009.9
1965	66	122.0	156.0	147.0	149.0	-	-	315.0	-	-	112.4	67.0	1068.4
1966	67	123.1	110.3	145.5	148.0	-	-	308.5	-	-	88.3	71.6	995.6
1967	68	140.1	153.0	163.1	147.0	-	-	352.5	-	-	125.1	73.4	1154.2
1968	69	106.7	127.5	158.1	128.3	-	-	347.3	-	-	113.0	72.0	1053.0
1969	70	104.2	123.9	164.9	110.1	-	-	323.7	-	-	121.2	87.9	1035.8
1970	71	91.1	129.2	152.4	101.0	-	-	287.0	-	-	123.4	80.1	964.2
1971	72	118.4	107.3	160.1	99.0	-	-	319.7	-	-	92.2	72.8	969.5
1972	73	49.5	138.5	155.9	103.5	-	-	320.0	-	-	94.8	73.6	935.7
1973	74	86.5	179.9	175.6	146.2	-	-	343.1	-	-	99.3	71.6	1102.1
1974	75	120.6	156.4	123.5	162.3	-	-	422.0	-	-	95.5	62.5	1142.8
1975	76	94.6	148.7	128.5	168.0	-	-	262.3	-	-	90.7	69.7	962.5
1976	77	99.9	132.4	121.6	161.5	-	-	281.5	-	-	91.1	59.5	947.7
1977	78	76.1	135.7	102.0	149.2	-	-	333.0	-	-	87.3	58.6	941.9
1978	79	91.6	161.0	110.0	161.2	-	-	366.8	-	-	103.2	60.3	1054.2
1979	80	38.5	142.5	113.9	172.4	-	-	328.9	-	-	104.5	66.4	967.2
1980	81	86.4	155.1	156.9	145.6	-	-	410.8	-	-	104.1	56.3	1115.1
1981	82	97.3	185.8	150.4	168.7	-	-	428.5	-	-	99.3	59.7	1189.7
1982	83	30.8	176.3	152.0	130.7	-	-	338.7	-	-	95.7	65.7	989.9
1983	84	24.4	65.1	134.1	108.2	-	-	349.8	-	-	84.3	61.7	827.6
1984	85	2.2	145.1	165.7	154.7	163.9	238.4	402.2	18.4	37.5	55.9	77.0	1002.7
1985	86	28.3	201.3	177.2	204.8	187.3	319.1	506.3	22.1	84.2	106.3	113.3	1337.7
1986	87	18.2	124.8	143.2	123.5	128.4	249.7	378.1	15.0	82.5	97.5	106.9	992.2
1987	88	17.4	157.6	119.9	141.2	143.8	293.8	437.6	7.8	87.9	95.6	103.4	1072.9
1988	89	26.2	138.4	100.2	126.4	131.9	296.2	428.1	9.2	84.8	94.0	108.7	1022.0
1989	90	15.3	144.1	115.8	135.3	153.9	348.8	502.6	10.5	90.7	101.2	69.3	1083.6
Source: MDRH/DA/DAS													
Average (85-89)		21.1	153.3	131.3	146.2	149.1	301.5	450.6	12.9	86.0	98.9	100.3	1101.7

Table 12 Senegal: Maize Area Planted (1000 hectares)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	4.3	–	–	–	–	–	2.3	–	–	13.3	10.7	30.5
1961 62	5.5	–	–	–	–	–	2.1	–	–	13.7	10.7	32.0
1962 63	4.9	–	–	–	–	–	2.2	–	–	12.3	12.0	31.4
1963 64	4.1	–	–	–	–	–	2.4	–	–	13.8	12.3	32.6
1964 65	4.5	–	–	–	–	–	2.4	–	–	17.8	12.5	37.2
1965 66	6.0	–	–	–	–	–	2.1	–	–	22.6	13.6	44.3
1966 67	4.5	–	–	–	–	–	0.8	–	–	22.0	16.6	43.8
1967 68	19.5	–	–	–	–	–	1.2	–	–	33.7	17.3	71.7
1968 69	7.0	–	–	–	–	–	0.9	–	–	21.7	6.8	36.3
1969 70	10.2	–	–	–	–	–	0.7	–	–	29.6	14.9	55.4
1970 71	8.4	–	–	–	–	–	0.6	–	–	25.2	16.6	50.6
1971 72	10.1	–	–	–	–	–	0.7	–	–	19.5	18.5	48.8
1972 73	0.4	–	–	–	–	–	0.8	–	–	13.0	18.2	32.3
1973 74	4.6	–	–	–	–	–	0.7	–	–	14.1	19.8	39.2
1974 75	7.7	–	–	–	–	–	1.2	–	–	15.3	24.4	48.6
1975 76	5.7	–	–	–	–	–	2.9	–	–	13.6	27.1	49.3
1976 77	3.0	–	–	–	–	–	12.9	–	–	16.0	15.8	47.7
1977 78	2.5	–	–	–	–	–	12.8	–	–	16.0	22.3	53.6
1978 79	5.6	–	–	–	–	–	10.1	–	–	22.8	17.9	56.4
1979 80	2.8	–	–	–	–	–	15.2	–	–	25.8	23.9	67.7
1980 81	5.9	–	–	–	–	–	25.0	–	–	24.4	22.9	78.1
1981 82	6.4	–	–	–	–	–	14.3	–	–	29.6	27.4	77.7
1982 83	8.8	–	–	–	–	–	27.0	–	–	25.5	24.9	86.2
1983 84	3.8	–	–	–	–	–	13.9	–	–	27.0	25.7	70.4
1984 85	2.9	–	–	–	0.4	15.8	16.2	5.5	30.0	35.5	29.9	84.5
1985 86	2.4	–	–	–	5.4	25.7	31.1	7.1	31.0	38.1	30.3	101.9
1986 87	3.5	–	–	–	4.6	19.2	23.8	5.1	34.9	40.0	29.0	96.3
1987 88	3.3	–	–	–	3.0	25.0	28.0	3.9	38.1	42.0	28.6	101.8
1988 89	2.3	–	–	–	2.7	30.6	33.3	2.7	38.4	41.0	35.6	112.3
1989 90	3.0	–	0.2	–	2.7	31.4	34.1	1.5	38.3	39.8	18.7	95.8
Source: MDRH/DA/DAS												
Average (85-89)	2.9	–	–	–	3.7	26.4	30.0	4.1	36.1	40.2	28.4	101.6

Table 13 Senegal: Paddy Area Planted (1000 hectares)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	6.6	–	–	–	–	–	7.0	–	–	52.6	1.6	67.7
1961 62	7.5	–	–	–	–	–	11.0	–	–	53.3	1.6	73.4
1962 63	8.0	–	–	–	–	–	6.2	–	–	55.7	1.6	71.5
1963 64	8.3	–	–	–	–	–	6.9	–	–	57.6	1.5	74.3
1964 65	9.5	–	–	–	–	–	7.4	–	–	61.9	1.5	80.4
1965 66	12.9	–	–	–	–	–	6.5	–	–	61.0	1.1	81.5
1966 67	15.5	–	–	–	–	–	4.5	–	–	65.3	1.9	87.3
1967 68	16.4	–	–	–	–	–	3.6	–	–	78.5	2.3	100.8
1968 69	15.9	–	–	–	–	–	3.5	–	–	54.5	3.0	76.8
1969 70	15.8	–	–	–	–	–	1.3	–	–	84.6	1.7	103.4
1970 71	15.8	–	–	–	–	–	1.1	–	–	74.5	1.9	93.3
1971 72	11.7	–	–	–	–	–	2.7	–	–	65.3	4.3	84.1
1972 73	11.5	–	–	–	–	–	2.8	–	–	35.0	4.0	53.3
1973 74	8.0	–	–	–	–	–	2.1	–	–	49.7	5.0	64.9
1974 75	9.4	–	–	–	–	–	4.3	–	–	63.8	7.7	85.1
1975 76	10.5	–	–	–	–	–	1.7	–	–	70.9	10.4	93.5
1976 77	10.7	–	–	–	–	–	1.8	–	–	65.1	11.0	88.7
1977 78	7.8	–	–	–	–	–	1.2	–	–	41.9	12.4	63.3
1978 79	9.5	–	–	–	–	–	1.2	–	–	71.8	8.8	91.3
1979 80	9.8	–	–	–	–	–	1.0	–	–	57.8	10.1	78.7
1980 81	9.7	–	–	–	–	–	1.7	–	–	48.7	7.0	67.[illegible]
1981 82	10.3	–	–	–	–	–	0.0	–	–	56.9	5.9	73.0
1982 83	13.7	–	–	–	–	–	0.0	–	–	50.3	4.2	68.2
1983 84	14.2	–	–	–	–	–	0.0	–	–	31.8	5.4	51.4
1984 85	16.6	–	–	–	–	–	0.0	20.1	25.1	45.2	4.3	66.1
1985 86	15.3	–	–	–	0.3		0.3	30.0	29.2	59.2	3.3	78.2
1986 87	15.9	–	–	–	0.3	0.2	0.5	21.0	29.5	50.5	4.5	71.4
1987 88	13.2	–	–	–	0.4	0.2	0.6	25.7	31.8	57.5	2.2	73.6
1988 89	15.0	–	–	–	0.3	0.2	0.5	25.4	32.3	57.7	5.6	78.8
1989 90	18.1	–	–	–	0.2	0.2	0.4	27.5	30.0	57.4	3.3	79.3
Source: MDRH/DA/DAS												
Average (85-89)	15.5	–	–	–	0.3	0.2	0.5	24.9	29.6	56.5	3.8	76.3

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Table 14 Senegal: Cowpea Area Planted (1000 hectares)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	7.4	9.5	8.9	4.8	–	–	12.0	–	–	0.1	2.3	45.0
1961	62	10.5	16.4	9.2	5.6	–	–	12.0	–	–	0.1	2.6	56.3
1962	63	11.7	9.3	9.1	4.3	–	–	12.0	–	–	–	2.7	49.1
1963	64	5.4	18.9	9.4	3.8	–	–	7.0	–	–	–	2.5	47.0
1964	65	17.8	16.7	10.3	3.4	–	–	7.0	–	–	0.1	0.9	56.1
1965	66	12.0	17.0	10.5	6.8	–	–	5.3	–	–	0.5	1.1	53.2
1966	67	18.5	27.4	12.1	19.1	–	–	6.4	–	–	0.9	1.2	85.5
1967	68	27.1	25.3	11.4	25.7	–	–	7.0	–	–	1.1	1.0	98.7
1968	69	18.0	20.4	12.0	7.9	–	–	6.9	–	–	1.2	1.5	67.8
1969	70	19.2	22.7	12.7	6.8	–	–	6.2	–	–	2.2	1.[illegible]	70.8
1970	71	8.5	26.7	12.5	5.2	–	–	6.5	–	–	2.0	1.3	62.7
1971	72	21.2	19.4	13.3	7.4	–	–	6.5	–	–	1.3	1.5	70.6
1972	73	0.8	48.5	20.8	9.0	–	–	6.2	–	–	1.1	–	86.3
1973	74	9.5	22.4	13.4	6.3	–	–	0.0	–	–	1.3	–	52.8
1974	75	15.8	23.1	15.9	2.6	–	–	0.0	–	–	2.0	–	59.3
1975	76	14.7	20.3	15.2	8.9	–	–	0.0	–	–	2.5	–	61.6
1976	77	15.3	20.1	20.0	7.0	–	–	0.0	–	–	0.9	–	63.3
1977	78	14.1	21.4	16.2	4.1	–	–	0.1	–	–	1.1	–	57.0
1978	79	12.8	28.8	16.0	1.3	–	–	0.3	–	–	3.9	–	63.1
1979	80	5.7	21.4	15.6	9.1	–	–	0.5	–	–	3.0	–	55.4
1980	81	9.3	28.5	9.1	5.1	–	–	0.0	–	–	2.2	–	54.2
1981	82	9.3	30.3	10.7	12.7	–	–	3.4	–	–	2.0	–	68.4
1982	83	6.3	28.6	9.0	0.0	–	–	0.0	–	–	2.8	1.2	47.9
1983	84	4.0	19.9	15.3	0.0	–	–	2.3	–	–	0.0	0.0	41.6
1984	85	0.0	21.0	15.3	10.9	–	–	0.0	3.4	–	3.4	0.5	51.1
1985	86	5.0	63.6	26.9	18.6	7.7	2.4	10.2	2.9	0.5	3.4	0.7	128.3
1986	87	2.3	53.3	22.6	28.0	6.4	0.2	6.7	1.8	0.4	2.2	2.1	117.1
1987	88	3.1	35.1	12.0	15.0	2.4	1.0	3.5	0.5	0.4	0.9	1.8	71.4
1988	89	1.7	29.1	16.0	15.8	2.8	0.4	3.2	0.7	0.4	1.1	2.2	69.1
1989	90	10.0	13.1	18.1	20.4	1.9	0.4	2.3	0.2	0.3	0.5	0.2	64.6
Source: MDRH/DA/DAS													
Average (85-89)		4.4	38.8	19.1	19.6	4.3	0.9	5.2	1.2	0.4	1.6	1.4	90.1

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Table 15 Senegal: Groundnuts-Oil Area Planted (1000 hectares)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum Fatick	Sine-Saloum Kaolack	Sine-Saloum Total	Casamance Ziguinchor	Casamance Kolda	Casamance Total	Tambacounda	Total Senegal
1960	61	6.5	105.8	130.1	146.5	–	–	429.7	–	–	123.9	31.0	973.5
1961	62	9.3	103.0	132.0	144.3	–	–	471.0	–	–	126.0	35.2	1020.5
1962	63	10.9	96.0	133.2	139.0	–	–	482.5	–	–	110.2	38.2	1010.1
1963	64	16.3	135.1	126.3	172.5	–	–	475.1	–	–	110.2	43.4	1078.9
1964	65	15.3	120.0	137.0	146.0	–	–	495.7	–	–	103.7	33.1	1050.7
1965	66	27.0	155.0	146.0	130.0	–	–	499.0	–	–	118.6	34.5	1108.1
1966	67	11.1	163.3	121.1	144.0	–	–	514.7	–	–	121.2	35.1	1110.5
1967	68	12.3	145.9	157.3	155.5	–	–	531.5	–	–	120.0	36.2	1158.7
1968	69	12.0	192.2	169.3	146.8	–	–	522.2	–	–	113.6	32.2	1188.1
1969	70	10.2	138.0	151.0	125.0	–	–	389.3	–	–	118.1	29.0	960.6
1970	71	9.8	163.6	136.3	141.5	–	–	435.7	–	–	114.7	44.3	1045.9
1971	72	12.0	142.0	155.5	129.3	–	–	450.4	–	–	125.2	41.1	1055.4
1972	73	4.5	155.7	158.8	152.3	–	–	454.9	–	–	99.6	43.6	1069.5
1973	74	6.6	125.3	151.0	126.9	–	–	458.9	–	–	107.4	46.8	1022.8
1974	75	5.9	159.6	154.8	136.6	–	–	430.0	–	–	122.2	41.1	1050.1
1975	76	6.8	190.0	195.8	184.3	–	–	537.7	–	–	136.6	58.9	1310.1
1976	77	5.9	180.9	160.5	179.0	–	–	599.7	–	–	116.9	50.7	1293.4
1977	78	5.8	175.6	135.0	178.5	–	–	522.3	–	–	101.8	42.2	1161.1
1978	79	7.0	180.4	105.9	174.9	–	–	483.0	–	–	138.0	64.1	1153.3
1979	80	2.5	200.2	161.1	135.4	–	–	380.1	–	–	106.6	61.1	1047.1
1980	81	3.8	177.2	150.3	136.0	–	–	462.3	–	–	76.9	57.1	1063.6
1981	82	3.9	187.9	117.3	123.8	–	–	428.7	–	–	88.5	58.8	1008.9
1982	83	7.1	185.2	165.3	167.1	–	–	470.1	–	–	95.7	51.2	1141.7
1983	84	7.6	142.5	148.0	151.0	–	–	483.2	–	–	87.4	60.1	1079.7
1984	85	0.0	120.0	86.0	104.0	140.0	260.0	400.0	26.0	64.0	90.0	56.0	858.0
1985	86	0.5	45.7	50.0	57.7	81.4	206.4	287.8	20.3	74.7	95.0	57.7	594.3
1986	87	1.1	59.5	97.7	67.7	108.0	286.8	394.8	22.7	80.7	103.4	65.3	789.4
1987	88	1.7	61.8	88.4	92.6	98.4	302.4	400.8	30.7	92.4	123.1	61.8	830.2
1988	89	2.0	98.2	90.8	97.0	102.1	307.3	409.4	28.7	89.7	118.4	69.1	884.9
1989	90	2.4	94.4	84.6	91.4	88.6	213.1	301.6	24.9	92.2	117.1	71.9	763.5
Source: MDRH/DA/DAS													
Average (85-89)		1.5	71.9	82.3	81.3	95.7	263.2	358.9	25.5	85.9	111.4	65.2	772.5

Table 16 Senegal Table Peanuts Area Planted (1000 hectares)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	-	-	-	-	-	-	-	-	-	-	-	-
1961 62	-	-	-	-	-	-	-	-	-	-	-	-
1962 63	-	-	-	-	-	-	-	-	-	-	-	-
1963 64	-	-	-	-	-	-	-	-	-	-	-	-
1964 65	-	-	-	-	-	-	-	-	-	-	-	-
1965 66	-	-	-	-	-	-	-	-	-	-	-	-
1966 67	-	-	-	-	-	-	-	-	-	-	-	-
1967 68	-	-	-	-	-	-	-	-	-	-	-	-
1968 69	-	-	-	-	-	-	-	-	-	-	-	-
1969 70	-	-	-	-	-	-	-	-	-	-	-	-
1970 71	-	-	-	-	-	-	6.1	-	-	1.1	0.5	7.7
1971 72	-	-	-	-	-	-	8.5	-	-	1.6	0.7	10.9
1972 73	-	-	-	-	-	-	11.3	-	-	3.8	0.2	15.3
1973 74	-	-	-	-	-	-	14.1	-	-	3.8	0.6	18.5
1974 75	-	-	-	-	-	-	17.4	-	-	4.0	0.9	22.3
1975 76	-	-	-	-	-	-	21.0	-	-	2.4	0.8	24.3
1976 77	-	-	-	-	-	-	14.0	-	-	1.9	1.1	17.0
1977 78	-	-	-	-	-	-	20.2	-	-	2.3	1.2	23.7
1978 79	-	-	-	-	-	-	18.9	-	-	3.8	1.4	24.2
1979 80	-	-	-	-	-	-	16.2	-	-	3.6	1.4	21.2
1980 81	-	-	-	-	-	-	6.0	-	-	1.9	1.1	8.9
1981 82	-	-	-	-	-	-	3.2	-	-	3.4	1.3	7.8
1982 83	-	-	-	-	-	-	13.5	-	-	3.0	1.6	18.2
1983 84	-	-	-	-	-	-	24.5	-	-	3.1	1.6	29.1
1984 85	-	-	-	-	0.9	8.3	9.2	-	4.0	4.0	1.8	15.0
1985 86	-	-	-	-	0.0	5.5	5.5	-	2.4	2.4	2.3	10.2
1986 87	-	-	-	-	2.0	15.9	17.9	-	-	-	0.0	17.9
1987 88	-	-	-	-	1.8	12.3	14.1	-	-	-	0.1	14.2
1988 89	-	-	-	-	2.5	14.7	17.2	-	-	-	-	17.2
1989 90	-	-	-	-	2.9	16.6	19.5	-	-	-	-	19.5
Source: MDRH/DA/DAS												
Average (85-89)	-	-	-	-	1.8	13.0	14.9	-	0.5	0.5	0.5	15.8

Table 19 Senegal Millet/Sorghum Production (1000 mt)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum Fatick	Sine-Saloum Kaolack	Sine-Saloum Total	Casamance Ziguinchor	Casamance Kolda	Casamance Total	Tambacounda	Total Senegal
1960	61	38.6	25.2	44.4	30.3	–	–	156.6	–	–	62.1	34.6	391.9
1961	62	51.8	26.3	45.3	59.4	–	–	127.2	–	–	62.0	34.1	406.1
1962	63	54.9	22.0	46.7	54.4	–	–	141.8	–	–	68.3	35.3	423.5
1963	64	39.1	50.7	51.4	69.6	–	–	157.1	–	–	72.5	38.0	478.3
1964	65	65.3	51.0	43.1	73.0	–	–	172.8	–	–	83.8	41.8	530.8
1965	66	52.7	51.8	52.8	72.6	–	–	184.0	–	–	94.4	46.6	554.8
1966	67	52.9	31.0	41.9	22.8	–	–	148.7	–	–	76.0	50.0	423.3
1967	68	72.6	73.4	68.3	84.8	–	–	187.9	–	–	114.0	53.5	654.4
1968	69	37.8	39.3	45.2	38.4	–	–	155.6	–	–	87.1	44.9	448.3
1969	70	63.7	41.6	77.7	56.3	–	–	126.2	–	–	121.4	69.0	556.0
1970	71	29.1	27.1	33.4	27.2	–	–	135.5	–	–	100.2	30.7	383.1
1971	72	49.4	49.7	81.0	59.1	–	–	197.6	–	–	90.9	54.8	582.5
1972	73	1.1	8.3	13.1	43.8	–	–	140.8	–	–	74.8	40.1	322.0
1973	74	27.4	43.2	103.4	58.5	–	–	160.2	–	–	83.7	32.5	508.8
1974	75	53.2	82.1	87.6	103.7	–	–	332.1	–	–	101.9	38.1	798.7
1975	76	41.0	74.1	98.2	88.7	–	–	179.2	–	–	74.0	60.0	615.2
1976	77	23.1	39.8	49.4	100.6	–	–	193.5	–	–	75.9	18.3	506.6
1977	78	8.5	27.5	21.5	87.7	–	–	165.8	–	–	64.6	34.2	409.9
1978	79	37.5	88.5	117.6	128.0	–	–	296.8	–	–	30.8	52.4	751.7
1979	80	11.9	47.0	62.4	95.7	–	–	192.4	–	–	81.4	29.6	520.5
1980	81	27.9	66.2	66.1	53.0	–	–	236.2	–	–	58.8	36.1	544.3
1981	82	48.7	49.2	75.7	91.1	–	–	317.9	–	–	94.7	64.4	741.7
1982	83	4.3	50.6	104.4	58.4	–	–	220.2	–	–	90.8	55.8	584.6
1983	84	6.4	8.1	44.8	31.9	–	–	172.4	–	–	67.6	23.5	354.8
1984	85	0.8	4.8	66.3	58.6	108.0	131.1	239.1	11.9	46.3	58.2	43.6	471.4
1985	86	16.2	117.0	139.1	153.4	114.9	207.4	322.3	17.7	72.2	89.9	111.6	949.4
1986	87	9.2	37.6	68.0	51.9	88.2	198.5	286.6	12.7	78.2	90.9	89.1	633.2
1987	88	9.8	100.4	76.3	98.4	115.5	249.5	365.1	5.4	80.3	85.7	65.1	800.7
1988	89	15.0	26.7	30.7	37.4	58.0	242.4	300.4	6.3	78.8	85.1	98.5	593.8
1989	90	8.4	30.7	58.4	99.4	109.2	300.4	409.6	7.6	86.1	93.7	62.6	762.6
Source: MDRH/DA/DAS													
Average (85-89)		11.7	62.5	74.5	88.1	97.2	239.6	336.8	9.9	79.1	89.0	85.4	748.0

Table 20 Senegal: Maize Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tamba-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	3.3	–	–	–	–	–	1.8	–	–	13.1	9.0	27.2
1961 62	4.3	–	–	–	–	–	1.8	–	–	5.3	9.3	20.7
1962 63	2.4	–	–	–	–	–	1.8	–	–	11.8	10.6	26.6
1963 64	1.5	–	–	–	–	–	2.0	–	–	12.1	11.1	26.6
1964 65	2.5	–	–	–	–	–	1.9	–	–	16.2	10.9	31.6
1965 66	2.9	–	–	–	–	–	1.7	–	–	19.2	12.1	35.9
1966 67	2.6	–	–	–	–	–	0.3	–	–	19.9	13.2	36.0
1967 68	9.1	–	–	–	–	–	0.9	–	–	32.1	14.7	56.8
1968 69	3.7	–	–	–	–	–	0.6	–	–	16.6	4.4	25.3
1969 70	7.0	–	–	–	–	–	0.6	–	–	28.1	13.1	48.8
1970 71	5.3	–	–	–	–	–	0.4	–	–	18.5	8.9	33.1
1971 72	6.6	–	–	–	–	–	0.6	–	–	16.2	14.2	37.6
1972 73	0.2	–	–	–	–	–	0.4	–	–	9.7	9.9	20.2
1973 74	2.7	–	–	–	–	–	1.0	–	–	13.9	16.2	33.9
1974 75	5.8	–	–	–	–	–	2.0	–	–	16.5	19.0	43.2
1975 76	0.0	–	–	–	–	–	5.6	–	–	14.9	23.4	43.9
1976 77	0.0	–	–	–	–	–	16.3	–	–	19.4	7.2	42.8
1977 78	1.2	–	–	–	–	–	9.9	–	–	11.4	10.6	33.1
1978 79	4.1	–	–	–	–	–	14.4	–	–	19.1	16.5	54.0
1979 80	3.5	–	–	–	–	–	2.9	–	–	23.5	16.3	46.3
1980 81	4.7	–	–	–	–	–	20.0	–	–	19.1	13.0	56.8
1981 82	4.3	–	–	–	–	–	27.2	–	–	23.7	39.4	94.6
1982 83	3.2	–	–	–	–	–	29.3	–	–	22.8	26.8	82.2
1983 84	1.6	–	–	–	–	–	7.7	–	–	35.0	16.2	60.6
1984 85	7.2	–	–	–	0.4	14.7	15.0	5.8	48.4	54.3	26.9	103.4
1985 86	6.0	–	–	–	6.8	40.1	46.9	8.2	51.3	59.5	38.1	150.5
1986 87	6.7	–	–	–	5.8	21.9	27.7	4.5	42.1	46.6	31.2	112.2
1987 88	5.9	–	–	–	4.3	36.6	40.9	3.9	43.7	47.6	24.5	118.9
1988 89	5.6	–	–	–	3.2	36.5	39.7	2.0	42.3	44.4	39.2	128.9
1989 90	7.1	–	0.3	–	4.0	52.7	56.7	1.7	49.1	46.4	21.3	131.7
Source: MDRH/DA/DAS												
Average (85-89)	6.3	–	0.1	–	4.8	37.5	42.4	4.1	45.7	48.9	30.9	128.4

Table 21 Senegal Paddy Production (1000 mt)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	15.7	–	–	–	–	–	2.1	–	–	62.1	1.3	81.3
1961	62	18.3	–	–	–	–	–	3.8	–	–	60.0	1.4	83.5
1962	63	18.9	–	–	–	–	–	2.8	–	–	67.0	1.2	89.9
1963	64	22.7	–	–	–	–	–	3.8	–	–	77.5	1.3	105.3
1964	65	21.1	–	–	–	–	–	4.9	–	–	80.9	1.4	108.3
1965	66	27.5	–	–	–	–	–	4.6	–	–	88.3	1.5	122.9
1966	67	38.1	–	–	–	–	–	3.0	–	–	82.2	1.4	124.7
1967	68	28.1	–	–	–	–	–	2.8	–	–	101.1	1.8	133.8
1968	69	15.5	–	–	–	–	–	0.0	–	–	43.0	2.6	61.2
1969	70	31.0	–	–	–	–	–	1.2	–	–	105.6	1.8	139.6
1970	71	23.0	–	–	–	–	–	2.1	–	–	68.5	1.4	94.9
1971	72	27.9	–	–	–	–	–	4.3	–	–	73.0	4.2	109.4
1972	73	6.5	–	–	–	–	–	1.7	–	–	27.6	3.5	39.4
1973	74	9.8	–	–	–	–	–	1.8	–	–	49.1	6.0	66.8
1974	75	17.2	–	–	–	–	–	1.2	–	–	86.3	12.5	117.2
1975	76	13.0	–	–	–	–	–	1.2	–	–	97.4	18.4	129.9
1976	77	23.3	–	–	–	–	–	1.0	–	–	88.8	12.7	125.8
1977	78	17.3	–	–	–	–	–	1.7	–	–	34.1	11.4	64.5
1978	79	27.4	–	–	–	–	–	0.8	–	–	108.4	9.8	146.4
1979	80	30.8	–	–	–	–	–	0.5	–	–	56.8	8.5	96.6
1980	81	31.6	–	–	–	–	–	0.7	–	–	26.8	5.5	64.7
1981	82	36.9	–	–	–	–	–	0.0	–	–	76.7	13.5	127.1
1982	83	48.7	–	–	–	–	–	0.0	–	–	55.2	4.0	107.9
1983	84	61.6	–	–	–	–	–	0.0	–	–	35.8	4.1	101.5
1984	85	79.2	–	–	–	–	–	0.0	22.7	29.4	52.2	4.4	135.8
1985	86	72.4	–	–	–	0.8	–	0.8	35.9	30.2	66.1	7.7	147.0
1986	87	75.1	–	–	–	0.7	0.2	0.9	23.6	35.0	58.6	8.1	142.7
1987	88	57.7	–	–	–	1.2	0.2	1.4	32.2	37.4	69.6	4.0	132.7
1988	89	70.6	–	–	–	0.7	0.2	0.9	28.7	36.4	65.1	9.8	146.4
1989	90	82.9	–	–	–	0.6	0.2	0.8	42.4	34.4	76.8	8.6	169.1
Source: MDRH/DA/DAS													
Average (85-89)		71.7	–	–	–	0.8	0.2	1.0	32.6	34.7	67.2	7.6	147.6

Table 22 Senegal: Cowpea Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tamba-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	2.2	1.5	2.3	1.0	–	–	3.6	–	–	–	0.5	11.1
1961 62	3.5	4.1	2.3	1.4	–	–	3.0	–	–	–	0.8	15.1
1962 63	3.4	2.6	2.3	1.0	–	–	3.0	–	–	–	0.8	13.1
1963 64	1.7	4.6	2.6	0.9	–	–	2.3	–	–	–	0.8	12.9
1964 65	5.8	4.2	3.3	0.9	–	–	2.3	–	–	–	0.3	16.7
1965 66	2.3	4.3	3.2	1.5	–	–	1.8	–	–	0.1	0.3	13.6
1966 67	6.1	6.0	2.9	0.3	–	–	2.2	–	–	0.3	0.4	18.0
1967 68	15.1	3.5	4.1	4.7	–	–	2.1	–	–	0.4	0.3	30.1
1968 69	4.0	5.8	2.8	1.7	–	–	2.1	–	–	0.4	0.4	17.2
1969 70	8.4	6.5	3.3	1.4	–	–	1.6	–	–	1.0	0.3	22.4
1970 71	5.4	6.1	3.0	1.3	–	–	0.5	–	–	0.8	0.5	17.6
1971 72	9.8	7.1	3.7	2.1	–	–	2.0	–	–	0.4	0.6	25.6
1972 73	0.2	5.7	2.0	2.6	–	–	0.1	–	–	0.4	–	10.8
1973 74	1.9	6.5	4.2	2.1	–	–	–	–	–	0.5	–	15.2
1974 75	3.4	10.1	6.9	0.9	–	–	–	–	–	1.0	–	22.3
1975 76	4.2	10.1	5.5	3.6	–	–	–	–	–	1.1	–	24.4
1976 77	4.1	4.1	4.7	2.8	–	–	–	–	–	0.4	–	16.1
1977 78	1.9	4.7	3.5	1.3	–	–	–	–	–	0.4	–	11.7
1978 79	3.9	12.3	4.0	0.7	–	–	0.1	–	–	0.7	–	21.7
1979 80	1.2	7.5	3.4	5.6	–	–	0.2	–	–	0.8	–	18.8
1980 81	2.5	10.6	2.3	1.0	–	–	0.0	–	–	0.8	–	17.1
1981 82	2.9	12.1	4.4	7.0	–	–	1.4	–	–	0.9	–	28.7
1982 83	1.0	6.7	3.8	0.0	–	–	0.0	–	–	1.4	0.3	13.2
1983 84	1.0	4.5	3.5	0.0	–	–	0.8	–	–	0.0	0.0	9.7
1984 85	0.0	7.8	2.8	2.0	0.8	–	0.8	2.4	–	2.4	0.0	15.8
1985 86	2.1	47.7	11.6	11.2	4.0	1.2	5.2	1.5	0.2	1.7	0.2	79.6
1986 87	0.5	23.3	9.6	14.8	3.7	0.1	3.8	1.2	0.2	1.4	1.1	54.5
1987 88	0.7	11.4	6.0	7.8	0.7	0.4	1.2	0.4	0.2	0.5	1.0	28.5
1988 89	0.4	6.8	3.7	4.3	0.8	0.1	0.9	0.3	0.1	0.4	0.7	17.3
1989 90	1.3	3.6	9.0	10.2	0.6	0.2	0.8	0.1	0.1	0.3	0.1	25.2
Source: MDRH/DA/DAS												
Average (85-89)	1.0	18.5	8.0	9.7	2.0	0.4	2.4	0.7	0.2	0.9	0.6	41.0

Table 23 Senegal: Groundnuts-Oil Production (1000 mt)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	5.1	84.6	130.1	117.2	–	–	408.2	–	–	112.8	31.0	889.0
1961	62	3.6	112.0	148.0	148.0	–	–	424.8	–	–	118.1	37.2	991.6
1962	63	3.5	69.4	119.2	121.5	–	–	416.9	–	–	120.1	41.0	897.5
1963	64	5.4	101.1	130.6	143.9	–	–	400.0	–	–	125.0	43.4	949.2
1964	65	6.3	94.4	122.1	125.6	–	–	498.1	–	–	129.8	41.1	1017.5
1965	66	15.9	132.3	142.6	132.2	–	–	527.9	–	–	132.4	36.3	1119.7
1966	67	7.9	78.9	85.4	34.1	–	–	489.0	–	–	126.8	33.3	855.3
1967	68	6.3	132.9	158.1	144.5	–	–	403.9	–	–	120.0	35.9	1001.6
1968	69	21.5	97.8	112.9	76.8	–	–	377.6	–	–	103.5	28.9	818.9
1969	70	5.1	111.0	114.5	67.0	–	–	372.6	–	–	91.7	25.0	786.8
1970	71	1.0	40.4	72.4	44.0	–	–	291.9	–	–	114.3	17.0	581.0
1971	72	2.0	130.4	169.2	110.0	–	–	410.3	–	–	129.1	30.4	981.3
1972	73	0.0	14.6	18.7	51.5	–	–	343.0	–	–	114.3	27.9	570.1
1973	74	0.6	63.3	92.3	67.4	–	–	297.4	–	–	113.4	22.2	675.4
1974	75	1.4	118.6	150.9	116.3	–	–	434.3	–	–	115.1	42.9	979.6
1975	76	5.1	191.7	191.3	220.0	–	–	618.4	–	–	147.7	58.0	1432.2
1976	77	1.0	108.5	119.9	175.1	–	–	586.5	–	–	135.1	60.3	1186.3
1977	78	1.3	47.9	33.1	87.8	–	–	218.8	–	–	87.2	33.3	509.5
1978	79	4.0	172.8	137.3	152.2	–	–	378.7	–	–	139.1	65.6	1049.6
1979	80	0.5	84.1	105.7	96.5	–	–	259.6	–	–	89.5	36.7	672.6
1980	81	1.8	127.1	51.4	41.6	–	–	235.3	–	–	36.3	26.8	520.2
1981	82	3.0	159.9	81.3	115.3	–	–	356.2	–	–	97.4	52.6	865.7
1982	83	4.3	172.8	164.5	150.4	–	–	497.8	–	–	101.0	48.0	1138.7
1983	84	0.0	22.4	77.8	50.7	–	–	283.1	–	–	104.7	31.6	570.3
1984	85	0.0	60.0	60.0	80.0	119.0	182.0	301.0	31.8	78.2	110.0	58.0	669.0
1985	86	0.3	47.0	50.0	51.9	77.3	206.4	283.7	22.4	77.5	99.8	57.7	590.5
1986	87	0.3	51.9	76.1	48.0	113.6	328.7	442.3	27.8	106.5	134.4	68.4	821.4
1987	88	1.1	59.1	76.9	97.2	119.8	360.5	480.3	38.3	123.7	162.0	69.0	945.6
1988	89	1.2	51.1	20.8	32.4	94.9	302.0	396.9	28.1	109.5	137.7	76.4	716.6
1989	90	1.2	93.8	78.1	88.5	88.6	242.4	331.0	25.7	116.7	142.4	83.7	818.7
Source: MDRH/DA, DAS													
Average (85-89)		0.8	60.6	60.4	63.6	98.9	284.0	366.8	28.5	106.8	135.3	71.0	778.5

Table 24 Senegal: Table Peanuts Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	-	-	-	-	-	-	-	-	-	-	-	-
1961 62	-	-	-	-	-	-	-	-	-	-	-	-
1962 63	-	-	-	-	-	-	-	-	-	-	-	-
1963 64	-	-	-	-	-	-	-	-	-	-	-	-
1964 65	-	-	-	-	-	-	-	-	-	-	-	-
1965 66	-	-	-	-	-	-	-	-	-	-	-	-
1966 67	-	-	-	-	-	-	-	-	-	-	-	-
1967 68	-	-	-	-	-	-	-	-	-	-	-	-
1968 69	-	-	-	-	-	-	-	-	-	-	-	-
1969 70	-	-	-	-	-	-	-	-	-	-	-	-
1970 71	-	-	-	-	-	-	6.2	-	-	1.6	0.5	8.2
1971 72	-	-	-	-	-	-	10.0	-	-	2.1	0.6	12.6
1972 73	-	-	-	-	-	-	12.9	-	-	3.8	0.2	16.9
1973 74	-	-	-	-	-	-	11.8	-	-	4.5	0.3	16.5
1974 75	-	-	-	-	-	-	15.3	-	-	2.4	0.7	18.5
1975 76	-	-	-	-	-	-	20.8	-	-	2.2	0.8	23.8
1976 77	-	-	-	-	-	-	10.2	-	-	1.5	1.0	12.7
1977 78	-	-	-	-	-	-	8.3	-	-	2.1	0.8	11.2
1978 79	-	-	-	-	-	-	5.1	-	-	3.8	1.6	10.4
1979 80	-	-	-	-	-	-	1.1	-	-	1.6	0.5	3.1
1980 81	-	-	-	-	-	-	0.5	-	-	0.9	0.2	1.6
1981 82	-	-	-	-	-	-	2.4	-	-	1.3	1.0	4.6
1982 83	-	-	-	-	-	-	1.4	-	-	2.6	1.4	5.3
1983 84	-	-	-	-	-	-	7.2	-	-	2.4	0.5	10.2
1984 85	-	-	-	-	0.6	7.4	8.0	-	3.0	3.0	2.2	13.2
1985 86	-	-	-	-	0.0	6.1	6.1	-	2.6	2.6	2.3	11.0
1986 87	-	-	-	-	2.2	17.1	19.3	-	-	-	0.0	19.3
1987 88	-	-	-	-	1.9	14.7	16.6	-	-	-	0.1	16.7
1988 89	-	-	-	-	2.8	16.7	19.5	-	-	-	-	19.5
1989 90	-	-	-	-	4.7	19.9	24.6	-	-	-	-	24.6
Source: MDRH/DA/DAS												
Average (85-89)	-	-	-	-	2.3	14.9	17.2	-	0.5	0.5	0.5	18.2

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Table 24 Senegal: Table Peanuts Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tamba-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	–	–	–	–	–	–	–	–	–	–	–	–
1961 62	–	–	–	–	–	–	–	–	–	–	–	–
1962 63	–	–	–	–	–	–	–	–	–	–	–	–
1963 64	–	–	–	–	–	–	–	–	–	–	–	–
1964 65	–	–	–	–	–	–	–	–	–	–	–	–
1965 66	–	–	–	–	–	–	–	–	–	–	–	–
1966 67	–	–	–	–	–	–	–	–	–	–	–	–
1967 68	–	–	–	–	–	–	–	–	–	–	–	–
1968 69	–	–	–	–	–	–	–	–	–	–	–	–
1969 70	–	–	–	–	–	–	–	–	–	–	–	–
1970 71	–	–	–	–	–	–	6.2	–	–	1.6	0.5	8.2
1971 72	–	–	–	–	–	–	10.0	–	–	2.1	0.6	12.6
1972 73	–	–	–	–	–	–	12.9	–	–	3.8	0.2	16.9
1973 74	–	–	–	–	–	–	11.8	–	–	4.5	0.3	16.5
1974 75	–	–	–	–	–	–	15.3	–	–	2.4	0.7	18.5
1975 76	–	–	–	–	–	–	20.8	–	–	2.2	0.8	23.8
1976 77	–	–	–	–	–	–	10.2	–	–	1.5	1.0	12.7
1977 78	–	–	–	–	–	–	8.3	–	–	2.1	0.8	11.2
1978 79	–	–	–	–	–	–	5.1	–	–	3.8	1.6	10.4
1979 80	–	–	–	–	–	–	1.1	–	–	1.6	0.5	3.1
1980 81	–	–	–	–	–	–	0.5	–	–	0.9	0.2	1.6
1981 82	–	–	–	–	–	–	2.4	–	–	1.3	1.0	4.6
1982 83	–	–	–	–	–	–	1.4	–	–	2.6	1.4	5.3
1983 84	–	–	–	–	–	–	7.2	–	–	2.4	0.5	10.2
1984 85	–	–	–	–	0.6	7.4	8.0	–	3.0	3.0	2.2	13.2
1985 86	–	–	–	–	0.0	6.1	6.1	–	2.6	2.6	2.3	11.0
1986 87	–	–	–	–	2.2	17.1	19.3	–	–	–	0.0	19.3
1987 88	–	–	–	–	1.9	14.7	16.6	–	–	–	0.1	16.7
1988 89	–	–	–	–	2.8	16.7	19.5	–	–	–	–	19.5
1989 90	–	–	–	–	4.7	19.9	24.6	–	–	–	–	24.6
Source: MDRH/DA/DAS												
Average (85-89)	–	–	–	–	2.3	14.9	17.2	–	0.5	0.5	0.5	18.2

Table 25 Senegal: Cotton Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambe-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	-	-	-	-	-	-	-	-	-	-	-	-
1961 62	-	-	-	-	-	-	-	-	-	-	-	-
1962 63	-	-	-	-	-	-	-	-	-	-	-	-
1963 64	-	-	-	-	-	-	-	-	-	-	-	-
1964 65	-	-	-	-	-	-	-	-	-	-	-	-
1965 66	-	-	-	-	-	-	0.0	-	-	0.2	0.5	0.7
1966 67	-	-	-	-	-	-	0.0	-	-	1.2	0.8	2.0
1967 68	-	-	-	-	-	-	0.2	-	-	0.8	3.3	4.3
1968 69	-	-	-	-	-	-	0.8	-	-	1.8	7.1	9.8
1969 70	-	-	-	-	-	-	1.4	-	-	2.7	7.4	11.5
1970 71	-	-	-	-	-	-	1.9	-	-	4.1	5.6	11.6
1971 72	-	-	-	-	-	-	3.4	-	-	7.7	10.1	21.2
1972 73	-	-	-	-	-	-	2.4	-	-	9.8	11.1	23.3
1973 74	-	-	-	-	-	-	3.2	-	-	16.7	12.8	32.6
1974 75	-	-	-	-	-	-	6.1	-	-	17.1	17.4	40.6
1975 76	-	-	-	-	-	-	4.7	-	-	10.9	15.1	30.7
1976 77	-	-	-	-	-	-	5.3	-	-	21.0	19.0	45.2
1977 78	-	-	-	-	-	-	2.5	-	-	23.5	11.1	37.2
1978 79	-	-	-	-	-	-	4.8	-	-	17.1	11.9	33.8
1979 80	-	-	-	-	-	-	5.0	-	-	13.0	9.3	27.2
1980 81	-	-	-	-	-	-	3.2	-	-	11.5	6.3	21.0
1981 82	-	-	-	-	-	-	5.3	-	-	23.2	12.5	41.0
1982 83	-	-	-	-	-	-	3.8	-	-	32.4	10.8	47.1
1983 84	-	-	-	-	-	-	1.6	-	-	26.8	8.6	37.0
1984 85	-	-	-	-	-	3.1	3.1	-	40.0	40.0	16.5	59.5
1985 86	-	-	-	-	0.4	5.2	5.6	-	21.1	21.1	10.9	37.6
1986 87	-	-	-	-	0.1	1.0	1.1	-	16.3	16.3	7.2	24.7
1987 88	-	-	-	-	1.2	0.0	1.2	-	23.9	23.9	10.0	35.2
1988 89	-	-	-	-	0.2	1.8	2.0	-	27.0	27.0	16.0	45.0
1989 90	-	-	-	-	0.2	4.0	4.2	-	15.1	15.1	10.0	29.3
Source: MDTJH/DA/DAS												
Average (85-89)	-	-	-	-	0.4	2.4	2.8	-	20.7	20.7	10.8	34.4

Table 26 Senegal: Manioc Production (1000 mt)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambe-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	–	41.6	33.3	5.0	–	–	22.4	–	–	48.6	8.2	159.2
1961 62	–	37.8	33.7	2.5	–	–	7.3	–	–	46.3	8.8	136.8
1962 63	–	37.8	36.5	11.2	–	–	7.4	–	–	48.7	9.0	150.6
1963 64	–	40.2	37.3	1.9	–	–	9.0	–	–	48.7	9.0	146.0
1964 65	–	45.3	40.7	3.4	..	–	9.4	–	–	47.5	8.8	155.1
1965 66	–	32.3	40.7	7.1	–	–	10.6	–	–	49.3	9.2	149.1
1966 67	–	101.9	45.2	18.5	–	–	9.2	–	–	53.7	8.8	237.2
1967 68	–	80.9	67.4	13.6	–	–	11.3	–	–	54.8	6.1	234.0
1968 69	–	92.0	53.7	10.9	–	–	13.0	–	–	49.3	7.3	226.1
1969 70	–	31.2	62.8	5.9	–	–	13.8	–	–	62.7	0.4	176.7
1970 71	–	27.6	63.2	4.3	–	–	12.4	–	–	53.3	0.3	161.1
1971 72	–	14.3	74.6	4.6	–	–	13.7	–	–	29.5	0.4	137.1
1972 73	–	23.3	85.1	4.8	–	–	13.0	–	–	24.0	–	150.2
1973 74	–	5.4	79.8	0.9	–	–	10.5	–	–	23.7	–	120.3
1974 75	–	39.6	40.6	1.9	–	–	11.4	–	–	26.1	–	119.6
1975 76	–	26.0	19.3	2.7	–	–	49.7	–	–	10.5	–	108.3
1976 77	–	22.3	21.5	5.5	–	–	5.0	–	–	11.6	0.4	66.2
1977 78	–	5.7	51.0	2.1	–	–	3.4	–	–	11.1	0.4	73.6
1978 79	–	5.4	61.2	0.6	–	–	3.5	–	–	9.9	0.4	81.0
1979 80	–	0.6	8.5	0.5	–	–	–	–	–	14.9	0.2	24.6
1980 81	–	–	5.0	0.2	–	–	–	–	–	19.5	0.4	25.1
1981 82	–	–	8.2	–	–	–	–	–	–	23.5	–	31.8
1982 83	–	–	11.3	–	–	–	–	–	–	20.8	–	32.1
1983 84	–	–	12.2	–	–	–	–	–	–	5.1	–	17.3
1984 85	–	–	13.2	–	–	–	–	4.6	1.5	6.1	–	19.2
1985 86	–	–	19.1	–	–	–	–	6.4	5.0	11.4	0.4	31.0
1986 87	–	–	59.4	–	5.5	–	5.5	3.1	6.2	9.3	0.8	75.0
1987 88	–	–	30.3	–	6.6	2.9	9.5	4.1	7.5	11.5	1.0	52.3
1988 89	–	–	37.8	–	3.6	1.2	4.9	4.2	7.5	11.7	..	54.4
1989 90	–	–	38.7	–	5.0	1.9	6.9	4.7	8.2	12.9	–	58.4
Source: MDRH/DA/DAS												
Average (85-89)	–	–	37.1	–	4.1	1.2	5.3	4.5	6.9	11.4	0.4	54.2

Table 27 Senegal Millet/Sorghum Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	498	231	351	383	–	–	641	–	–	858	672	515
1961	62	472	231	354	666	–	–	479	–	–	769	655	484
1962	63	482	246	368	414	–	–	525	–	–	876	663	491
1963	64	354	333	389	524	–	–	539	–	–	839	715	499
1964	65	522	340	310	541	–	–	579	–	–	814	703	526
1965	66	432	332	359	487	–	–	584	–	–	840	696	519
1966	67	430	281	287	154	–	–	482	–	–	861	698	425
1967	68	518	480	419	577	–	–	533	–	–	911	728	567
1968	69	354	308	286	299	–	–	448	–	–	771	624	426
1969	70	612	336	471	511	–	–	390	–	–	1002	785	537
1970	71	319	210	219	269	–	–	472	–	–	812	383	397
1971	72	417	463	506	597	–	–	618	–	–	986	753	601
1972	73	23	60	84	423	–	–	440	–	–	789	545	344
1973	74	317	240	589	400	–	–	467	–	–	842	454	462
1974	75	441	525	709	639	–	–	787	–	–	1067	610	699
1975	76	434	498	764	528	–	–	683	–	–	816	861	639
1976	77	231	301	406	623	–	–	708	–	–	833	308	535
1977	78	112	203	211	588	–	–	498	–	–	740	583	435
1978	79	410	550	1069	794	–	–	809	–	–	298	869	713
1979	80	310	330	548	555	–	–	585	–	–	779	446	538
1980	81	323	427	421	364	–	–	575	–	–	565	642	488
1981	82	500	265	503	540	–	–	742	–	–	954	1079	623
1982	83	141	287	687	447	–	–	650	–	–	949	849	591
1983	84	264	124	334	295	–	–	493	–	–	802	361	429
1984	85	355	33	400	379	659	550	594	649	1234	1042	566	470
1985	86	570	581	785	749	614	650	636	800	858	846	985	710
1986	87	507	301	475	420	687	795	758	847	948	932	833	638
1987	88	564	637	636	697	803	849	834	699	914	896	629	746
1988	89	572	193	306	296	440	818	702	680	930	905	906	581
1989	90	545	213	504	735	709	861	815	721	949	925	903	704
Source: MDRH/DA/DAS													
Average (85-89)		552	385	541	579	651	795	749	749	920	901	851	676

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Table 28 Senegal: Maize Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	780	..	..	–	..	.	800			953	839	891
1961	62	791	..	–	–	–	–	638	–	–	347	867	646
1962	63	484	–	..	..	–	–	840	–	–	962	88.	847
1963	64	364	..	–	–	–	–	806	–	–	678	901	81
1964	65	558	–	–	–	–	–	817	..	–	913	872	850
1965	66	488	–	–	–	–	–	800	–	–	850	891	811
1966	67	577	–	–	–	–	–	449	–	–	906	798	824
1967	68	467	–	–	–	–	–	759	–	–	953	850	793
1968	69	539	–	–	–	–	–	688	–	–	765	637	696
1969	70	685	–	–	.–	–	–	884	–	–	951	878	881
1970	71	631	–	–	–	–	–	659	–	–	737	536	653
1971	72	656	..	–	–	–	–	812	–	–	831	766	770
1972	73	543	–	–	–	–	–	570	–	–	747	542	625
1973	74	591	..	–	..	–	–	1496	–	–	989	818	864
1974	75	747	–	–	..	–	–	1665	–	–	1077	779	890
1975	76	0	–	–	..	–	–	1932	–	–	1094	861	890
1976	77	0	..	..	–	–	–	1259	–	–	1211	456	898
1977	78	483	–	–	–	–	–	774	–	..	711	475	617
1978	79	724	–	..	–	–	..	1424	–	–	838	921	958
1979	80	1257	–	..	–	–	..	193	–	–	911	684	684
1980	81	807	..	..	–	–	–	800	–	–	784	567	727
1981	82	677	..	–	–	–	–	1909	–	–	800	1438	1219
1982	83	369	..	..	–	–	–	1086	–	–	894	1074	953
1983	84	424	–	–	–	–	..	556	–	–	1298	630	860
1984	85	2458	–	..	–	959	930	930	1060	1612	1527	900	1223
1985	86	2500	–	–	–	1272	1559	1509	1150	1658	1563	1257	1478
1986	87	1920	..	–	..	1265	1141	1165	890	1206	1166	1073	1165
1987	88	1787	..	..	–	1433	1466	1462	983	1148	1132	859	1167
1988	89	2404	–	–	..	1163	1192	1190	764	1102	1081	1101	1147
1989	90	2376	..	–	–	1489	1678	1663	1122	1282	1165	1137	1375
Source: MDRH/DA/DAS													
Average (55-69)		2197	..	–	–	1324	1407	1398	982	1279	1221	1085	1266

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Table 29 Senegal: Paddy Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	2401	–	–	–	–	–	306	–	–	1181	855	1201
1961	62	2443	–	–	–	–	–	342	–	–	1125	893	1138
1962	63	2372	–	–	–	–	–	451	–	–	1202	777	1258
1963	64	2726	–	–	–	–	–	550	–	–	1344	904	1417
1964	65	2210	–	–	–	–	–	660	–	–	1306	934	1347
1965	66	2131	–	–	–	–	–	710	–	–	1447	1400	1496
1966	67	2456	–	–	–	–	–	651	–	–	1258	742	1428
1967	68	1713	–	–	–	–	–	788	–	–	1287	799	1327
1968	69	975	–	–	–	–	–	5	–	–	790	892	797
1969	70	1959	–	–	–	–	–	869	–	–	1248	1113	1350
1970	71	1459	–	–	–	–	–	1855	–	–	919	728	1017
1971	72	2378	–	–	–	–	–	1556	–	–	1117	992	1301
1972	73	567	–	–	–	–	–	570	–	–	791	878	734
1973	74	1219	–	–	–	–	–	898	–	–	988	1195	1030
1974	75	1834	–	–	–	–	–	273	–	–	1354	1621	1377
1975	76	1231	–	–	–	–	–	715	–	–	1273	1774	1390
1976	77	2174	–	–	–	–	–	529	–	–	1364	1152	1418
1977	78	2225	–	–	–	–	–	1479	–	–	813	913	1018
1978	79	2885	–	–	–	–	–	659	–	–	1510	1116	1604
1979	80	3141	–	–	–	–	–	484	–	–	983	840	1227
1980	81	3259	–	–	–	–	–	414	–	–	550	792	963
1981	82	3574	–	–	–	–	–	–	–	–	1349	2297	1739
1982	83	3558	–	–	–	–	–	–	–	–	1097	946	1562
1983	84	4330	–	–	–	–	–	–	–	–	1125	769	1975
1984	85	4773	–	–	–	–	–	–	1132	1172	1154	1028	2055
1985	86	4716	–	–	–	2429	–	2429	1200	1032	1117	2338	1881
1986	87	4730	–	–	–	2467	1025	1961	1123	1186	1160	1778	1998
1987	88	4371	–	–	–	2604	1082	2202	1254	1175	1210	1778	1803
1988	89	4700	–	–	–	2250	1070	1758	1130	1128	1129	1754	1858
1989	90	4568	–	–	–	2735	1009	1831	1542	1149	1337	2593	2131
Source: MDRH/DA/DAS													
Average (85-89)		4617	–	–	–	2517	837	2036	1250	1134	1191	2048	1934

Table 30 Senegal: Cowpea Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine Saloum			Casamance			Tamba-counda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	302	156	253	209	–	–	300	–	–	–	230	247
1961	62	334	252	254	245	..	..	250	–	–	–	300	268
1962	63	291	282	253	228	..	–	250	–	–	–	300	267
1963	64	315	243	275	243	–	–	327	–	–	–	300	273
1964	65	328	250	319	257	–	–	327	–	–	–	290	298
1965	66	192	254	309	218	–	–	344	–	–	300	300	257
1966	67	328	218	239	15	–	–	344	–	–	298	308	211
1967	68	557	137	356	182	–	–	304	–	–	355	300	305
1968	69	223	283	232	222	–	–	303	–	–	322	254	253
1969	70	437	287	257	206	–	–	254	–	–	443	300	317
1970	71	628	230	243	253	–	–	79	–	–	389	385	281
1971	72	460	367	281	283	–	–	303	–	–	303	382	363
1972	73	208	117	95	266	–	–	11	–	–	353	–	125
1973	74	201	290	310	340	–	–	–	–	–	376	–	287
1974	75	216	438	433	337	–	..	–	–	–	509	–	375
1975	76	285	497	361	400	..	–	..	–	–	432	–	396
1976	77	270	205	235	400	..	–	..	–	..	400	–	255
1977	78	134	219	213	309	–	–	–	–	–	358	–	205
1978	79	304	428	250	559	–	–	231	–	–	170	–	344
1979	80	213	352	220	615	–	..	491	–	–	265	–	340
1980	81	270	370	251	169	–	..	–	..	–	349	–	315
1981	82	313	400	410	552	–	–	407	..	–	465	–	420
1982	83	166	233	424	–	..	..	–	–	–	478	283	276
1983	84	259	225	226	–	..	–	321	–	–	–	568	234
1984	85	ERR	370	181	187	–	–	–	688	–	688	70	309
1985	86	421	750	430	600	519	490	512	500	517	502	306	621
1986	87	234	437	425	528	573	400	567	691	485	651	534	466
1987	88	211	325	500	518	308	399	335	674	481	594	568	400
1988	89	217	235	232	273	276	379	268	417	364	398	313	250
1989	90	133	271	497	500	314	501	346	863	364	528	528	391
Source: MDRH/DA/DAS													
Average (85-89)		243	404	417	484	398	434	410	629	442	535	450	425

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Table 31 Senegal: Groundnuts-Oil Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tamba-counda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	781	800	1000	800	–	–	950	–	–	910	1000	913
1961	62	382	1087	1121	1028	–	–	902	–	–	937	1057	972
1962	63	321	723	895	874	–	–	864	–	–	1089	1073	883
1963	64	329	748	1034	834	–	–	842	–	–	1134	1000	880
1964	65	414	787	891	860	–	–	1005	–	–	1252	1242	968
1965	66	589	865	977	1017	–	–	1058	–	–	1116	1051	1010
1966	67	709	483	705	237	–	–	950	–	–	1046	949	770
1967	68	513	911	1005	929	–	–	760	–	–	1000	992	864
1968	69	1792	509	667	523	–	–	723	–	–	911	899	689
1969	70	500	804	758	536	–	–	957	–	–	777	862	819
1970	71	100	247	531	311	–	–	670	–	–	996	385	556
1971	72	168	918	1088	851	–	–	911	–	–	1031	739	930
1972	73	0	94	118	338	–	–	754	–	–	1147	641	533
1973	74	90	505	611	531	–	–	648	–	–	1056	474	642
1974	75	244	743	975	852	–	–	1010	–	–	942	1045	933
1975	76	750	1009	977	1194	–	–	1150	–	–	1081	985	1093
1976	77	163	600	747	978	–	–	978	–	–	1156	1190	917
1977	78	229	273	245	492	–	–	419	–	–	857	789	439
1978	79	574	958	1296	870	–	–	784	–	–	1008	1023	910
1979	80	203	420	656	713	–	–	683	–	–	839	600	642
1980	81	464	717	342	306	–	–	509	–	–	472	469	489
1981	82	772	851	693	931	–	–	831	–	–	1100	895	858
1982	83	600	933	995	900	–	–	1059	–	–	1055	938	997
1983	84	0	157	526	336	–	–	586	–	–	1198	525	528
1984	85	ERR	500	698	769	850	700	753	1222	1222	1222	1000	780
1985	86	639	1029	1000	900	950	1000	986	1100	1037	1051	1000	993
1986	87	313	873	779	709	1052	1146	1120	1225	1321	1300	1048	1041
1987	88	651	956	870	1050	1217	1192	1198	1250	1339	1317	1116	1139
1988	89	621	520	229	334	930	983	970	981	1221	1163	1107	810
1989	90	508	993	924	969	1001	1138	1097	1032	1265	1216	1163	1072
Source: MDRH/DA/DAS													
Average (85-89)		546	874	760	792	1030	1092	1074	1117	1237	1209	1087	1011

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Table 17 Senegal Cotton Area Planted (1000 hectares)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tamba-counda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	–	–	–	–	–	–	–	–	–	–	–	–
1961 62	–	–	–	–	–	–	–	–	–	–	–	–
1962 63	–	–	–	–	–	–	–	–	–	–	–	–
1963 64	–	–	–	–	–	–	–	–	–	–	–	–
1964 65	–	–	–	–	–	–	–	–	–	–	–	–
1965 66	–	–	–	–	–	–	0.0	–	–	0.6	0.8	1.5
1966 67	–	–	–	–	–	–	0.1	–	–	1.0	1.2	2.3
1967 68	–	–	–	–	–	–	0.3	–	–	1.6	2.2	4.0
1968 69	–	–	–	–	–	–	0.9	–	–	1.2	4.6	6.7
1969 70	–	–	–	–	–	–	1.3	–	–	1.8	6.7	9.8
1970 71	–	–	–	–	–	–	2.6	–	–	3.1	7.9	13.6
1971 72	–	–	–	–	–	–	4.1	–	–	5.8	8.4	18.3
1972 73	–	–	–	–	–	–	3.1	–	–	6.8	10.5	20.4
1973 74	–	–	–	–	–	–	4.5	–	–	11.5	12.1	28.1
1974 75	–	–	–	–	–	–	6.0	–	–	15.7	16.3	38.0
1975 76	–	–	–	–	–	–	5.6	–	–	16.4	17.2	39.2
1976 77	–	–	–	–	–	–	6.0	–	–	18.1	19.8	43.8
1977 78	–	–	–	–	–	–	7.7	–	–	20.1	19.2	47.1
1978 79	–	–	–	–	–	–	8.0	–	–	22.6	17.7	48.3
1979 80	–	–	–	–	–	–	6.2	–	–	13.1	11.7	30.9
1980 81	–	–	–	–	–	–	5.0	–	–	14.8	10.2	29.9
1981 82	–	–	–	–	–	–	5.0	–	–	15.9	11.1	32.0
1982 83	–	–	–	–	–	–	5.9	–	–	24.5	11.6	42.0
1983 84	–	–	–	–	–	–	2.9	–	–	19.5	11.0	33.4
1984 85	–	–	–	–	–	5.6	5.6	–	26.7	26.7	14.1	46.3
1985 86	–	–	–	–	0.4	5.5	5.9	–	20.7	20.7	12.2	38.8
1986 87	–	–	–	–	0.1	1.5	1.6	–	15.5	15.5	8.4	25.4
1987 88	–	–	–	–	1.2	0.0	1.2	–	18.4	18.4	9.2	28.9
1988 89	–	–	–	–	0.2	2.5	2.7	–	21.9	21.9	13.9	38.6
1989 90	–	–	–	–	0.3	3.4	3.6	–	12.6	12.6	8.0	24.2
Source: MDRH/DA/DAS												
Average (85-89)	–	–	–	–	0.5	2.6	3.0	–	17.8	17.8	10.3	31.2

Table 18 Senegal: Manioc Area Planted (1000 hectares)

Year	Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
					Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960 61	0.0	13.4	8.3	1.3	–	–	5.6	–	–	5.1	1.3	34.9
1961 62	0.5	12.5	8.8	2.5	–	–	4.6	–	–	5.0	2.5	36.4
1962 63	0.5	12.6	9.2	3.7	–	–	4.4	–	–	4.9	3.7	38.8
1963 64	0.0	10.1	6.5	0.7	–	–	5.4	–	–	4.9	0.7	28.2
1964 65	0.0	10.1	9.7	0.9	–	–	5.4	–	–	4.7	0.9	31.5
1965 66	0.0	12.2	9.7	2.8	–	–	5.8	–	–	4.7	2.8	38.0
1966 67	0.3	31.9	12.7	6.4	–	–	5.4	–	–	4.7	6.4	67.6
1967 68	0.4	33.8	14.7	3.5	–	–	5.7	–	–	5.3	3.5	66.9
1968 69	0.7	30.6	13.0	5.0	–	–	6.0	–	–	5.2	5.0	65.3
1969 70	–	10.3	13.6	3.8	–	–	6.5	–	–	6.0	3.8	43.9
1970 71	–	10.0	13.6	3.7	–	–	6.6	–	–	4.7	3.9	42.5
1971 72	–	4.1	14.5	2.1	–	–	6.9	–	–	3.4	2.1	33.0
1972 73	–	8.5	19.0	4.1	–	–	6.5	–	–	2.6	4.1	44.7
1973 74	–	2.0	16.1	0.5	–	–	6.8	–	–	3.3	0.5	29.1
1974 75	–	12.7	9.9	0.6	–	–	7.2	–	–	2.9	0.6	33.9
1975 76	–	8.2	10.3	0.9	–	–	7.2	–	–	1.4	0.9	28.8
1976 77	–	8.2	12.0	1.8	–	–	1.4	–	–	1.6	1.8	26.9
1977 78	–	2.0	12.7	1.3	–	–	1.0	–	–	1.6	1.3	19.8
1978 79	–	2.1	18.5	0.2	–	–	1.0	–	–	1.4	0.2	23.3
1979 80	–	0.3	5.3	0.2	–	–	–	–	–	1.9	0.2	7.9
1980 81	–	–	4.1	0.2	–	–	–	–	–	3.2	0.2	7.7
1981 82	–	–	4.7	–	–	–	–	–	–	2.9	–	7.6
1982 83	–	–	5.6	–	–	–	–	–	–	3.0	–	8.6
1983 84	–	–	5.0	–	–	–	–	–	–	1.3	–	6.3
1984 85	–	–	5.0	–	–	–	–	1.1	0.4	1.5	–	6.5
1985 86	–	–	5.9	–	–	–	–	1.1	0.7	1.8	–	7.7
1986 87	–	–	17.3	–	0.9	–	0.9	0.6	0.9	1.6	–	19.8
1987 88	–	–	10.1	–	1.1	0.5	1.6	0.8	1.1	1.9	–	13.5
1988 89	–	–	12.8	0.9	2.8	0.2	3.0	0.9	1.1	1.9	–	18.7
1989 90	–	–	12.9	0.8	1.9	0.4	2.3	0.7	1.2	1.9	–	17.9
Source: MDRH/DA/DAS												
Average (85-89)	–	–	11.8	0.4	1.3	0.2	1.6	0.8	1.0	1.8	–	15.5

Table 32 Senegal: Table Peanuts Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	-	-	-	-	-	-	-	-	-	-	-	-
1961	62	-	-	-	-	-	-	-	-	-	-	-	-
1962	63	-	-	-	-	-	-	-	-	-	-	-	-
1963	64	-	-	-	-	-	-	-	-	-	-	-	-
1964	65	-	-	-	-	-	-	-	-	-	-	-	-
1965	66	-	-	-	-	-	-	-	-	-	-	-	-
1966	67	-	-	-	-	-	-	-	-	-	-	-	-
1967	68	-	-	-	-	-	-	-	-	-	-	-	-
1968	69	-	-	-	-	-	-	-	-	-	-	-	-
1969	70	-	-	-	-	-	-	-	-	-	-	-	-
1970	71	-	-	-	-	-	-	1014	-	-	1362	1000	1064
1971	72	-	-	-	-	-	-	1165	-	-	1287	846	1164
1972	73	-	-	-	-	-	-	1142	-	-	997	1004	1104
1973	74	-	-	-	-	-	-	835	-	-	1187	404	892
1974	75	-	-	-	-	-	-	880	-	-	608	761	827
1975	76	-	-	-	-	-	-	990	-	-	914	916	980
1976	77	-	-	-	-	-	-	726	-	-	771	907	743
1977	78	-	-	-	-	-	-	411	-	-	894	653	470
1978	79	-	-	-	-	-	-	268	-	-	1000	1092	432
1979	80	-	-	-	-	-	-	69	-	-	434	322	148
1980	81	-	-	-	-	-	-	91	-	-	466	185	181
1981	82	-	-	-	-	-	-	745	-	-	372	771	589
1982	83	-	-	-	-	-	-	103	-	-	850	838	293
1983	84	-	-	-	-	-	-	296	-	-	797	309	349
1984	85	-	-	-	-	700	894	875	-	750	750	1199	880
1985	86	-	-	-	-	-	1100	1100	-	1100	1100	1000	1078
1986	87	-	-	-	-	1100	1074	1077	-	-	-	-	1077
1987	88	-	-	-	-	1036	1196	1175	-	-	-	1000	1175
1988	89	-	-	-	-	1131	1133	1133	-	-	-	-	1133
1989	90	-	-	-	-	1651	1197	1263	-	-	-	-	1263
Source: MDRH/DA/DAS													
Average (85-89)		-	-	-	-	984	1140	1150	-	220	220	400	1145

Table 33 Senegal: Cotton Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	-	-	-	-	-	-	-	-	-	-	-	-
1961	62	-	-	-	-	-	-	-	-	-	-	-	-
1962	63	-	-	-	-	-	-	-	-	-	-	-	-
1963	64	-	-	-	-	-	-	-	-	-	-	-	-
1964	65	-	-	-	-	-	-	-	-	-	-	-	-
1965	66	-	-	-	-	-	-	386	-	-	262	633	473
1966	67	-	-	-	-	-	-	566	-	-	1232	641	888
1967	68	-	-	-	-	-	-	798	-	-	493	1485	1054
1968	69	-	-	-	-	-	-	863	-	-	1541	1557	1459
1969	70	-	-	-	-	-	-	1042	-	-	1508	1109	1172
1970	71	-	-	-	-	-	-	732	-	-	1302	713	852
1971	72	-	-	-	-	-	-	826	-	-	1322	1200	1155
1972	73	-	-	-	-	-	-	784	-	-	1448	1053	1145
1973	74	-	-	-	-	-	-	704	-	-	1448	1054	1159
1974	75	-	-	-	-	-	-	1028	-	-	1084	1071	1070
1975	76	-	-	-	-	-	-	838	-	-	665	877	783
1976	77	-	-	-	-	-	-	879	-	-	1159	959	1031
1977	78	-	-	-	-	-	-	329	-	-	1168	576	789
1978	79	-	-	-	-	-	-	606	-	-	755	672	700
1979	80	-	-	-	-	-	-	799	-	-	993	799	881
1980	81	-	-	-	-	-	-	636	-	-	779	620	701
1981	82	-	-	-	-	-	-	1068	-	-	1459	1126	1282
1982	83	-	-	-	-	-	-	645	-	-	1324	935	1120
1983	84	-	-	-	-	-	-	559	-	-	1377	778	1108
1984	85	-	-	-	-	-	550	550	-	1499	1499	1168	1284
1985	86	-	-	-	-	948	950	950	-	1020	1020	893	969
1986	87	-	-	-	-	569	699	689	-	1055	1055	866	970
1987	88	-	-	-	-	1011	-	1011	-	1299	1299	1087	1219
1988	89	-	-	-	-	729	731	731	-	1233	1233	1148	1167
1989	90	-	-	-	-	800	1200	1171	-	1200	1200	1250	1212
Source: MDRH/DA/DAS													
Average (85-89)		-	-	-	-	812	716	910	-	1161	1161	1049	1108

Table 34 Senegal: Manioc Yield (kg/ha)

Year		Saint-Louis	Louga	Thies	Diourbel	Sine-Saloum			Casamance			Tambacounda	Total Senegal
						Fatick	Kaolack	Total	Ziguinchor	Kolda	Total		
1960	61	–	3110	4007	4000	–	–	4000	–	–	9548	6540	4561
1961	62	–	3020	3834	1000	–	–	1710	–	–	9260	3504	3764
1962	63	–	3000	3959	3043	–	–	1704	–	–	10000	2460	3878
1963	64	–	3995	5738	2774	–	–	1669	–	–	10000	13168	5182
1964	65	–	4485	4196	4000	–	–	1756	–	–	10169	10353	4920
1965	66	–	2656	4196	2529	–	–	1828	–	–	10401	3286	3927
1966	67	–	3192	3569	2912	–	–	1698	–	–	11537	1381	3507
1967	68	–	2392	4578	3871	–	–	1986	–	–	10431	1731	3499
1968	69	–	3007	4141	2210	–	–	2175	–	–	9549	1471	3464
1969	70	–	3031	4629	1559	–	–	2123	–	–	10438	94	4023
1970	71	–	2776	4661	1150	–	–	1882	–	–	11330	79	3794
1971	72	–	3488	5148	2199	–	–	1993	–	–	8767	193	4152
1972	73	–	2745	4475	1195	–	–	1993	–	–	9340	–	3361
1973	74	–	2736	4957	1915	–	–	1549	–	–	7272	–	4139
1974	75	–	3113	4094	3195	–	–	1591	–	–	9008	–	3528
1975	76	–	3183	1879	3174	–	–	6933	–	–	7329	–	3765
1976	77	–	2738	1792	2965	–	–	3484	–	–	7075	194	2461
1977	78	–	2832	4032	1653	–	–	3483	–	–	6822	283	3722
1978	79	–	2583	3308	3459	–	–	3500	–	–	7300	2175	3475
1979	80	–	1990	1619	2000	–	–	–	–	–	7806	786	3109
1980	81	–	–	1237	1138	–	–	–	–	–	6030	1852	3271
1981	82	–	–	1759	–	–	–	–	–	–	7986	–	4162
1982	83	–	–	2023	–	–	–	–	–	–	6837	–	3722
1983	84	–	–	2459	–	–	–	–	–	–	3798	–	2742
1984	85	–	–	2644	–	–	–	–	4237	3364	3985	–	2958
1985	86	–	–	3251	–	–	–	–	6000	7000	6401	–	4035
1986	87	–	–	3427	–	6000	–	6000	4956	6657	5966	–	3788
1987	88	–	–	3000	–	6000	6000	6000	5140	6886	6149	–	3861
1988	89	–	–	2950	–	1307	5000	1609	4879	6914	6016	–	2904
1989	90	–	–	3000	–	2578	5000	2982	6252	7079	6755	–	3258
Source: MDRH/DA/DAS													
Average (85-89)		–	–	3126	–	3177	3200	3318	5445	6907	6258	–	3569

Table 35. Fertilizer Use by Crop, Total Use and Total Distribution (1000 tons).

Crop Year	G'Nuts/ Cowpea	Cotton	Millet/ Sorghum Maize	RICE			Urea*	Other	Total Consumed	Total Distributed
				Rainfed	Irrigated	Total				
1965/66	26.106	–	4.685	–	–	–	–	–	30.791	31.937
1966/67	38.423	–	9.122	–	–	–	–	–	47.545	49.163
1967/68	48.214	–	12.096	–	–	–	–	–	60.310	63.277
1968/69	25.891	–	9.645	–	–	–	–	–	35.536	37.885
1969/70	12.790	–	8.400	–	–	–	–	–	21.190	24.923
1970/71	6.490	1.570	6.200	0.490	–	0.490	–	0.070	14.820	29.740
1971/72	12.600	2.400	10.480	0.960	–	0.960	–	3.390	29.830	29.740
1972/73	22.430	3.300	16.430	0.880	–	0.880	–	6.530	49.570	51.160
1973/74	16.100	4.890	10.780	–	–	0.000	–	5.030	36.800	44.030
1974/75	30.470	4.030	24.910	3.200	1.100	4.300	–	0.120	63.830	75.000
1975/76	36.890	7.410	28.200	2.000	1.900	3.900	–	1.460	77.860	105.350
1976/77	38.360	7.790	30.950	5.680	2.290	7.970	–	1.600	86.670	116.320
1977/78	25.330	9.930	25.520	4.170	1.800	5.970	–	2.160	68.910	74.570
1978/79	24.800	8.690	27.330	4.380	2.250	6.630	–	2.240	69.690	110.540
1979/80	22.920	6.340	14.200	2.360	1.440	3.800	–	3.210	50.470	57.850
1980/81	29.600	5.100	26.820	4.710	3.580	8.290	–	4.870	74.680	102.350
1981/82	13.710	5.810	19.540	2.880	1.300	4.180	–	1.320	44.560	57.120
1982/83	1.520	8.490	8.100	5.200	2.100	7.300	–	–	25.410	38.700
1983/84	1.200	7.500	14.700	6.000	5.720	11.720	–	–	35.120	35.000
1984/85	8.920	8.700	11.548	5.800	6.200	12.000	–	–	41.168	39.000
1985/86	4.200	7.900	8.582	–	6.400	6.400	–	–	27.082	41.000
1986/87	4.470	4.430	7.000	–	4.000	4.000	–	–	19.900	38.100
1987/88	2.330	8.970	6.560	0.890	2.270	3.160	–	1.380	22.400	31.580
1988/89	3.339	5.164	2.420	–	–	8.935	–	0.653	23.032	27.189
1989/90	2.966	4.536	3.119	0.127	2.238	2.365	9.763	3.596	26.345	24.051

Source: Various sources. USAID/ADO database. (fert_na)

* Urea included in the other crops prior to 1989.

Note: 1986/87 millet/sorghum/maize and irrigated rice estimated by trend.

TABLE 37. FERTILIZER CONSUMED FOR THE 1989/90 CROP YEAR (METRIC TONS)

REGION	CEREALS	VEGET-ABLES	GROUND NUTS/ COWPEAS	COTTON	SUGAR	OTHER	TOTAL	PRIVATE % OF REGION	REGION % OF NATION	Consump-tion (kg/ha)
THIES/DA	2,163	665	46			84	2,958	98.5	11.2	12.7
ST. LOUIS	7,271	345	250		1,730	595	10,191	98.7	38.7	242.0
LOUGA	62		4				66	99.5	0.3	0.3
DIOURBE	189		0				189	1.2	0.7	0.8
KAOLAC	3,302		2,615				5,917	35.7	22.5	9.6
FATIK	254		5				259	100.0	1.0	1.0
TAMBA	1,243	1	35	4,536			5,815	2.9	22.1	34.6
KOLDA	492	115	9			16	632	100.0	2.4	2.4
ZIGUINC	271	45	2				318	99.0	1.2	4.9
TOTAL	15,247	1,171	2,966	4,536	1,730	695	26,345	62.7	100.0	12.3
- PRIVAT	12,546	1,171	379	2	1,730	695	16,523			
- PUBLIC	2,701	0	2,587	4,534			9,822			

Source: USAID/ADO DATABASE (MDRII INPUTS COMMITTEE)

Table 36. Fertilizer: Price Paid by Farmers, Total Value, and Subsidy

CROP YEAR	TOTAL VALUE (MILLION FCF			FARM PRICE (FCFA/KG)	SUB-SIDY (FCFA/KG)	% SUB-SIDY	
	FARMERS	SUBSIDY	TOTAL				
1965/66	383.2	329.8	713.0	12.0	10.3	46	
1966/67	590.0	470.3	1,060.3	12.0	9.6	44	
1967/68	822.6	557.7	1,380.3	13.0	8.8	40	
1968/69	454.6	367.4	822.0	12.0	9.7	45	
1969/70	274.2	131.7	405.9	11.0	5.3	32	
1970/71	327.1	171.4	498.5	11.0	5.8	34	
1971/72	356.9	286.5	643.4	12.0	9.6	45	
1972/73	613.9	991.9	1,605.8	12.0	19.4	62	
1973/74	704.5	869.5	1,574.0	16.0	19.7	55	
1974/75	1,200.0	949.0	2,149.0	16.0	12.7	44	
1975/76	2,107.0	4,906.4	7,013.4	20.0	46.6	70	
1976/77	2,908.0	3,827.8	6,735.8	25.0	32.9	57	
1977/78	1,864.2	2,143.2	4,007.5	25.0	28.7	53	
1978/79	2,763.5	2,811.5	5,575.0	25.0	25.4	50	
1979/80	1,446.3	1,679.1	3,125.4	25.0	29.0	54	
1980/81	2,558.8	4,028.5	6,587.3	25.0	39.4	61	
1981/82	1,428.0	3,349.6	4,777.6	25.0	58.6	70	
1982/83	967.5	3,246.6	4,214.1	25.0	83.9	77	
1983/84	1,750.0	1,780.1	3,530.1	50.0	50.9	50	
1984/85	3,510.0	–	3,510.0	90.0	0.0	0	<--No subsidy
1985/86	4,305.0	820.0	5,125.0	105.0	20.0	16	
1986/87	2,499.4	161.9	2,661.3	65.6	24.0	27	<-- to 17.6% of sales
1987/88	2,071.6	186.1	2,257.7	78.5	16.0	20	<-- to 17.5% of sales
1988/89	2,134.3	64.5	2,198.8	80.0	8.0	9	<-- to 25.4% of sales
1989/90	2,339.4	–	2,339.4	88.8	0.0	0	<-- eliminated

Source: Various sources. USAID/ADO database. (fert-na)

Budget.13

Rice(Hot Season - Small Perimeters): Upper Valley Senegal River (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	80.0	5500	440000	5000	400000
Margin				123571		83571
Couts Variables						
Semences	Kg	125.0	50	6250	50	6250
Npk (18 46 0)	Kg	101.1	100	10105	100	10105
Uree	Kg	93.1	225	20936	225	20936
Carburant	Litre	229.1	300	68715	300	68715
Lubrifiant		769.1		6300		6300
Frais De Battage				37400		37400
Main D'oeuvre		500.0	269	134500	269	134500
Couts Variables Avec Main D'oeuvre				284206		284206
Couts Variables Sans Main D'oeuvre				149706		149706
Couts Fixes Annuels						
Petit Materiel	Utilisation	322.6	1	323	1	323
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				10307		10307
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	706.6	1	707	1	707
Ane Ou Cheval	Animal-Jour	784.0	4	3136	4	3136
Total Couts Fixes				32222		32222
Total Avec Main D'oeuvre				316429		316429
Total Sans Main D'oeuvre				181929		181929
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			58		63
Sans Main D'oeuvre	FCFA/Kg			33		36
Return To Labor/Day	FCFA			959		811
Return to Labor(Kcal)	000Kcal/Day			79.0		74.5

Rice(Hivernage - Small Perimeters): Upper Valley Senegal River (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	80.0	5000	400000	4500	360000
Margin				149347		115047
Couts Variables						
Semences	Kg	125.0	50	6250	50	6250
Npk (18-46-0)	Kg	101.1	100	10105	100	10105
Uree	Kg	93.1	225	20936	225	20936
Carburant	Litre	229.1	150	34358	150	34358
Lubrifiant		769.1		3436		3436
Frais De Battage				32000		28800
Main D'oeuvre	Homme-Jour	500.0	233	116500	228	114000
Couts Variables Avec Main D'oeuvre				223585		217885
Couts Variables Sans Main D'oeuvre				107085		103885
Couts Fixes Annuels						
Petit Materiel	Utilisation	322.6	1	323	1	323
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				5154		5154
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	706.6	1	707	1	707
Ane Ou Cheval	Animal-Jour	784.0	4	3136	4	3136
Total Couts Fixes				27069		27069
Total Avec Main D'oeuvre				250653		244953
Total Sans Main D'oeuvre				134153		130953
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			50		54
Sans Main D'oeuvre	FCFA/Kg			27		29
Return To Labor/Day	FCFA			1141		1005
Return to Labor(Kcal)	000Kcal/Day			34.7		30.5

Budget 11

Tomatoes(Cold Season - Small Perimeters): Middlde Senegal River Valley (Zone 4: Matam) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	30.0	15000	450000	10000	300000
Margin				233342		93790
Couts Variables						
Semences	Kg	17000.0	1	8500	1	8500
Npk (18-46-0)	Kg	98.1	100	9805	100	9805
Kcl	Kg	98.6	150	14783	150	14783
Uree	Kg	90.1	250	22513	250	22513
Insecticide (Deltamethrine)	Traitement	11262.1	1	11262	1	11262
Fongicide (Manebe)	Traitement	5032.1	2	10064	2	10064
Carburant	Litre	226.1	150	33908	150	33908
Lubrifiant		756.1		3391		3391
Main D'oeuvre	Homme-Jour	500.0	149	74500	129	64500
Couts Variables Avec Main D'oeuvre				188725		178725
Couts Variables Sans Main D'oeuvre				114225		114225
Couts Fixes Annuels						
Petit Materiel	Utilisation	1153.8	1	1154	1	1154
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				5086		5086
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Pulverisateur	Utilisation	0.0	3	0	3	0
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	6	2688	5	2240
Total Couts Fixes				27933		27485
Total Avec Main D'oeuvre				216658		206210
Total Sans Main D'oeuvre				142158		141710
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			14		21
Sans Main D'oeuvre	FCFA/Kg			9		14
Return To Labor/Day	FCFA			2066		1227
Return to Labor(Kcal)	000Kcal/Day			14.5		8.6

Sorghum(Decru): Middle Senegal River Valley (Zone 4: Matam) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Low Technology		Low Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	73.0	450	32850	400	29200
Margin				-14391		-18041
Couts Variables						
Semences	Kg	88.4	10	884	10	884
Main D'oeuvre		500.0	87	43500	87	43500
Couts Variables Avec Main D'oeuvre				44384		44384
Couts Variables Sans Main D'oeuvre				884		884
Couts Fixes Annuels						
Petit Materiel	Utilisation	1153.8	1	1154	1	1154
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	1	448	1	448
Total Couts Fixes				2857		2857
Total Avec Main D'oeuvre				47241		47241
Total Sans Main D'oeuvre				3741		3741
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			105		118
Sans Main D'oeuvre	FCFA/Kg			8		9
Return To Labor/Day	FCFA			335		293
Return to Labor(Kcal)	000Kcal/Day			16.9		14.8

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Budget.9

Maize and Sorghum(Cold Season - Small Perimeters): Middle Senegal River Valley (Zone 4: Matam)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire Mais	Mais				Prix Unitaire Sorgho	Sorgo			
			Medium Technology		Medium Tech , Late			Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur		Quantite	Valeur	Quantite	Valeur
Revenu	Kg	75.0	2000	150000	1500	112500	73	2000	146000	1700	124100
Margin				-37141		-71382			-30893		-50793
Couts Variables											
Semences	Kg	94.0	20	1880	20	1880	88	10	884	10	884
Npk (18-46-0)	Kg	98.1	100	9805	100	9805	98	0	0	0	0
Uree	Kg	90.1	150	13508	150	13508	90	100	9005	100	9005
Carburant	Litre	226.1	150	33908	150	33908	226	130	29387	130	29387
Lubrifiant		766.1		3150		3391	766		2939		2939
Main D'oeuvre		500.0	198	98750	191	95250	500	218	108750	214	106750
Couts Variables Avec Main D'oeuvre				161000		157741			150964		148964
Couts Variables Sans Main D'oeuvre				62250		62491			42214		42214
Couts Fixes Annuels											
Petit Materiel	Utilisation	1153.8	1	1154	1	1154	1154	1	1154	1	1154
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250	14250	1	14250	1	14250
Reparations Du Groupe Motopompe				5086		5086			4408		4408
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500	3500	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255	1255	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	2	896	2	896	681	2	1362	2	1362
Total Couts Fixes				26141		26141			25929		25929
Total Avec Main D'oeuvre				187141		183882			176893		174893
Total Sans Main D'oeuvre				88391		88632			68143		68143
Cout Unitaire De Production											
Avec Main D'oeuvre	FCFA/Kg			94		123			83		103
Sans Main D'oeuvre	FCFA/Kg			44		59			34		40
Return To Labor/Day	FCFA			312		125			358		267
Return to Labor(Kcal)	000Kcal/Day			15.3		6.1			16.7		11.8

Maize and Sorghum(Hivernage - Small Perimeters): Middle Senegal River Valley (Zone 4: Matam) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire Mais	Mais				Prix Unitaire Sorgho	Sorgo			
			Medium Technology		Medium Tech., Late			Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur		Quantite	Valeur	Quantite	Valeur
Revenu	Kg	75.0	1700	127500	1500	112500	73	2000	146000	1700	124100
Margin				-26678		-40678			4444		-15456
Couts Variables											
Semences	Kg	94.0	20	1880	20	1880	88	10	884	10	884
Npk (18-46-0)	Kg	98.1	100	9805	100	9805	98	0	0	0	0
Uree	Kg	90.1	150	13508	150	13508	90	100	9005	100	9005
Carburant	Litre	226.1	90	20345	90	20345	226	75	16954	75	16954
Lubrifiant		766.1		2034		2034	766		1695		1695
Main D'oeuvre		500.0	165	82500	163	81500	500	179	89500	175	87500
Couts Variables Avec Main D'oeuvre				130071		129071			118038		116038
Couts Variables Sans Main D'oeuvre				47571		47571			28538		28538
Couts Fixes Annuels											
Petit Materiel	Utilisation	1153.8	1	1154	1	1154	1154	1	1154	1	1154
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250	14250	1	14250	1	14250
Reparations Du Groupe Motopompe				3052		3052			2543		2543
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500	3500	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255	1255	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	2	896	2	896	272	3	816	3	816
Total Couts Fixes				24107		24107			23518		23518
Total Avec Main D'oeuvre				154178		153178			141556		139556
Total Sans Main D'oeuvre				71678		71678			52056		52056
Cout Unitaire De Production											
Avec Main D'oeuvre	FCFA/Kg			91		102			71		82
Sans Main D'oeuvre	FCFA/Kg			42		48			26		31
Return To Labor/Day	FCFA			338		250			525		417
Return to Labor(Kcal)	000Kcal/Day			16.6		12.3			23.7		18.6

Budget.7

Rice(Hot Season - Small Perimeters): Middle Valley Senegal River (Zone 4: Matam) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	80.0	5500	440000	5000	400000
Margin				125545		85545
Couts Variables						
Semences	Kg	125.0	50	6250	50	6250
Npk (18-46-0)	Kg	98.1	100	9805	100	9805
Uree	Kg	90.1	225	20261	225	20261
Carburant	Litre	226.1	300	67815	300	67815
Lubrifiant		766.1		6300		6300
Frais De Battage				37400		37400
Main D'oeuvre		500.0	269	134500	269	134500
Couts Variables Avec Main D'oeuvre				282331		282331
Couts Variables Sans Main D'oeuvre				147831		147831
Couts Fixes Annuels						
Petit Materiel	Utilisation	1153.8	1	1154	1	1154
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				10172		10172
Saisire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	4	1792	4	1792
Total Couts Fixes				32124		32124
Total Avec Main D'oeuvre				314455		314455
Total Sans Main D'oeuvre				179955		179955
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			57		63
Sans Main D'oeuvre	FCFA/Kg			33		36
Return To Labor/Day	FCFA			967		818
Return to Labor(Kcal)	000Kcal/Day			29.2		24.7

Rice(Hivernage - Small Perimeters): Middle Valley Senegal River (Zone 4: Matam) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu (Paddy)	Kg	80.0	5000	400000	4500	360000
Margin				150848		116548
Couts Variables						
Semences	Kg	125.0	50	6250	50	6250
Npk (18-46-0)	Kg	98.1	100	9805	100	9805
Uree	Kg	90.1	225	20261	225	20261
Carburant	Litre	226.1	150	33908	150	33908
Lubrifiant		766.1		3391		3391
Frais De Battage				32000		28800
Main D'oeuvre	Homme-Jour	500.0	233	116500	228	114000
Couts Variables Avec Main D'oeuvre				222115		216415
Couts Variables Sans Main D'oeuvre				105615		102415
Couts Fixes Annuels						
Petit Materiel	Utilisation	1153.8	1	1154	1	1154
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				5086		5086
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	1255.5	1	1255	1	1255
Ane Ou Cheval	Animal-Jour	448.0	4	1792	4	1792
Total Couts Fixes				27037		27037
Total Avec Main D'oeuvre				249152		243452
Total Sans Main D'oeuvre				132652		129452
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			50		54
Sans Main D'oeuvre	FCFA/Kg			27		29
Return To Labor/Day	FCFA			1147		1011
Return to Labor(Kcal)	000Kcal/Day			34.9		30.7

Tomatoes(Cold Season - Large Perimeters): Senegal River Valley (Zone 3: Delta)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	30.0	15000	450000	10000	300000
Margin				206904		66904
Couts Variables						
Semences	Kg	17000.0	1	8500	1	8500
Npk (18 46 0)	Kg	93.6	100	9355	100	9355
Kcl	Kg	94.1	150	14108	150	14108
Uree	Kg	85.6	250	21388	250	21388
Insecticide (Deltamethrine)	Traitement	11256.7	1	11257	1	11257
Fongicide (Manebe)	Traitement	5023.1	2	10046	2	10046
Main D'oeuvre		500.0	99	49500	79	39500
Couts Variables Avec Main D'oeuvre				124153		114153
Couts Variables Sans Main D'oeuvre				74653		74653
Couts Fixes Annuels						
Petit Materiel	Utilisation	750.0	1	750	1	750
Preparation Du Sol (Billonage)	Operation	25000.0	1	25000	1	25000
Preparation Du Sol (Offsettage)	Operation	12800.0	1	12800	1	12800
Irrigation	Operation	73000.0	1	73000	1	73000
Pulverisateur	Utilisation	1296.3	3	3889	3	3889
Charrette Asine Ou Equine	Utilisation	816.1	1	816	1	816
Ane Ou Cheval	Animal-Jour	448.0	6	2688	6	2688
Total Couts Fixes				118943		118943
Total Avec Main D'oeuvre				243096		233096
Total Sans Main D'oeuvre				193596		193596
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			16		23
Sans Main D'oeuvre	FCFA/Kg			13		19
Return To Labor/Day	FCFA			7590		1347
Return to Labor(Kcal)	000Kcal/Day			18.1		9.4

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Maize and Sorghum(Cold Season - Large Perimeters): Senegal River Valley (Zone 3: Delta) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire Mais	Mais				Prix Unitaire Sorgho	Sorgo			
			Medium Technology		Medium Tech, Late			Medium Technology		Medium Tech, Late	
			Quantite	Valeur	Quantite	Valeur		Quantite	Valeur	Quantite	Valeur
Revenu	Kg	75.0	2500	187500	1700	127500	73	3000	219000	2500	182500
Margin				-2552		-59052			18510		-14490
Couts Variables											
Semences	Kg	94.0	20	1880	20	1880	88	6	530	6	530
Npk (18-46-0)	Kg	93.6	100	9355	100	9355	94	100	9355	100	9355
Uree	Kg	85.6	100	8555	100	8555	86	100	8555	100	8555
Main D'oeuvre	Homme-Jour	500.0	114	57000	107	53500	500	138	69000	131	65500
Couts Variables Avec Main D'oeuvre				76790		73290			87440		83940
Couts Variables Sans Main D'oeuvre				19790		19790			18440		18440
Couts Fixes Annuels											
Petit Materiel	Utilisation	750.0	1	750	1	750	750	1	750	1	750
Preparation Du Sol (Billonage)	Operation	25000.0	1	25000	1	25000	25000	1	25000	1	25000
Preparation Du Sol (Offsettage)	Operation	12800.0	1	12800	1	12800	12800	1	12800	1	12800
(74) Irrigation	Operation	73000.0	1	73000	1	73000	73000	1	73000	1	73000
(75) Charrette Asine Ou Equine	Utilisation	816.1	1	816	1	816	816	1	816	1	816
(76) Ane Ou Cheval	Animal Jour	448.0	2	896	2	896	228	3	684	3	684
(80) Total Couts Fixes				113262		113262			113050		113050
Cout Total Avec Main D'oeuvre				190052		186552			200490		196990
(94) Cout Total Sans Main D'oeuvre				133052		133052			131490		131490
Cout Unitaire De Production											
Avec Main D'oeuvre	FCFA/Kg			76		110			67		79
Sans Main D'oeuvre	FCFA/Kg			53		78			44		53
Return To Labor/Day	FCFA			478		-52			634		389
Return to Labor(Kcal)	000Kcal/Day			23.4		-2.5			28.7		17.6

Maize and Sorghum(Hivernage - Large Perimeters): Senegal River Valley (Zone 3: Delta)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire Mais	Mais				Prix Unitaire Sorgho	Sorgo			
			Medium Technology		Medium Tech., Late			Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur		Quantite	Valeur	Quantite	Valeur
Revenu	Kg	75.0	2500	187500	1700	127500	73	3000	219000	2700	197100
Margin				6198		-53052			27760		7110
Couts Variables											
Semences	Kg	94.0	20	1880	20	1880	88	6	530	6	530
Npk (18-46-0)	Kg	93.6	100	9355	100	9355	94	100	9355	100	9355
Uree	Kg	85.6	100	8555	100	8555	86	100	8555	100	8555
Main D'oeuvre		500.0	97	48250	95	47500	500	120	59750	117	58500
Couts Variables Avec Main D'oeuvre				68040		67290			78190		76940
Couts Variables Sans Main D'oeuvre				19790		19790			18440		18440
Couts Fixes Annuels											
Petit Materiel	Utilisation	750.0	1	750	1	750	750	1	750	1	750
Preparation Du Sol (Billonage)	Operation	25000.0	1	25000	1	25000	25000	1	25000	1	25000
Preparation Du Sol (Offsettage)	Operation	12800.0	1	12800	1	12800	12800	1	12800	1	12800
Irrigation	Operation	73000.0	1	73000	1	73000	73000	1	73000	1	73000
Charrette Asine Ou Equine	Utilisation	816.1	1	816	1	816	816	1	816	1	816
Ane Ou Cheval	Animal-Jour	448.0	2	896	2	896	228	3	684	3	684
Total Couts Fixes				113262		113262			113050		113050
Total Avec Main D'oeuvre				181302		180552			191240		189990
Total Sans Main D'oeuvre				133052		133052			131490		131490
Cout Unitaire De Production											
Avec Main D'oeuvre	FCFA/Kg			73		106			64		70
Sans Main D'oeuvre	FCFA/Kg			53		78			44		49
Return To Labor/Day	FCFA			564		-58			732		561
Return to Labor(Kcal)	000Kcal/Day			27.7		-2.9			33		25

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Rice(Hot Season - Large Perimeters): Senegal River Valley (Zone 3: Delta) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		High Tech, Late		Medium Technology		Medium Tech, Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu (Paddy)	Kg	82.0	5500	451000	5500	451000	5000	410000	5000	410000
Margin				201445		203945		193282		195282
Couts Variables										
Semences	Kg	125.0	120	15000	120	15000	120	15000	120	15000
Npk (18 46 0)	Kg	93.6	100	9355	100	9355	0	0	0	0
Uree	Kg	85.6	200	17110	200	17110	125	10694	125	10694
Herbicide (Propanyl)	Litre	2505.6	10	25056	10	25056	4	8769	4	8769
Frais De Battage				36080		36080		32800		32800
Main D'oeuvre	Homme-Jour	500.0	113	56500	108	54000	118	59000	114	57000
Couts Variables Avec Main D'oeuvre				159101		156601		126263		124263
Couts Variables Sans Main D'oeuvre				102601		102601		67263		67263
Couts Fixes Annuels										
Petit Materiel	Utilisation	750.0	1	750	1	750	1	750	1	750
Preparation Du Sol (Offsettage)	Operation	12800.0	1	12800	1	12800	1	12800	1	12800
Irrigation	Operation	73000.0	1	73000	1	73000	1	73000	1	73000
Pulverisateur	Utilisation	1296.3	1	1296	1	1296	1	1296	1	1296
Charrette Asine Ou Equine	Utilisation	816.1	1	816	1	816	1	816	1	816
Ane Ou Cheval	Animal Jour	448.0	4	1792	4	1792	4	1792	4	1792
Total Couts Fixes				90454		90454		90454		90454
Total Avec Main D'oeuvre				249555		247055		216718		214718
Total Sans Main D'oeuvre				193055		193055		157718		157718
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			45		45		43		43
Sans Main D'oeuvre	FCFA/Kg			35		35		32		32
Return To Labor/Day	FCFA			2283		2388		2138		2213
Return to Labor(Kcal)	000Kcal/Day			67.6		70.8		63.4		65.6

Budget.1

Rice(Hivernage - Large Perimeters): Senegal River Valley (Zone 3: Delta) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		High Tech., Late		Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu (Paddy)	Kg	82.0	5000	410000	4500	369000	4500	369000	4000	328000
Margin				171725		136505		162060		129092
Couts Variables										
Semences	Kg	125.0	120	15000	120	15000	120	15000	120	15000
Npk (18 46 0)	Kg	93.6	100	9355	100	9355	0	0	0	0
Uree	Kg	85.6	200	17110	200	17110	125	10694	125	10694
Herbicide (Propanyl)	Litre	2505.6	10	25056	10	25056	4	10022	4	8769
Frais De Battage				32890		29520		29520		26240
Main D'oeuvre	Homme-Jour	500.0	97	48500	92	46000	103	51250	96	47750
Couts Variables Avec Main D'oeuvre				147821		142041		116486		108453
Couts Variables Sans Main D'oeuvre				99321		96041		65236		60703
Couts Fixes Annuels										
Petit Materiel	Utilisation	750.0	1	750	1	750	1	750	1	750
Preparation Du Sol (Offectage)	Operation	12800.0	1	12800	1	12800	1	12800	1	12800
Irrigation	Operation	73000.0	1	73000	1	73000	1	73000	1	73000
Pulverisateur	Utilisation	1296.3	1	1296	1	1296	1	1296	1	1295
Charrette Asine Ou Equine	Utilisation	816.1	1	816	1	816	1	816	1	816
Ane Ou Cheval	Animal-Jour	448.0	4	1792	4	1792	4	1792	4	1792
Total Couts Fixes				90454		90454		90454		90454
Total Avec Main D'oeuvre				238275		232495		206940		198908
Total Sans Main D'oeuvre				189775		186495		155690		151158
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			48		52		46		50
Sans Main D'oeuvre	FCFA/Kg			38		41		35		38
Return To Labor/Day	FCFA			2210		1984		2081		1852
Return to Labor(Kcal)	000Kcal/Day			67.3		58.8		61.7		54.9

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Maize and Sorghum(Cold Season - Small Perimeters): Upper Senegal River Valley (Zone 5: Bakel)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire Mais	Mais				Prix Unitaire Sorgho	Sorgo			
			Medium Technology		Medium Tech., Late			Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur		Quantite	Valeur	Quantite	Valeur
Revenu	Kg	63.0	2000	126000	1500	94500	61	2000	122000	1700	103700
Margin				-61501		-89787			-54204		-70504
Couts Variables											
Semences	Kg	84.0	20	1680	20	1680	79	10	788	10	788
Npk (18-46-0)	Kg	101.1	100	10105	100	10105	101	0	0	0	0
Uree	Kg	93.1	150	13958	150	13958	93	100	9305	100	9305
Carburant	Litre	229.1	150	34358	150	34358	229	130	29777	130	29777
Lubrifiant		769.1		3150		3436	769		2978		2978
Main D'oeuvre		500.0	196	98750	191	95250	500	218	108750	214	106750
Couts Variables Avec Main D'oeuvre				162[illegible]		158786			151597		149597
Couts Variables Sans Main D'oeuvre				63250		63536			42847		42847
Couts Fixes Annuels											
Petit Materiel	Utilisation	322.6	1	323	1	323	323	1	323	1	323
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250	14250	1	14250	1	14250
Reparations Du Groupe Motopompe				5154		5154			4466		4466
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500	3500	1	3500	1	3500
Charrette Asine Ou Equine	Utilisation	706.6	1	707	1	707	707	1	707	1	707
Ane Ou Cheval	Animal Jour	784.0	2	1568	2	1568	681	2	1362	2	1362
Total Couts Fixes				25501		25501			24607		24607
Total Avec Main D'oeuvre				187501		184287			176204		174204
Total Sans Main D'oeuvre				88751		89037			67454		67454
Cout Unitaire De Production											
Avec Main D'oeuvre	FCFA/Kg			94		123			88		102
Sans Main D'oeuvre	FCFA/Kg			44		59			34		40
Return To Labor/Day	FCFA			189		29			251		170
Return to Labor(Kcal)	000Kcal/Day			11.0		1.7			13.6		9.2

Tomatoes(Cold Season - Small Perimeters): Upper Senegal River Valley (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	Medium Technology		Medium Tech., Late	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	30.0	15000	450000	10000	300000
Margin				223628		84412
Couts Variables						
Semences	Kg	17000.0	1	8500	1	8500
Npk (18-46-0)	Kg	101.1	100	10105	100	10105
Kcl	Kg	101.6	150	15233	150	15233
Uree	Kg	93.1	250	23263	250	23263
Insecticide (Deltamethrine)	Traitement	11265.7	1	11266	1	11266
Fongicide (Manebe)	Traitement	5038.1	2	10076	2	10076
Carburant	Litre	229.1	150	34358	150	34358
Lubrifiant		769.1		3436		3436
Main D'oeuvre	Homme-Jour	500.0	149	74500	129	64500
Couts Variables Avec Main D'oeuvre				190735		180735
Couts Variables Sans Main D'oeuvre				116235		116235
Couts Fixes Annuels						
Petit Materiel	Utilisation	322.6	1	323	1	323
Amortissement Du Groupe Motopompe	Utilisation	14250.0	1	14250	1	14250
Reparations Du Groupe Motopompe				5154		5154
Salaire Pompiste Et Entretien Du Reseau	Utilisation	3500.0	1	3500	1	3500
Pulverisateur	Utilisation	2333.3	3	7000	3	7000
Charrette Asine Ou Equine	Utilisation	706.6	1	707	1	707
Ane Ou Cheval	Animal-Jour	784.0	6	4794	5	3920
Total Couts Fixes				35637		34853
Total Avec Main D'oeuvre				226372		215588
Total Sans Main D'oeuvre				151872		151088
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			15		22
Sans Main D'oeuvre	FCFA/Kg			10		15
Return To Labor/Day	FCFA			2001		1154
Return to Labor(Kcal)	000Kcal/Day			14.0		8.1

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Millet/Sorghum(Rainfed): Upper Senegal River Valley (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Tech.		Medium Tech.		Low Tech.		Home Field		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	65.0	700	45500	550	35750	400	26000	700	45500	250	16250
Margin				1884		-1464		1718		12002		-3680
Couts Variables												
Semences	Kg	80.0	6	480	6	480	6	480	6	430	6	480
Npk (14-7-7)	Kg	85.9	100	8585	100	8585	0	0	0	0	0	0
Uree	Kg	93.1	50	4653	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	46	22750	42	21000	37	18500	57	28500	31	15500
Couts Variables Avec Main D'oeuvre				36468		30065		18980		28980		15980
Couts Variables Sans Main D'oeuvre				13718		9065		480		480		480
Couts Fixes Annuels												
Petit Materiel	Utilisation	322.6	1	323	1	323	1	323	1	323	1	323
Semoir Super-Eco	Utilisation	1846.4	1	1846	1	1846	0	0	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	568.7	2	1137	2	1137	2	1137	2	1137	1	569
Charrette Equine Ou Bovine	Utilisation	706.6	1	707	1	707	1	707	1	707	1	707
Cheval ou Paire de Boeufs	Animal-Jour	784.0	4	3136	4	3136	4	3136	3	2352	3	2352
Total Couts Fixes				7149		7149		5302		4518		3950
Total Avec Main D'oeuvre				43616		37214		24282		33498		19930
Total Sans Main D'oeuvre				20866		16214		5782		4998		4430
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			62		68		61		48		80
Sans Main D'oeuvre	FCFA/Kg			30		29		14		7		18
Return To Labor/Day	FCFA			541		465		546		711		381
Return to Labor(Kcal)	000Kcal/Day			27.5		23.6		27.7		36.1		19.4

Cowpeas(Rainfed): Upper Senegal River Valley (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Tech.		Medium Tech.	
			Quantite	Valeur	Quantite	Valeur
Revenu (Pois)	Kg	71.0	700	49700	500	35500
Revenu (Fanes)	Kg	29.0	1400	40600	1000	29000
Revenu Total				90300		64500
Margin				-28104		-18068
Couts Variables						
Semences	Kg	99.8	20	1996	20	1996
Npk (6-20-10)	Kg	89.7	150	13447	0	0
Insecticide (Endosulfan-Thiodan)	Traitement	13164.2	1	13164	1	13164
Insecticide (Deltamethrine)	Traitement	9388.1	2	18776	1	9388
Main D'oeuvre	Homme-Jour	500.0	121	60500	95	47500
Couts Variables Avec Main D'oeuvre				107884		72048
Couts Variables Sans Main D'oeuvre				47384		24548
Couts Fixes Annuels						
Petit Materiel	Utilisation	322.6	1	323	1	323
Semoir Super-Eco	Utilisation	1846.4	1	1846	1	1846
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	1087.6	2	2175	2	2175
Pulverisateur	Utilisation	2333.3	1	2333	1	2333
Charrette Equine Ou Bovine	Utilisation	706.6	1	707	1	707
Cheval ou Paire de Boeufs	Animal-Jour	784.0	4	3136	4	3136
Total Couts Fixes				10520		10520
Total Avec Main D'oeuvre				118404		82568
Total Sans Main D'oeuvre				57904		35068
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			93		91
Sans Main D'oeuvre	FCFA/Kg			46		39
Return To Labor/Day	FCFA			-68		5
Return to Labor(Kcal)	000Kcal/Day			-3.3		0.2

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Groundnuts(Rainfed): Upper Senegal River Valley (Zone 5: Bakel) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Tech.		Medium Tech.		Low Tech.		Late Planting (COST: 1990)	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu (Gousses)	Kg	68.0	950	64600	850	57800	800	54400	600	40800
Revenu (Fanes)	Kg	40.0	1500	60000	1340	53600	1260	50400	930	37200
Revenu Total				124600		111400		104800		78000
Margin				61837		56031		58194		37031
Couts Variables										
Semences	Kg	100.0	120	12000	120	12000	160	16000	160	16000
Npk (6-20-10)	Kg	89.7	120	10758	80	7172	0	0	0	0
Fongicide	Traitement	3019.1	1	3019	1	3019	1	3019	1	3019
Main D'oeuvre	Homme-Jour	500.0	44	22000	47	23500	43	21500	36	18000
Couts Variables Avec Main D'oeuvre				47777		45691		40519		37919
Couts Variables Sans Main D'oeuvre				25777		22191		19019		19019
Couts Fixes Annuels										
Petit Materiel	Utilisation	322.6	1	323	1	323	1	323	1	323
Semoir Super-Eco	Utilisation	1846.4	1	1846	1	1846	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	568.7	3	1706	3	1706	2	1137	1	569
Souleveuse Firdou ou Arara + Bati	Utilisation	3740.9	1	3741	0	0	0	0	0	0
Charrette Equine Ou Bovine	Utilisation	706.6	1	707	1	707	1	707	1	707
Cheval ou Paire de Boeufs	Animal-Jour	784.0	9	6664	7	5096	5	3920	3	2352
Total Couts Fixes				14986		9678		6086		3950
Total Avec Main D'oeuvre				62763		55369		46606		40969
Total Sans Main D'oeuvre				40763		31869		25106		22969
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			34		34		30		36
Sans Main D'oeuvre	FCFA/Kg			22		19		16		20
Return To Labor/Day	FCFA			542		532		681		495

Groundnuts: Central Groundnut Basin (Zone 1: Thies, Diourbel, North Fatick, North Kaolack) COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Par ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu Des Gousses	kg	68.0	950	64600	850	57800	800	54400	600	40800
Revenu Des Fanes	kg	41.0	1500	61500	1340	54940	1260	51660	930	38130
Revenu Total				126100		112740		106060		78930
Margin				73253		66002		70514		47589
Couts Variables										
Semences (En Gousses)	kg	100.0	120	12000	120	12000	120	12000	120	12000
Npk (6-20-10)	kg	80.5	120	9660	80	6440	0	0	0	0
Fongicide	Traitement	3009.9	1	3010	1	3010	1	3010	1	3010
Main D'oeuvre	Homme-Jour	500.0	44	22000	38	19000	30	15000	24	12000
Couts Variables Avec Main D'oeuvre				46670		40450		30010		27010
Couts Variables Sans Main D'oeuvre				24670		21450		15010		15010
Couts Fixes Annuels										
Petit Materiel	Utilization	230.8	1	231	1	231	1	231	1	231
Semoir Super-Eco	Utilization	511.3	1	511	1	511	1	511	1	511
3 Dents Sarclage + Bati Sine Ou Oec.	Utilization	299.2	3	898	3	898	2	598	1	299
Souleveuse Firdou Ou Arara + Bati	Utilization	1428.3	1	1428	1	1428	1	1428	1	1428
Charrette Equine	Utilization	502.2	1	502	1	502	1	502	1	502
Cheval	Animal-Jour	302.0	8.5	2567	9	2718	8	2265	5	1359
Total Couts Fixes				6137		6288		5536		4331
Cout Total Avec Main D'oeuvre				52807		46738		35546		31341
Cout Total Sans Main D'oeuvre				30807		27738		20546		19341
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			28		28		23		27
Sans Main D'oeuvre	FCFA/Kg			17		17		13		17
Return To Labor/Day	FCFA			2166		2237		2650		2483

**Note: Production Cost Allocated According To Percent Of Revenue.

Millet/Sorghum: Central Groundnut Basin (Zone 11: Southern Kaolack) COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Per ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Home Field		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	kg	68.0	700	47600	550	37400	400	27200	700	47600	250	17000
Margin				9053		5048		7518		18220		920
Couts Variables												
Semences	kg	80.0	6	480	6	480	6	480	6	480	6	480
Npk (14-7-7)	kg	76.7	100	7670	100	7670	0	0	0	0	0	0
Uree	kg	83.9	50	4195	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	46	23000	42	21000	32	16000	52	26000	26	13000
Couts Variables Avec Main D'oeuvre				35345		29150		16480		26480		13480
Couts Variables Sans Main D'oeuvre				12345		8150		480		480		480
Couts Fixes Annuels												
Petit Materiel	Utilization	230.8	1	231	1	231	1	231	1	231	1	231
Semoir Super-Eco	Utilization	511.3	1	511	1	511	1	511	1	511	1	511
3 Dents Sarclage + Bati Sine Ou Occ.	Utilization	299.2	2	598	2	598	2	598	2	598	1	299
Charrette Equine	Utilization	502.2	1	502	1	502	1	502	1	502	1	502
Cheval	Animal-Jour	302.0	4.5	1359	5	1359	5	1359	4	1057	4	1057
Total Couts Fixes				3202		3202		3202		2900		2600
Cout Total Avec Main D'oeuvre				38547		32352		19682		29380		16080
Cout Total Sans Main D'oeuvre				15547		11352		3682		3380		3080
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			55		59		49		42		64
Sans Main D'oeuvre	FCFA/Kg			22		21		9		5		12
Return To Labor/Day	FCFA			697		620		735		850		535
Return to Labor(Kcal)	000Kcal/Day			33.8		30.1		35.7		41.3		26.0

Cowpeas: Central Groundnut Basin (Zone 1: Thies, Diourbel, North Fatick, North Kaolack) COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Par ha	Prix Unitaire	High Technology		Medium Technology	
			QUANTIT	Valeur	QUANTIT	Valeur
Revenu						
Revenu Des Pois	kg	79.0	700	55300	500	39500
Revenu Des Fanes	kg	30.0	1400	42000	1000	30000
Revenu Total				97300		69500
Margin				-17701		-9316
Couts Variables						
Semences	kg	106.2	20	2124	20	2124
Npk (6-20-10)	kg	80.5	150	12075	0	0
Insecticide (Endosulfan-Thiodan)	Traitement	13136.7	1	13137	1	13137
Insecticide (Deltamethrine)	Traitement	9378.9	2	18758	1	9379
Main D'oeuvre	Homme-Jour	500.0	121	60500	95	47500
Couts Variables Avec Main D'oeuvre				106594		72140
Couts Variables Sans Main D'oeuvre				46094		24640
Couts Fixes Annuels						
Petit Materiel	Utilization	230.8	1	231	1	231
Semoir Super-Eco	Utilization	511.3	1	511	1	511
3 Dents Sarclage + Bati Sine Ou Occident.	Utilization	759.4	2	1519	2	1519
Pulverisateur	Utilization	1428.3	3	4285	2	2857
Charrette Equine	Utilization	502.2	1	502	1	502
Cheval	Animal-Jour	302.0	4.5	1359	4	1057
Total Couts Fixes				8407		6677
Cout Total Avec Main D'oeuvre				115001		78816
Cout Total Sans Main D'oeuvre				54501		31316
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			164		158
Sans Main D'oeuvre	FCFA/Kg			78		63
Return To Labor/Day	FCFA			354		402
Return to Labor(Kcal)	000Kcal/Day			15.3		17.4

(techgb)

Groundnuts: Southeast Groundnut Basin (Zone 11: Southern Kaolack)

COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Par ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	kg	68.0	1100	74800	1000	68000	900	61200	700	47600
Revenu Des Fanes	kg	26.0	1750	45500	1590	41340	1420	36920	1090	28340
Revenu Total				120300		109340		98120		75940
Margin				66082		61529		62244		43685
Couts Variables										
Semences (En Gousses)	kg	100.0	120	12000	120	12000	120	12000	120	12000
Npk (6-20-10)	kg	85.2	120	10222	80	6814	0	0	0	0
Fongicide	Traitement	3014.6	1	3015	1	3015	1	3015	1	3015
Main D'oeuvre	Homme-Jour	500.0	48	24000	42	21000	33	16500	27	13500
Couts Variables Avec Main D'oeuvre				49236		42829		31515		28515
Couts Variables Sans Main D'oeuvre				25236		21829		15015		15015
Couts Fixes Annuels										
Petit Materiel	Utilization	176.5	1	176	1	176	1	176	1	176
Semoir Super-Eco	Utilization	391.0	1	391	1	391	1	391	1	391
3 Dents Sarclage + Bati Houe Sine	Utilization	293.8	3	881	3	881	2	588	1	294
Souleveuse Firdou + Bati Houe Sine	Utilization	369.7	1	370	1	370	1	370	1	370
Charrette Equine Ou Bovine	Utilization	384.0	1	384	1	384	1	384	1	384
Cheval Ou Paire De Boeufs	Animal-Jour	327.0	8.5	2780	9	2780	8	2453	7	2126
Total Couts Fixes				4982		4982		4361		3741
Total Avec Main D'oeuvre				54218		47811		35876		32255
Total Sans Main D'oeuvre				30218		26811		19376		18755
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			31		30		25		29
Sans Main D'oeuvre	FCFA/Kg			17		17		13		17
Return To Labor/Day	FCFA			1877		1965		2386		2118

Millet/Sorghum: Southeast Groundnut Basin (Zone 11: Southern Ksolack) COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Par ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Home Field		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	kg	59.0	1100	64900	700	41300	500	29500	900	53100	300	17700
Margin				6003		6335		8173		20100		670
Couts Variables												
Semences	kg	80.0	6	480	6	480	6	480	6	480	6	480
Npk (14-7-7)	kg	81.4	100	8138	100	8138	0	0	0	0	0	0
Uree	kg	88.6	50	4429	0	0	0	0	0	0	0	0
Herbicide (Propasine-Tazalon)	Traitement	12213.2	1	12213	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	57.5	28750	47	23500	36	18000	60	30000	31	15500
Couts Variables Avec Main D'oeuvre				54010		32118		18480		30480		15980
Couts Variables Sans Main D'oeuvre				25260		8618		480		480		480
Couts Fixes Annuels												
Petit Materiel	Utilization	176.5	1	176	1	176	1	176	1	176	1	176
Semoir Super-Eco	Utilization	391.0	1	391	1	391	1	391	1	391	1	391
Pulverisateur	Utilization	2333.3	1	2333	0	0	0	0	0	0	0	0
3 Dents Sarclage + Bati Houe Sine	Utilization	293.8	1	294	2	588	2	588	2	588	1	294
Charrette Equine Ou Bovine	Utilization	384.0	1	384	1	384	1	384	1	384	1	384
Cheval Ou Paire De Boeufs	Animal-Jour	327.0	4	1308	4	1308	4	1308	3	981	4	1145
Total Couts Fixes				4887		2847		2847		2520		2390
Total Avec Main D'oeuvre				58897		34965		21327		33000		18370
Total Sans Main D'oeuvre				30147		11465		3327		3000		2870
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			54		50		43		37		61
Sans Main D'oeuvre	FCFA/Kg			27		16		7		3		10
Return To Labor/Day	FCFA			604		635		727		835		478
Return to Labor(Kcal)	000Kcal/Day			33.8		35.5		40.7		46.7		26.8

Maize: Southeast Groundnut Basin (Zone 11: Southern Kaolack) COST: 1990

	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Home Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	63.0	2000	126000	1400	88200	1700	107100
Margin				51250		49172		81945
Couts Variables								
Semences	Kg	84.4	16	1350	16	1350	16	1350
Npk (8-18-27)	Kg	91.9	200	18376	100	9188	0	0
Uree	Kg	88.6	200	17716	100	8858	0	0
Herbicide (Propasine-Tazalon)	Traitement	12213.2	1	12213	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	39.5	19750	32	16000	41	20500
Couts Variables Avec Main D'oeuvre				69406		35396		21850
Couts Variables Sans Main D'oeuvre				49656		19396		1350
Couts Fixes Annuels								
Petit Materiel	Utilisation	176.5	1	176	1	176	1	176
Semoir Super-Eco	Utilisation	391.0	1	391	1	391	1	391
Pulverisateur	Utilisation	2333.3	1	2333	0	0	0	0
3 Dents Serclage + Bati Houe Sine	Utilisation	293.8	2	588	3	881	3	881
Charrette Equine Ou Bovine	Utilisation	384.0	1	384	1	384	1	384
Cheval Ou Paire De Boeufs	Animal-Jour	327.0	4.5	1472	6	1799	5	1472
Total Couts Fixes				5344		3631		3304
Total Avec Main D'oeuvre				74750		39028		25155
Total Sans Main D'oeuvre				55000		23028		4655
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			37		28		15
Sans Main D'oeuvre	FCFA/Kg			27		16		3
Return To Labor/Day	FCFA			1797		2037		2499
Return to Labor(Kcal)	000Kcal/Day			105.0		119.0		146.0

Groundnuts: Southwest Groundnut Basin (Zone 10: Southern Fatick)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	Kg	68.0	1100	74800	1000	68000	900	61200	700	47600
Revenu Des Fanes	Kg	27.0	1750	47250	1590	42930	1420	38340	1090	29430
Revenu Total				122050		110930		99540		77030
Margin				61609		56782		58473		40494
Couts Variables										
Semences (En Gousses)	Kg	100.0	120	12000	120	12000	120	12000	120	12000
Npk (6-20-10)	Kg	82.3	120	9876	80	6586	0	0	0	0
Fongicide	Traitement	3011.7	1	3012	1	3012	1	3012	1	3012
Main D'oeuvre	Homme-Jour	500.0	54	27000	48	24000	38	19000	31	15500
Couts Variables Avec Main D'oeuvre				51890		45597		34012		30512
Couts Variables Sans Main D'oeuvre				24890		21597		15012		15012
Couts Fixes Annuels										
Petit Materiel	Utilisation	214.3	1	214	1	214	1	214	1	214
Semoir Super-Eco	Utilisation	474.8	1	475	1	475	1	475	1	475
3 Dents Sarclage + Bati Houe Sine	Utilisation	333.5	3	1001	3	1001	2	667	1	334
Souleveuse Firdou + Bati Houe Sine	Utilisation	1047.5	1	1047	1	1047	1	1047	1	1047
Charrette Bovine Ou Equine	Utilisation	466.3	1	466	1	466	1	466	1	466
Paire De Boeufs Ou Cheval	Animal-Jour	465.0	11.5	5348	12	5348	9	4185	8	3488
Total Couts Fixes				8551		8551		7055		6024
Total Avec Main D'oeuvre				60441		54148		41067		36536
Total Sans Main D'oeuvre				33441		30148		22067		21036
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			34		33		28		32
Sans Main D'oeuvre	FCFA/Kg			19		18		15		19
Return To Labor/Day	FCFA			1641		1673		2039		1806

**Note: Production Cost Allocated According To Percent Of Revenue.

Millet/Sorghum: Southwest Groundnut Basin (Zone 10: Southern Fatick)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Home Field		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	61.0	900	54900	700	42700	500	30500	900	54900	300	18300
Margin				10115		6166		7318		20183		49
Couts Variables												
Semences	Kg	0.0	6	0	6	0	6	0	6	0	6	0
Npk (14-7-7)	Kg	78.5	100	7852	100	7852	0	0	0	0	0	0
Uree	Kg	85.7	50	4286	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	57	28500	50	25000	39	19500	63	31500	30	15000
Couts Variables Avec Main D'oeuvre				40638		32852		19500		31500		15000
Couts Variables Sans Main D'oeuvre				12138		7852		0		0		0
Couts Fixes Annuels												
Petit Materiel	Utilisation	214.3	1	214	1	214	1	214	1	214	1	214
Semoir Super-Eco	Utilisation	474.8	1	475	1	475	1	475	1	475	1	475
3 Dents Sarclage + Bati Houe Sine	Utilisation	333.5	2	667	2	667	2	667	2	667	1	334
Charrette Bovine Ou Equine	Utilisation	466.3	1	466	1	466	1	466	1	466	1	466
Paire De Boeufs Ou Cheval	Animal-Jour	465.0	5	2325	4	1860	4	1860	3	1395	4	1860
Total Couts Fixes				4147		3682		3682		3217		3349
Total Avec Main D'oeuvre				44785		36534		23182		34717		18349
Total Sans Main D'oeuvre				16285		11534		3682		3217		3349
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			50		52		46		39		61
Sans Main D'oeuvre	FCFA/Kg			18		16		7		4		11
Return To Labor/Day	FCFA			677		623		688		820		498
Return to Labor(Kcal)	000Kcal/Day			36.6		33.7		37.2		44.4		27.0

Groundnuts: Northern Groundnut Basin (Zone 2: Louga) COST: 1990

Revenu Et Couts (Fcfa)	Unite de Quantite Par ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late Planting	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu Des Gousses	kg	68.0	450	30600	400	27200	350	23800	250	17000
Revenu Des Fanes	kg	41.0	620	25420	620	25420	540	22140	380	15580
Revenu Total				56020		52620		45940		32580
Margin				4365		7086		11658		2459
Couts Variables										
Semences (En Gousses)	kg	100.0	120	12000	120	12000	120	12000	120	12000
Npk (6-20-10)	kg	81.8	120	9816	80	6544	0	0	0	0
Fongicide	Traitement	3011.2	1	3011	1	3011	1	3011	1	3011
Main D'oeuvre	Homme-Jour	500.0	44	22000	38	19000	30	15000	24	12000
Couts Variables Avec Main D'oeuvre				46827		40555		30011		27011
Couts Variables Sans Main D'oeuvre				24827		21555		15011		15011
Couts Fixes Annuels										
Petit Materiel	Utilization	184.6	1	185	1	185	1	185	1	185
Semoir Super-Eco	Utilization	415.4	1	415	1	415	1	415	1	415
3 Dents Sarclage + Bati Sine Ou Occ.	Utilization	254.7	3	764	3	764	2	509	1	255
Souleveuse Firdou Ou Arara + Bati	Utilization	488.5	1	488	1	488	1	488	1	488
Charrette Equine	Utilization	408.0	1	408	1	408	1	408	1	408
Cheval	Animal-Jour	302.0	8.5	2567	9	2718	8	2265	5	1359
Total Couts Fixes				4828		4979		4271		3110
Cout Total Avec Main D'oeuvre				51655		45534		34282		30121
Cout Total Sans Main D'oeuvre				29655		26534		19282		18121
Cout Unitaire De Production (Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			28		59		51		63
Sans Main D'oeuvre	FCFA/Kg			16		16		12		16
Return To Labor/Day	FCFA			599		686		889		602

**Note: Production Cost Allocated According To Percent Of Revenue.

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Millet/Sorghum: Northern Groundnut Basin (Zone 2: Louga)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Home Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	78.0	450	35100	400	31200	250	19500	450	35100
Margin				1845		2205		805		10671
Couts Variables										
Semences	Kg	80.0	6	480	6	480	6	480	6	480
Npk (14-7-7)	Kg	78.0	100	7800	100	7800	0	0	0	0
Uree	Kg	85.2	50	4260	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	36	18000	36	18000	31	15500	43	21500
Couts Variables Avec Main D'oeuvre				30540		26280		15980		21980
Couts Variables Sans Main D'oeuvre				12540		8280		480		480
Couts Fixes Annuels										
Petit Materiel	Utilisation	184.6	1	185	1	185	1	185	1	185
Semoir Super-Eco	Utilisation	415.4	1	415	1	415	1	415	1	415
3 Dents Sarclage + Bati Houe Occidentale	Utilisation	254.7	2	509	2	509	2	509	2	509
Charrette Equine Ou Asine	Utilisation	408.0	1	408	1	408	1	408	1	408
Cheval Ou Ane	Animal-Jour	266.0	4.5	1197	5	1197	5	1197	4	931
Total Couts Fixes				2715		2715		2715		2449
Total Avec Main D'oeuvre				33255		28995		18695		24429
Cout Total Sans Main D'oeuvre				15255		10995		3195		2929
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			74		72		75		54
Sans Main D'oeuvre	FCFA/Kg			34		27		13		7
Return To Labor/Day	FCFA			551		561		526		748
Return to Labor(Kcal)	000Kcal/Day			23.3		23.7		22.3		31.7

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Cowpeas Northern Groundnut Basin (Zone 2: Louga) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu								
Revenu Des Pois	Kg	79.0	800	63200	400	31600	150	11850
Revenu Des Fanes	Kg	30.0	1000	30000	800	24000	300	9000
Revenu Total				93200		55600		20850
Margin				-5748		-16359		-28589
Couts Variables								
Semences	Kg	106.2	20	2124	20	2124	20	2124
Npk (0-15-20)	Kg	81.8	100	8180	0	0	0	0
Insecticide (Endosulfan-Thiodan)	Traitement	13140.6	1	13141	1	13141	0	0
Insecticide (Deltamethrine)	Traitement	9380.2	2	18760	1	9380	0	0
Main D'oeuvre	Homme-Jour	500.0	98	49000	82	41000	82	41000
Couts Variables Avec Main D'oeuvre				91205		65645		43124
Couts Variables Sans Main D'oeuvre				42205		24645		2124
Couts Fixes Annuels								
Petit Materiel	Utilisation	184.6	1	185	1	185	1	185
Semoir Super-Eco	Utilisation	415.4	1	415	1	415	1	415
3 Dents Sarclage + Bati Houe Occidentale	Utilisation	759.4	2	1519	2	1519	2	1519
Pulverisateur	Utilisation	1428.3	3	4285	2	2857	2	2857
Charrette Equine Ou Asine	Utilisation	408.0	1	408	1	408	1	408
Cheval Ou Ane	Animal-Jour	266.0	3.5	931	4	931	4	931
Total Couts Fixes				7743		6315		6315
Total Avec Main D'oeuvre				98948		71959		49439
Cout Total Sans Main D'oeuvre				49948		30959		8439
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			124		180		330
Sans Main D'oeuvre	FCFA/Kg			62		77		56
Return To Labor/Day	FCFA			441		300		151
Return to Labor(Kcal)	000Kcal/Day			19.1		13.0		6.6

(techgb)

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Millet/Sorghum: Lower Casamance (Zone 9: Ziguinchor)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Newly Cleared Land		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	80.0	1200	96000	800	64000	600	48000	800	64000	400	32000
Margin				8373		534		5338		-1662		9662
Couts Variables												
Semences	Kg	80.0	6	480	6	480	6	480	6	480	6	480
Npk (14-7-7)	Kg	88.0	100	8804	100	8804	0	0	0	0	0	0
Uree	Kg	91.4	50	4572	0	0	0	0	0	0	0	0
Herbicide (Propasine-Tazalon)	Traitement	12221.8	1	12222	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	76	37750	107	53500	83	41500	129	64500	81	40500
Couts Variables Avec Main D'oeuvre				63828		62784		41980		64980		40980
Couts Variables Sans Main D'oeuvre				26078		9284		480		480		480
Couts Fixes Annuels												
Petit Materiel	Utilisation	681.8	1	682	1	682	1	682	1	682	1	682
Charrue Ucf	Utilisation	3751.3	1	3751	0	0	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0	0	0
Pulverisateur	Utilisation	2333.3	1	2333	0	0	0	0	0	0	0	0
Charrette Bovine	Utilisation	1564.9	1	1565	0	0	0	0	0	0	0	0
Paire De Boeufs	Animal-Jour	1518.0	8	12144	0	0	0	0	0	0	0	0
Total Couts Fixes				23799		682		682		682		682
Total Avec Main D'oeuvre				87627		63466		42662		65662		41662
Cout Total Sans Main D'oeuvre				49877		9966		1162		1162		1162
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			73		79		71		82		104
Sans Main D'oeuvre	FCFA/Kg			42		12		2		1		3
Return To Labor/Day	FCFA			611		505		564		487		381
Return to Labor(Kcal)	000Kcal/Day			25.2		20.8		23.3		20.1		15.7

Maize: Lower Casamance (Zone 9: Ziguinchor) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech /Mech.		Medium Tech./Manual		Household Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	70.0	1500	105000	1200	84000	1200	84000	1200	84000
Margin				-2099		29403		10706		29878
Couts Variables										
Semences	Kg	90.0	16	1440	16	1440	16	1440	16	1440
Npk (8-18-27)	Kg	94.7	200	18948	100	9474	100	9474	0	0
Uree	Kg	91.4	200	18288	100	9144	100	9144	0	0
Herbicide (Propasine-Tazalon)	Traitement	12221.8	1	12222	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	52	25750	62	31000	96	48000	104	52000
Couts Variables Avec Main D'oeuvre				76648		51058		68058		53440
Couts Variables Sans Main D'oeuvre				50898		20058		20058		1440
Couts Fixes Annuels										
Petit Materiel	Utilisation	681.8	1	682	1	682	1	682	1	682
Charrue Ucf	Utilisation	3751.3	1	3751	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	2333.3	1	2333	0	0	0	0	0	0
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	1	2857	0	0	0	0
Charrette Bovine	Utilisation	1564.9	1	1565	0	0	0	0	0	0
Paire De Boeufs	Animal-Jour	1518.0	11	15939	0	0	3	4554	0	0
Total Couts Fixes				30451		3539		5236		682
Total Avec Main D'oeuvre				107099		54597		73294		54122
Total Sans Main D'oeuvre				81349		23597		25294		2122
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			71		45		61		45
Sans Main D'oeuvre	FCFA/Kg			54		20		21		2
Return To Labor/Day	FCFA			459		974		612		787
Return to Labor(Kcal)	000Kcal/Day			24.1		51.2		32.1		41.4

Rice (Lowland): Lower Casamance (Zone 9: Ziguinchor)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech./Mech.		Medium Tech./Manual		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	2000	166000	1500	124500	1500	124500	1000	83000	800	66400
Margin				20329		-21873		-13517		-14432		27037
Couts Variables												
Semences	Kg	125.0	90	11250	90	11250	90	11250	90	11250	90	11250
Npk (18-46-0)	Kg	99.4	150	14916	75	7458	75	7458	0	0	0	0
Uree	Kg	91.4	100	9144	50	4572	50	4572	0	0	0	0
Herbicide (Tamariz)	Traitement	12221.8	1	12222	1	12222	1	12222	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	134	66750	162	81000	199	99500	171	85500	163	81500
Couts Variables Avec Main D'oeuvre				114282		116502		135002		96750		92750
Couts Variables Sans Main D'oeuvre				47532		35502		35502		11250		11250
Couts Fixes Annuels												
Petit Materiel	Utilisation	681.8	1	682	1	682	1	682	1	682	1	682
Charrue Ucf	Utilisation	3751.3	1	3751	1	3751	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	2333.3	1	2333	1	2333	1	2333	0	0	0	0
Charrette Bovine	Utilisation	1564.9	1	1565	1	1565	0	0	0	0	0	0
Paire De Boeufs	Animal-Jour	1518.0	13	19734	12	18216	0	0	0	0	0	0
Total Couts Fixes				31389		29871		3015		682		682
Total Avec Main D'oeuvre				145671		146373		138017		97432		93432
Total Sans Main D'oeuvre				78921		65373		38517		11932		11932
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			73		98		92		97		117
Sans Main D'oeuvre	FCFA/Kg			39		44		26		12		15
Return To Labor/Day	FCFA			652		365		432		416		334
Return to Labor(Kcal)	000Kcal/Day			19.1		10.7		12.6		12.2		9.8

Rice (Transplanted): Lower Casamance (Zone 9: Ziguinchor) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Low Technology	
			Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	2500	207500	1200	99600
Margin				72152		8668
Couts Variables						
Semences	Kg	125.0	50	6250	50	6250
Npk (18-46-0)	Kg	99.4	150	14916	0	0
Main D'oeuvre	Homme-Jour	500.0	227	113500	168	84000
Couts Variables Avec Main D'oeuvre				134666		90250
Total Couts Variables Sans Main D'oeuvre				21166		6250
Couts Fixes Annuels						
Petit Materiel	Utilisation	681.8	1	682	1	682
Total Couts Fixes				682		682
Total Avec Main D'oeuvre				135348		90932
Total Sans Main D'oeuvre				21848		6932
Cout Unitaire De Production						
Avec Main D'oeuvre	FCFA/Kg			54		76
Sans Main D'oeuvre	FCFA/Kg			9		6
Return To Labor/Day	FCFA			818		552
Return to Labor(Kcal)	000Kcal/Day			23.9		16.[illegible]

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Groundnuts: Lower Casamance (Zone 9: Ziguinchor)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	Kg	68.0	1200	81600	1000	68000	800	54400	700	47600
Revenu Des Fanes	Kg	13.0	1920	24960	1590	20670	1260	16380	1090	14170
Revenu Total				106560		88670		70780		61770
Margin				14807		-72		-1919		8071
Couts Variables										
Semences (En Gousses)	Kg	100.0	120	12000	160	16000	160	16000	160	16000
Npk (6-20-10)	Kg	88.0	120	10565	80	7043	0	0	0	0
Fongicide	Traitement	3017.4	1	3017	1	3017	1	3017	1	3017
Main D'oeuvre	Homme-Jour	500.0	88	44000	124	62000	106	53000	68	34000
Couts Variables Avec Main D'oeuvre				69582		88061		72017		53017
Couts Variables Sans Main D'oeuvre				25582		26061		19017		19017
Couts Fixes Annuels										
Petit Materiel	Utilisation	681.8	1	682	1	682	1	682	1	682
Charrue Ucf	Utilisation	3751.3	1	3751	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Souleveuse Firdou Ou Arara + Bati	Utilisation	3740.9	1	3741	0	0	0	0	0	0
Charrette Bovine	Utilisation	1564.9	1	1565	0	0	0	0	0	0
Paire De Boeufs	Animal-Jour	1518.0	6	9108	0	0	0	0	0	0
Total Couts Fixes				22170		682		682		682
Total Avec Main D'oeuvre				91753		88742		72699		53699
Cout Total Sans Main D'oeuvre				47753		26742		19699		19699
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			59		68		70		59
Sans Main D'oeuvre	FCFA/Kg			30		21		19		22
Return To Labor/Day	FCFA			668		499		482		619

**Note: Production Cost Allocated According To Percent Of Revenue.

Millet/Sorghum: Middle Casamance (Zone 8: West Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Newly Cleared Land		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	1200	99600	800	66400	600	49800	800	66400	400	33200
Margin				-13126		3512		3566		10949		-11269
Couts Variables												
Semences	Kg	100.0	6	600	6	600	6	600	6	600	6	600
Npk (14-7-7)	Kg	101.8	100	10178	100	10178	0	0	0	0	0	0
Uree	Kg	93.8	50	4689	0	0	0	0	0	0	0	0
Herbicide (Propasine-Tazalon)	Traitement	33575.3	1	33575	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	72	35750	75	37500	83	41500	106	53000	81	40500
Couts Variables Avec Main D'oeuvre				84792		48278		42100		53600		41100
Couts Variables Sans Main D'oeuvre				49042		10778		600		600		600
Couts Fixes Annuels												
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2885.6	1	2886	1	2886	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	0	0	0	0	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	5307.5	1	5308	0	0	0	0	0	0		
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	0	0	0	0
Paire De Boeufs	Animal-Jour	1518.0	10	14421	7	10626	2	3036	1	1518	2	3036
Total Couts Fixes				27933		14610		4134		1851		3369
Total Avec Main D'oeuvre				112726		62888		46234		55451		44469
Cout Total Sans Main D'oeuvre				76976		25388		4734		2451		3969
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			94		79		77		69		111
Sans Main D'oeuvre	FCFA/Kg			64		32		8		3		10
Return To Labor/Day	FCFA			316		547		543		603		361
Return to Labor(Kcal)	000Kcal/Day			12.6		21.7		21.6		24.0		14.3

Rice (Lowland): Middle Casamance (Zone 8: West Kolda)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech./Mech.		Medium Tech./Manual		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	2000	166000	1500	124500	1500	124500	1000	83000	800	66400
Margin				4091		-37819		-32948		-14652		-26234
Couts Variables												
Semences	Kg	100.0	90	9000	90	9000	90	9000	90	9000	90	9000
Npk (18-46-0)	Kg	101.8	150	15267	75	7634	75	7634	0	0	0	0
Uree	Kg	93.8	100	9378	50	4689	50	4689	0	0	0	0
Herbicide (Tamariz)	Traitement	33575.3	1	33575	1	33575	1	33575	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	134	66750	162	81000	192	96000	166	83000	159	79500
Couts Variables Avec Main D'oeuvre				133970		135898		150898		92000		88500
Couts Variables Sans Main D'oeuvre				67220		54898		54898		9000		9000
Couts Fixes Annuels												
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2885.6	1	2886	1	2886	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	1	897	1	897	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1518.0	13	19734	12	18216	3	4554	3	4554	2	3036
Total Couts Fixes				27939		26421		6550		5652		4134
Total Avec Main D'oeuvre				161909		162319		157448		97652		92634
Total Sans Main D'oeuvre				95159		81319		61448		14652		13134
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			81		108		105		98		116
Sans Main D'oeuvre	FCFA/Kg			48		54		41		15		16
Return To Labor/Day	FCFA			531		267		328		412		335
Return to Labor(Kcal)	000Kcal/Day			15.5		7.8		9.6		12.1		9.8

Maize: Middle Casamance (Zone 8: West Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Household Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	70.0	1500	105000	1200	84000	1200	84000
Margin				1040		18304		29884
Couts Variables								
Semences	Kg	0.0	16	0	16	0	16	0
Npk (8-18-27)	Kg	97.1	200	19416	100	9708	0	0
Uree	Kg	93.8	200	18756	100	9378	0	0
Herbicide (Propanine-Tazalon)	Traitement	12228.8	1	12229	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	43	21250	64	32000	103	51500
Couts Variables Avec Main D'oeuvre				71651		51086		51500
Couts Variables Sans Main D'oeuvre				50401		19086		0
Couts Fixes Annuels								
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333
Charrue Ucf	Utilisation	2885.6	1	2886	1	2886	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0
Pulverizateur	Utilisation	897.4	1	897	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	5307.5	1	5308	0	0		0
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1518.0	11	15939	7	10626	1	1518
Total Couts Fixes				32309		14610		2616
Total Avec Main D'oeuvre				103960		65696		54116
Total Sans Main D'oeuvre				82710		33696		2616
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			69		55		45
Sans Main D'oeuvre	FCFA/Kg			55		28		2
Return To Labor/Day	FCFA			524		786		790
Return to Labor(Kcal)	000Kcal/Day			27.6		41.3		41.5

Rice (Rainfed): Middle Casamance (Zone 8: West Kolda)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech./Mech.		Newly Cleared Land	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	1600	132800	1300	107900	600	49800
Margin				-15885		10952		-41102
Couts Variables								
Semences	Kg	100.0	90	9000	90	9000	90	9000
Npk (18-46-0)	Kg	101.8	100	10178	50	5089	0	0
Uree	Kg	93.8	100	9378	50	4689	0	0
Herbicide (Tamariz)	Traitement	33575.3	1	33575	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	96	48000	142	71000	153	76250
Couts Variables Avec Main D'oeuvre				110131		89778		85250
Couts Variables Sans Main D'oeuvre				62131		18778		9000
Couts Fixes Annuels								
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333
Charrue Uef	Utilisation	2885.6	1	2886	0	0	0	0
Semoir Manuel	Utilisation	3323.5	1	3324	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	0	0	0	0
3 Dents Sarclage _ Bati Sine ou Arara	Utilisation	5307.5	2	10615	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1518.0	13	19734	4	6072	3	4554
Total Couts Fixes				38554		7170		5652
Total Avec Main D'oeuvre				148685		96948		90902
Total Sans Main D'oeuvre				100685		25948		14652
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			93		75		152
Sans Main D'oeuvre	FCFA/Kg			63		20		24
Return To Labor/Day	FCFA			335		577		230
Return to Labor(Kcal)	000Kcal/Day			9.8		16.9		6.7

Groundnuts: Middle Crusamance (Zone 8: West Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	Kg	68.0	1200	81600	1000	68000	800	54400	700	47600
Revenu Des Fanes	Kg	13.0	1920	24960	1590	20670	1260	16380	1090	14170
Revenu Total				106560		88670		70780		61770
Margin				25538		11267		-5892		3098
Couts Variables										
Semences (En Gousses)	Kg	100.0	120	12000	160	16000	160	16000	160	16000
Npk (6-20-10)	Kg	90.4	120	10846	80	7230	0	0	0	0
Fongicide	Traitement	3019.8	1	3020	1	3020	1	3020	1	3020
Main D'oeuvre	Homme-Jour	500.0	70	35000	91	45500	106	53000	68	34000
Couts Variables Avec Main D'oeuvre				60865		71750		72020		53020
Couts Variables Sans Main D'oeuvre				25865		26250		19020		19020
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2885.6	1	2886	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Souleveuse Firdou Ou Arara + Bati	Utilisation	3740.9	1	3741	0	0	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1518.0	6	9108	3	4554	3	4554	3	4554
Total Couts Fixes				20156		5652		5652		5652
Total Avec Main D'oeuvre				81022		77403		77672		58672
Cout Total Sans Main D'oeuvre				46022		31903		24672		24672
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			52		59		75		65
Sans Main D'oeuvre	FCFA/Kg			29		24		24		27
Return To Labor/Day	FCFA			865		624		435		546

**Note: Production Cost Allocated According To Percent Of Revenue.

Cotton: Middle Casamance (Zone 8: West Kolda)

COST 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	100.0	1500	150000	1300	130000	700	70000	400	40000
Margin				1759		-3722		-17453		-26511
Couts Variables										
Semences	Kg	110.0	50	5500	50	5500	50	5500	50	5500
Npk (6-14-35)	Kg	82.5	150	12375	100	8250	100	8250	0	0
Uree	Kg	93.8	50	4689	50	4689	0	0	0	0
Herbicide (Cotodon Mixte)	Traitement	14055.1	1	14055	1	14055	0	0	0	0
Insecticide (Cypermethrine-Dimethoate)	Traitement	2400.0	5	12000	5	12000	5	12000	2	4800
Main D'oeuvre		500.0	104	52000	95	47500	97	48250	79	39500
Couts Variables Avec Main D'oeuvre				100619		91994		74000		49800
Coute Variables Sans Main D'oeuvre				48619		44494		25750		10300
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Uef	Utilisati	2885.6	1	2886	1	2886	1	1443	1	1443
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	7	6282	7	6282	5	4487	2	1795
3 Dents Sarclage + Bati Sine Ou Arara	Utilisation	5307.5	2	10615	2	10615	0	0	1	5308
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	16	20560	14	17990	5	6425	6	7068
Total Couts Fixes				47622		41728		13453		16711
Total Avec Main D'oeuvre				148241		133722		87453		66511
Total Sans Main D'oeuvre				96241		86222		39203		27011
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			99		103		125		166
Sans Main D'oeuvre	FCFA/Kg			64		66		56		68
Return To Labor/Day	FCFA			517		461		319		164

Millet/Sorghum: Upper Casamance (Zone 7: East Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Newly Cleared Land		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	78.0	1200	93600	800	62400	600	46800	800	62400	400	31200
Margin				10341		-715		14561		8517		5468
Couts Variables												
Semences	Kg	0.0	6	0	6	0	6	0	6	0	6	0
Npk (14-7-7)	Kg	87.4	100	8736	100	8736	0	0	0	0	0	0
Uree	Kg	94.6	50	4728	0	0	0	0	0	0	0	0
Herbicide (Propasine-Tazalon)	Traitement	12231.2	1	12231	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	72	35750	68	34000	49	24500	103	51500	66	33000
Couts Variables Avec Main D'oeuvre				61445		42736		24500		51500		33000
Couts Variables Sans Main D'oeuvre				25695		8736		0		0		0
Couts Fixes Annuels												
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2143.6	1	2144	1	2144	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	0	0	0	0	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	2143.6	1	2144	2	4287	1	2144	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	10	12208	10	12850	4	4498	1	1285	2	2570
Total Couts Fixes				21814		20379		7739		2383		3668
Total Avec Main D'oeuvre				83259		63115		32239		53883		36668
Cout Total Sans Main D'oeuvre				47509		29115		7739		2383		3668
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			69		79		54		67		92
Sans Main D'oeuvre	FCFA/Kg			40		36		13		3		9
Return To Labor/Day	FCFA			645		489		797		583		317
Return to Labor(Kcal)	000Kcal/Day			27.3		20.7		33.7		24.7		17.6

Maize: Upper Casamance (Zone 7: East Kolda)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Household Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	70.0	1500	105000	1200	84000	1200	84000
Margin				7930		24586		30117
Couts Variables								
Semences	Kg	0.0	16	0	16	0	16	0
Npk (8-18-27)	Kg	97.9	200	19572	100	9786	0	0
Uree	Kg	9[illegible]	200	18912	100	9456	0	0
Herbicide (Propasine-Tazalon)	Traitement	[illegible]	1	12231	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	43	21250	52	26000	103	51500
Couts Variables Avec Main D'oeuvre				71965		45742		51500
Couts Variables Sans Main D'oeuvre				50715		19242		0
Couts Fixes Annuels								
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333
Charrue Ucf	Utilisation	2143.6	1	2144	1	2144	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	1292.1	1	1292	1	1292	0	0
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	11	13493	8	9638	1	1285
Total Couts Fixes				25105		14172		2383
Total Avec Main D'oeuvre				97070		59414		53883
Total Sans Main D'oeuvre				75820		33414		2383
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			65		50		45
Sans Main D'oeuvre	FCFA/Kg			51		28		2
Return To Labor/Day	FCFA			687		973		792
Return to Labor(Kcal)	000Kcal/Day			36.1		51.1		41.7

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Rice (Lowland): Upper Casamance (Zone 7: East Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech./Mech.		Medium Tech./Manual		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	2000	166000	1500	124500	1500	124500	1000	83000	800	66400
Margin				7659		-34386		-27354		-13953		-25768
Couts Variables												
Semences	Kg	100.0	90	9000	90	9000	90	9000	90	9000	90	9000
Npk (18-46-0)	Kg	102.6	150	15384	75	7692	75	7692	0	0	0	0
Uree	Kg	94.6	100	9456	50	4728	50	4728	0	0	0	0
Herbicide (Tamariz)	Traitement	33583.1	1	33583	1	33583	1	33583	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	134	66750	162	81000	182	91000	166	83000	159	79500
Couts Variables Avec Main D'oeuvre				134173		136003		146003		92000		88500
Couts Variables Sans Main D'oeuvre				67423		55003		55003		9000		9000
Couts Fixes Annuels												
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2143.6	1	2144	1	2144	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	1	897	1	897	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	13	16705	12	15420	3	3855	3	3855	2	2570
Total Couts Fixes				24168		22883		5851		4953		3668
Total Avec Main D'oeuvre				158341		158886		151854		96953		92168
Total Sans Main D'oeuvre				91591		77886		60854		13953		12668
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			79		106		101		97		115
Sans Main D'oeuvre	FCFA/Kg			46		52		41		14		16
Return To Labor/Day	FCFA			557		288		350		416		338
Return to Labor(Kcal)	000Kcal/Day			16.3		8.4		10.2		12.2		9.9

Rice (Rainfed): Upper Casamance (Zone 7: East Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Tech./Mech.		Newly Cleared Land	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	83.0	1500	124500	1200	99600	600	49800
Margin				-24047		2748		-46903
Couts Variables								
Semences	Kg	100.0	90	9000	90	9000	90	9000
Npk (18-46-0)	Kg	102.6	100	10256	50	5128	0	0
Uree	Kg	94.6	100	9456	50	4728	0	0
Herbicide (Tamariz)	Traitement	33583.1	1	33583	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	119	59500	114	56750	166	82750
Couts Variables Avec Main D'oeuvre				121795		75606		91750
Couts Variables Sans Main D'oeuvre				62295		18856		9000
Couts Fixes Annuels								
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333
Charrue Uef	Utilisation	2143.6	1	2144	1	2144	0	0
Semoir Manuel	Utilisation	3323.5	1	3324	0	0	0	0
Pulverisateur	Utilisation	897.4	1	897	0	0	0	0
3 Dents Sarclage _ Bati Sine ou Arara	Utilisation	1292.1	2	2584	2	2584	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	13	16705	12	15420	3	3855
Total Couts Fixes				26752		21246		4953
Total Avec Main D'oeuvre				148547		96852		96703
Total Sans Main D'oeuvre				89047		40102		13953
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			99		81		161
Sans Main D'oeuvre	FCFA/Kg			59		33		23
Return To Labor/Day	FCFA			298		524		217
Return to Labor(Kcal)	000Kcal/Day			5.7		15.3		6.3

Groundnuts: Upper Casamance (Zone 7: East Kolda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	Kg	68.0	1200	81600	1000	68000	900	61200	700	47600
Revenu Des Fanes	Kg	13.0	1920	24960	1590	20670	1420	18460	1090	14170
Revenu Total				106560		88670		79660		61770
Margin				28792		19468		25102		3796
Couts Variables										
Semences (En Gousses)	Kg	100.0	120	12000	160	16000	160	16000	160	16000
Npk (6-20-10)	Kg	91.2	120	10939	80	7293	0	0	0	0
Fongicide	Traitement	3020.6	1	3021	1	3021	1	3021	1	3021
Main D'oeuvre	Homme-Jour	500.0	65	32500	69	34500	56	28000	68	34000
Couts Variables Avec Main D'oeuvre				58460		60813		47021		53021
Couts Variables Sans Main D'oeuvre				25960		26313		19021		19021
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Uef	Utilisation	2143.6	1	2144	1	2144	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
3 Dents Sarclage _ Bati Sine ou Arara	Utilisation	1292.1	1	1292	1	1292	2	2584	0	0
Souleveuse Firdou Ou Arara + Bati	Utilisation	3740.9	1	3741	0	0	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	6	7710	3	3855	3	3855	3	3855
Total Couts Fixes				19309		8389		7538		4953
Total Avec Main D'oeuvre				77768		69202		54558		57974
Cout Total Sans Main D'oeuvre				45268		34702		26558		23974
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			50		53		52		64
Sans Main D'oeuvre	FCFA/Kg			29		27		26		26
Return To Labor/Day	FCFA			943		782		948		556

**Note: Production Cost Allocated According To Percent Of Revenue.

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Cotton: Upper Casamance (Zone 7: East Kolda)

COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	100.0	1500	150000	1300	130000	700	70000	400	40000
Margin				10490		5003		-17082		-22125
Couts Variables										
Semences	Kg	110.0	50	5500	50	5500	50	5500	50	5500
Npk (6-14-35)	Kg	82.5	150	12375	100	8250	100	8250	0	0
Uree	Kg	94.6	50	4728	50	4728	0	0	0	0
Herbicide (Cotodon Mixte)	Traitement	14058.2	1	14058	1	14058	0	0	0	0
Insecticide (Cypermethrine-Dimethoate)	Traitement	2400.0	5	12000	5	12000	5	12000	2	4800
Main D'oeuvre		500.0	104	52000	95	47500	97	48250	79	39500
Couts Variables Avec Main D'oeuvre				100661		92036		74000		49800
Couts Variables Sans Main D'oeuvre				48661		44536		25750		10300
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Uef	Utilisation	2143.6	1	2144	1	2144	1	1072	1	1072
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	897.4	7	6282	7	6282	5	4487	2	1795
3 Dents Sarclage + Bati Sine Ou Arara	Utilisation	1292.1	2	2584	2	2584	0	0	1	1292
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1285.0	16	20560	14	17990	5	6425	6	7068
Total Couts Fixes				38849		32956		13082		12325
Total Avec Main D'oeuvre				139510		124992		87082		62125
Total Sans Main D'oeuvre				87510		77492		38832		22625
Cout Unitaire De Production										
Avec Main D'oeuvre	FCFA/Kg			93		96		124		155
Sans Main D'oeuvre	FCFA/Kg			58		60		55		57
Return To Labor/Day	FCFA			601		553		323		220

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Millet/Sorghum: Central East Senegal (Zone 6: Central Tambacounda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Newly Cleared Land		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	65.0	1200	78000	800	52000	600	39000	1000	65000	400	26000
Margin				-3824		-8810		7137		8130		-15162
Couts Variables												
Semences	Kg	80.0	6	480	6	480	6	480	6	480	6	480
Npk (14-7-7)	Kg	85.8	100	8580	100	8580	0	0	0	0	0	0
Uree	Kg	93.0	50	4650	0	0	0	0	0	0	0	0
Herbicide (Propasine-Tazalon)	Traitement	12226.5	1	12227	0	0	0	0	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	70	34750	66	33000	49	24500	108	54000	74	37000
Couts Variables Avec Main D'oeuvre				60687		42060		24980		54480		37480
Couts Variables Sans Main D'oeuvre				25937		9060		480		480		480
Couts Fixes Annuels												
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2206.6	1	2207	1	2207	0	0	0	0	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0	0	0
Pulverisateur	Utilisation	972.2	1	972	0	0	0	0	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	1262.4	1	1262	2	2525	1	1262	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1292.0	10	12274	10	12920	4	4522	1	1292	2	2584
Total Couts Fixes				21137		18750		6883		2390		3682
Total Avec Main D'oeuvre				81824		60810		31863		56870		41162
Cout Total Sans Main D'oeuvre				47074		27810		7363		2870		4162
Cout Unitaire De Production												
Avec Main D'oeuvre	FCFA/Kg			68		76		53		71		103
Sans Main D'oeuvre	FCFA/Kg			39		35		12		4		10
Return To Labor/Day	FCFA			445		367		646		575		295
Return to Labor(Kcal)	000Kcal/Day			22.6		18.6		32.8		29.2		15.0

Maize: Central East Senegal (Zone 6: Central Tambacounda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Household Field	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	63.0	2200	138600	1600	100800	1900	119700
Margin				40127		41762		71459
Couts Variables								
Semences	Kg	84.4	16	1350	16	1350	16	1350
Npk (8-18-27)	Kg	96.3	209	19260	100	9630	0	0
Uree	Kg	93.0	200	18600	100	9300	0	0
Herbicide (Propasine-Tazalon)	Traitement	12226.5	1	12227	0	0	0	0
Main D'oeuvre	Homme-Jour	500.0	44	21750	49	24500	89	44500
Couts Variables Avec Main D'oeuvre				73187		44780		45850
Couts Variables Sans Main D'oeuvre				51437		20280		1350
Couts Fixes Annuels								
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333
Charrue Ucf	Utilisation	2206.6	1	2207	1	2207	0	0
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0
Pulverisateur	Utilisation	972.2	1	972	0	0	0	0
3 Dents Sarclage + Bati Sine ou Arara	Utilisation	1262.4	1	1262	1	1262	0	0
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1292.0	11	13566	8	9690	1	1292
Total Couts Fixes				25286		14257		2390
Total Avec Main D'oeuvre				98473		59038		48241
Total Sans Main D'oeuvre				76723		34538		3741
Cout Unitaire De Production								
Avec Main D'oeuvre	FCFA/Kg			45		37		25
Sans Main D'oeuvre	FCFA/Kg			35		22		2
Return To Labor/Day	FCFA			1422		1352		1303
Return to Labor(Kcal)	000Kcal/Day			83.1		79.0		76.1

Groundnuts: Central East Senegal (Zone 6: Central Tambacounda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Par Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu										
Revenu Des Gousses	Kg	68.0	1100	74800	1000	68000	900	61200	700	47600
Revenu Des Fanes	Kg	26.0	1750	45500	1590	41340	1420	36920	1090	28340
Revenu Total				120300		109340		98120		75940
Margin				44145		40210		44102		24447
Couts Variables										
Semences (En Gousses)	Kg	100.0	120	12000	160	16000	160	16000	160	16000
Npk (6 20-10)	Kg	89.6	120	10752	80	7168	0	0	0	0
Fongicide	Traitement	3019.0	1	3019	1	3019	1	3019	1	3019
Main D'oeuvre	Homme-Jour	500.0	62	31000	69	34500	55	27500	55	27500
Couts Variables Avec Main D'oeuvre				56771		60687		46519		46519
Couts Variables Sans Main D'oeuvre				25771		26187		19019		19019
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2206.6	1	2207	1	2207	0	0	0	0
Semoir Super-Eec	Utilisation	3323.5	1	3324	0	0	0	0	0	0
3 Dents Sarclage _ Bati Sine ou Arara	Utilisation	1262.4	1	1262	1	1262	2	2525	0	0
Souleveuse Firdou Ou Arara + Bati	Utilisation	3740.9	1	3741	0	0	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1292.0	6	7752	3	3876	3	3876	3	3876
Total Couts Fixes				19384		8443		7499		4974
Total Avec Main D'oeuvre				76155		69130		54018		51493
Cout Total Sans Main D'oeuvre				45155		34630		26518		23993
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			49		53		52		57
Sans Main D'oeuvre	FCFA/Kg			29		27		25		26
Return To Labor/Day	FCFA			1212		1083		1302		944

**Note: Production Cost Allocated According To Percent Of Revenue.

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Cotton. Central East Senegal (Zone 6: Central Tambacounda) COST: 1990

Revenu Et Couts (Fcfa)	Unite De Quantite Per Ha	Prix Unitaire	High Technology		Medium Technology		Low Technology		Late	
			Quantite	Valeur	Quantite	Valeur	Quantite	Valeur	Quantite	Valeur
Revenu	Kg	100.0	1200	120000	1000	100000	550	55000	300	30000
Margin				-11773		-17241		-28523		-28023
Couts Variables										
Semences	Kg	110.0	50	5500	50	5500	50	5500	50	5500
Npk (6-14-35)	Kg	82.5	150	12375	100	8250	100	8250	0	0
Uree	Kg	93.0	50	4650	50	4650	0	0	0	0
Herbicide (Cotodon Mixte)	Traitement	14052.0	1	14052	1	14052	0	0	0	0
Insecticide (Cypermethrine-Dimethoate)	Traitement	2400.0	5	12000	5	12000	5	12000	2	4800
Main D'oeuvre		500.0	90	45000	81	40500	89	44250	73	36500
Couts Variables Avec Main D'oeuvre				93577		84952		70000		46800
Couts Variables Sans Main D'oeuvre				48577		44452		25750		10300
Couts Fixes Annuels										
Petit Materiel	Utilisation	333.3	1	333	1	333	1	333	1	333
Charrue Ucf	Utilisation	2206.6	1	2207	1	2207	1	1103	1	1103
Semoir Super-Eco	Utilisation	3323.5	1	3324	0	0	0	0	0	0
Pulverisateur	Utilisation	972.2	7	6806	7	6806	5	4861	2	1944
3 Dents Sarclage + Bati Sine Ou Arara	Utilisation	1262.4	2	2525	2	2525	0	0	1	1262
Corps Butteur + Bati Arara	Utilisation	2857.3	1	2857	1	2857	0	0	0	0
Charrette Bovine	Utilisation	765.1	1	765	1	765	1	765	1	765
Paire De Boeufs	Animal-Jour	1292.0	15	19380	13	16796	5	6460	5	5814
Total Couts Fixes				38196		32289		13523		11223
Total Avec Main D'oeuvre				131773		117241		83523		58023
Total Sans Main D'oeuvre				86773		76741		39273		21523
Cout Unitaire De Production(Gousses)**										
Avec Main D'oeuvre	FCFA/Kg			110		117		152		193
Sans Main D'oeuvre	FCFA/Kg			72		77		71		72
Return To Labor/Day	FCFA			369		287		178		116

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Budget 52 Green Beans Production Cost under Improved and Traditional Technology (ha)
Niayes - FCFA/ha, 1990

Item	Units of Measure	FCFA per Unit	Improved Units	Improved Cost	Traditional(manual) Units	Traditional(manual) Cost
Water Requirement	m3/ha		4,300		4,300	
Length Crop Cycle	days		80		80	
Yield	mt	150,000	10	1,500,000	10	1,500,000
Input Cost				365,658		259,800
Seed	kg	1,400	80	112,000	80	112,000
Fuel + Oil(0.5/hr)	lt	394	269	105,888		
Fertilizer-Organic	kg	6	15,000	90,000	15,000	90,000
Fertilizer(10-10-20)	kg	84	550	46,200	550	46,200
Pesticides						
Maneb	kg	2,900	4	11,600	4	11,600
Equipment(Irrigation)						
Improved	m3	11.6	4,300	49,680		
Traditional	m3	11.9			4,300	51,000
Equipment (non-irr)	per ha		1	7,501	1	7,501
Labor			4,030	503,750	6,180	772,500
Irrigation	hr	125	2,150	268,750	4,300	537,500
Nursery Prep.	hr	125		0		0
Land Prep.	hr	125	160	20,000	160	20,000
Planting	hr	125	125	15,625	125	15,625
Fertilizer App.	hr	125	375	46,875	375	46,875
Weeding	hr	125				
Harvest	hr	125	1,220	152,500	1,220	152,500
Containers - exporter	ha	0	1	0	1	0
Total Cost	ha			926,619		1,090,801
Margins						
Including labor	ha	1		573,381		409,199
Excluding labor	FCFA/hr		267	1,077,131	191	1,181,699
Returns to Labor	FCFA/Day			2,138		1,530
Cost per kg	Fcfa/kg			93		115

Equipment Costs		Purchase	Annual	Maintain	Total
Irrigation Equipment	- Improved (1+2+3+4+5)			(10%)	207,040
	- Traditional (3+5)			Purchase	51,000
1. Water Pump 1.6hp 8m3/hr					
life 2.5 years at 280 days/year		153,500	61,400	15,350	76,750
2. Pump accessories (5 year life)		114,300	22,860	11,430	34,290
3. Wells (7)			42,000		42,000
4. Concrete Basins (6 at 5 yrs)		150,000	30,000	15,000	45,000
5. 6 Water cans life 2 years		18,000	9,000		9,000
Cost per m3					
Improved (total cost)/(280*8*8) =		11.6			
Traditional (total)/(water req'd) =		11.9			
Other Equipment					71,500
1. Hand tools life 5 years		70,000	14,000	7,000	21,000
2. Pesticide app. equip. 5 years		35,000	7,000	3,500	10,500
3. Cart and horse 10 years		200,000	20,000	20,000	40,000
Cost/ha					
(Total Other)*(non-irrigation labor/280*8)					7,501

Source: Centre pour le Developpement de l'Horticulture, "Cout de l'Eau d'irrigation: Cout et Rentability des Production Maraicherse", Direction de l'Agriculture/ISRA, Dakar, 1988

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Budget 53. Onions: Production Cost under Improved and Traditional Technology (ha)
Niayes - FCFA/ha, 1990

Item	Units of Measure	FCFA per Unit	Improved Units	Improved Cost	Traditional(manual) Units	Traditional(manual) Cost
Water Requirement	m3/ha		5,200		5,200	
Length Crop Cycle	days		150		150	
Yield	mt	150,000	15	2,250,000	15	2,250,000
Input Cost				402,825		274,775
Seed	kg	15,000	4.7	70,500	4.7	70,500
Fuel + Oil (0.5/hr)	lt	394	325	128,050		
Fertilizer-Organic	kg	6	20,000	120,000	20,000	120,000
Fertilizer(10-10-20)	kg	77	800	61,600	800	61,600
Pesticides						
Systoate	lt	1,650	2.5	4,125	2.5	4,125
Orthene	kg	1,300	3.5	4,550	3.5	4,550
Etaidyne	lt	2,000	7.0	14,000	7.0	14,000
Equipment(Irrigation)						
Improved	m3	11.6	5,200	60,079		
Traditional	m3	9.8			5,200	51,000
Equipment (non-irr)	per ha		1	9,097	1	9,097
Labor			4,880	610,000	7,480	935,000
Irrigation	hr	125	2,600	325,000	5,200	650,000
Nursery Prep.	hr	125	580	72,500	580	72,500
Land Prep.	hr	125	160	20,000	160	20,000
Planting	hr	125	660	82,500	660	82,500
Fertilizer App.	hr	125	560	70,000	560	70,000
Weeding	hr	125		0		0
Harvest	hr	125	320	40,000	320	40,000
Other Costs(per sack)	ha	100,000	1	100,000	1	100,000
Total Cost	ha			1,182,001		1,369,872
Margins						
Including labor	ha	1		1,067,999		880,128
Excluding labor	FCFA/hr		344	1,677,999	243	1,815,128
Returns to Labor	FCFA/Day			2,751		1,941
Cost per kg	Fcfa/kg			79		91
Equipment Costs			Purchase	Annual	Maintain	Total
Irrigation Equipment	- Improved (1+2+3+4+5)				(10%)	207,040
	- Traditional (3+5)				Purchase	51,000
1. Water Pump 1.6hp 8m3/hr						
life 2.5 years at 280 days/year			153,500	61,400	15,350	76,750
2. Pump accessories (5 year life)			114,300	22,860	11,430	34,290
3. Wells (7)				42,000		42,000
4. Concrete Basins (6 at 5 yrs)			150,000	30,000	15,000	45,000
5. 8 Water cans life 2 years			18,000	9,000		9,000
Cost per m3						
Improved (total cost)/(280*8*8) =			11.6			
Traditional (total)/(water req'd) =			9.8			
Other Equipment						71,500
1. Hand tools life 5 years			70,000	14,000	7,000	21,000
2. Pesticide app. equip. 5 years			35,000	7,000	3,500	10,500
3. Cart and horse 10 years			200,000	20,000	20,000	40,000
Cost/ha						
(Total Other)*(non-irrigation labor/280*8)						9,097

Source: Centre pour le Developpement de l'Horticulture, "Cout de l'Eau d'irrigation: Cout et Rentability des Production Maraicherse", Direction de l'Agriculture/ISRA, Dakar, 1988

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Budget 54. Potatoe. Production Cost under Improved and Traditional Technology (ha)
Niayes - FCFA/ha, 1990

Item	Units of Measure	FCFA per Unit	Improved Units	Improved Cost	Traditional(manual) Units	Traditional(manual) Cost
Water Requirement	m3/ha		5,400		5,400	
Length Crop Cycle	days		90		90	
Yield	mt	150,000	20	3,000,000	20	3,000,000
Input Cost				1,027,675		894,700
Seed	kg	250	2,500	625,000	2,500	625,000
Fuel+Oil(0.5/hr)	lt	394	338	132,975		
Fertilizer-Organic	kg	6	20,000	120,000	20,000	120,000
Fertilizer(10-10-20)	kg	77	400	30,800	400	30,800
Pesticides						
Dyfonate	kg	830	80.0	66,400	80.0	66,400
Nemacur	kg	1,750	30.0	52,500	30.0	52,500
Equipment(Irrigation)						
Improved	m3	11.6	5,400	62,389		
Traditional	m3	9.4			5,400	51,000
Equipment (non-irr)	per ha		1	5,706	1	5,706
Labor			4,130	516,250	6,830	853,750
Irrigation	hr	125	2,700	337,500	5,400	675,000
Nursery Prep.	hr	125		0		0
Land Prep.	hr	125	175	21,875	175	21,875
Planting	hr	125	170	21,250	170	21,250
Fertilizer App.	hr	125	265	33,125	265	33,125
Weeding	hr	125	165	20,625	165	20,625
Harvest	hr	125	655	81,875	655	81,875
Other Costs(box/sack)	ha	100,000	1	100,000	1	100,000
Total Cost	ha			1,712,020		1,905,156
Margins						
Including labor	ha	1		1,287,980		1,094,844
Excluding labor	FCFA/hr		437	1,804,230	285	1,948,594
Returns to Labor	FCFA/Day			3,495		2,282
Cost per kg	FCFA/kg			86		95

Equipment Costs		Purchase	Annual	Maintain	Total
Irrigation Equipment	- Improved (1+2+3+4+5)			(10%)	207,040
	- Traditional (3+5)			Purchase	51,000
1. Water Pump 1.6hp &m3/hr					
life 2.5 years at 280 days/year		153,500	61,400	15,350	76,750
2. Pump accessories (5 year life)		114,300	22,860	11,430	34,290
3. Wells (7)			42,000		42,000
4. Concrete Basins (6 at 5 yrs)		150,000	30,000	15,000	45,000
5. & Water cans life 2 years		18,000	9,000		9,000
Cost per m3					
Improved (total cost)/(280*&*&) =		11.6			
Traditional (total)/(water req'd) =		9.4			
Other Equipment					71,500
1. Hand tools life 5 years		70,000	14,000	7,000	21,000
2. Pesticide app. equip. 5 years		35,000	7,000	3,500	10,500
3. Cart and horse 10 years		200,000	20,000	20,000	40,000
Cost/ha					
(Total Other)*/non-irrigation labor/280*&					5,706

Source: Centre pour le Developpement de l'Horticulture, "Cout de l'Eau d'irrigation: Cout et Rentability des Production Maraicherse", Direction de l'Agriculture/ISRA, Dakar, 1988

Budget 55. Tomato: Production Cost under Improved and Traditional Technology (ha)
Niayes - FCFA/ha, 1990

Item	Units of Measure	FCFA per Unit	Improved Units	Improved Cost	Traditional(manual) Units	Traditional(manual) Cost
Water Requirement	m3/ha		7,200		7,200	
Length Crop Cycle	days		120		120	
Yield	mt	70,000	30	2,100,000	30	2,100,000
Input Cost				584,525		407,225
Seed	kg	660,000	0.24	158,400	0.24	158,400
Fuel + Oil(0.5/hr)	lt	394	450	177,300		
Fertilizer-Organic	kg	6	20,000	120,000	20,000	120,000
Fertilizer(10-10-20)	kg	77	400	30,800	30	30,800
Pesticides						
Systoate	lt	1,650	3.5	5,775	3.5	5,775
Mocap	kg	1,250	60.0	75,000	60.0	75,000
Decis	lt	6,900	2.5	17,250	2.5	17,250
Equipment(Irrigation)						
Improved	m3	11.6	7,200	83,186		
Traditional	m3	7.1			7,200	51,000
Equipment (non-irr)	per ha		1	5,307	1	5,307
Labor			4,930	616,250	8,530	1,066,250
Irrigation	hr	125	3,600	450,000	7,200	900,000
Nursery Prep.	hr	125	145	18,125	145	18,125
Land Prep.	hr	125	175	21,875	175	21,875
Planting	hr	125	145	18,125	145	18,125
Fertilizer App.	hr	125	305	38,125	305	38,125
Weeding	hr	125		0		0
Harvest	hr	125	560	70,000	560	70,000
Other Costs(boxes)	ha	86,250	1	86,250	1	86,250
Total Cost	ha			1,375,517		1,616,032
Margins						
Including labor	ha	1		724,453		483,968
Excluding labor	FCFA/hr		272	1,340,733	152	1,550,216
Returns to Labor	FCFA/Day			2,176		1,454
Cost per kg	FCFA/kg			46		54
Equipment Costs			Purchase	Annual	Maintain	Total
Irrigation Equipment	- Improved (1+2+3+4+5)				10%	207,040
	- Traditional (3+5)				Purchase	51,000
1. Water Pump 1.6hp 8m3/hr						
life 2.5 years at 280 days/year			153,500	61,400	15,350	76,750
2. Pump accessories (5 year life)			114,300	22,860	11,430	34,290
3. Wells (7)				42,000		42,000
4. Concrete Basins (6 at 5 yrs)			150,000	30,000	15,000	45,000
5. 8 Water cans life 2 years			18,000	9,000		9,000
Cost per m3						
Improved (total cost)/(280*8*8) =			11.6			
Traditional (total)/(water req'd) =			7.1			
Other Equipment						71,500
1. Hand tools life 5 years			70,000	14,000	7,000	21,000
2. Pesticide app. equip. 5 years			35,000	7,000	3,500	10,500
3. Cart and horse 10 years			200,000	20,000	20,000	40,000
Cost/ha						
(Total Other)*(non-irrigation labor/280*8)						5,307

Source: Centre pour le Developpement de l'Horticulture, "Cout de l'Eau d'irrigation: Cout et Rentability des Production Maraicherse", Direction de l'Agriculture/ISRA, Dakar, 1988

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Budget 56. Onion Production Cost for the Middle Valley
(Cold Season-Small Irrigated Perimeters)

Item	Units of Measure	FCFA per Unit	Non-Mechanized	
			Units	Cost
Revenue	kg	50	20,000	1,000,000
Margin				
Seed	kg	3600	5	18,000
NPK(15-46-0)	kg	105.4	200	21,080
KCL	kg	92.0	200	18,400
Urea	kg	97.5	250	24,375
Dimethdate	Treatment	5,000	1	5,000
Sacks	FCFA	250.0	80	20,000
Transport	FCFA	25,000	1	25,000
Fuel	Liter	210.0	150	[illegible].500
Lubricant	FCFA	1.0		3,150
Labor	Days	500.0	303.5	151,750
Variable Cost	FCFA			
Including Labor	FCFA			318,255
Excluding Labor				166,505
Fixed Costs				
Small Tools	FCFA	4,000	1	4,000
Depreciation-pump	FCFA	14,250	1	14,250
Pump repair	FCFA	4,725	1	4,725
Salary-pump operator	FCFA	3,500	1	3,500
Cart (Horse)	FCFA	1,173	1	1,173
Total Fixed Costs	FCFA			27,648
Total Cost				
Including Labor				345,903
Excluding Labor				194,153
Returns to Labor	FCFA/Day			2,655
Unit Production Cost	FCFA/kg			
Including Labor				17.3
Excluding Labor				9.7

Source: ISRA/Sidibe

Annex IV

Grain Consumption
Family Expenditures
Cereal Banks
Grain Processing Costs

Table 1. Urban and Rural Consumption of Cereal Grains and Cowpeas (un-milled, kg/capita)

Region	Millet/Sorghum			Maize			Paddy			Cowpeas			Millet Equivalent*		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total	Urba	Rural	Total
Dakar	15	51	16	8	8	8	169	169	169	1.2	5	1	150	190	151
St. Louis *	2[illegible]	70	59	11	15	14	120	131	128	1.2	5	4	131	188	173
Louga	63	161	148	8	8	8	106	37	46	1.2	5	4	151	202	195
Thies	63	161	131	10	10	10	106	37	58	1.2	5	4	153	205	189
Diourbel	63	161	140	8	8	8	106	37	52	1.2	5	4	151	202	191
Fatick	60	160	150	15	17	17	123	37	46	1.2	5	5	169	211	207
Kaolack	53	141	121	15	13	13	80	24	36	1.2	5	4	130	178	168
Ziguinchor	13	62	44	33	46	41	157	122	135	1.2	5	4	167	208	193
Kolda	13	62	57	33	46	45	157	122	125	1.2	5	5	167	208	204
Tambacounda	45	140	81	18	24	20	87	25	64	1.2	5	3	130	190	153
Total	30	126	87	12	19	16	140	64	94	1	5	3	148	199	178

Millet equivalent calculated using calory ratios. (cons)

Source: [Martin, 1988], [USAID/Food Needs, 1990]

Table 2. Sagatta Zone (Louga): Grain Transactions
(FCFA/Adult Equivalent, 1988/89)

Commodity	Purchase	Gifts Received	Sales	Gifts Given	Balance
FCFA/Adult Equivalent					
Millet	3,604	24	6	22	(3,600)
Sorghum	--	--	--	--	--
Maize	559	--	--	--	(559)
Rice	11,570	96	--	--	(11,666)
Wheat	13	--	--	--	(13)
Cowpeas	641	22	265	47	(351)
Total Grain	16,387	142	271	69	(16,189)
Groundnuts	2,067	5	3,556	251	1,735
Total	18,454	147	3,827	320	(14,454)
Percent of Total					
Millet	19.5	16.3	0.2	6.9	24.9
Sorghum	0.0	0.0	0.0	0.0	0.0
Maize	3.0	0.0	0.0	0.0	3.9
Rice	62.7	65.3	0.0	0.0	80.7
Wheat	0.1	0.0	0.0	0.0	0.1
Cowpeas	3.5	15.0	6.9	14.7	2.4
Total Grain	88.8	96.6	7.1	21.6	112.0
Groundnuts	11.2	3.4	92.9	78.4	-12.0
Total	100.0	100.0	100.0	100.0	100.0

Source: ISRA/IFPRI preliminary survey results IFPRI_EXP

Table 3. Niakhar Zone (Fatick): Grain Transactions
(FCFA/Adult Equivalent, 1988/89)

Commodity	Purchase	Gifts Received	Sales	Gifts Given	Balance
FCFA/Adult Equivalent					
Millet	1,480	5	39	159	(1,287)
Sorghum	--	--	--	--	--
Maize	241	--	--	--	(241)
Rice	3,014	22	--	--	(3,036)
Wheat	--	--	--	--	0
Cowpeas	8	1	--	--	(9)
Total Grain	4,743	28	39	159	(4,573)
Groundnuts	333	2	1,719	--	1,384
Total	5,076	30	1,758	159	(3,189)
Percent of Total					
Millet	29.2	16.7	2.2	100.0	40.4
Sorghum	--	--	--	--	--
Maize	4.7	--	--	--	7.6
Rice	59.4	73.3	--	--	95.2
Wheat	--	--	--	--	0.0
Cowpeas	0.2	3.3	--	--	0.3
Total Grain	93.4	93.3	2.2	100.0	143.4
Groundnuts	6.6	6.7	97.8	--	-43.4
Total	100.0	100.0	100.0	100.0	100.0

Source: ISRA/IFPRI preliminary survey results IFPRI_EXP

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Table 4. Grain Sales and Purchases - Groundnut Basin
(Kg/Carre, 1981-82)

Item	Village				
	Diamsil	Got	Kumbija		
	(Near Bombey - Diourbel)	(Near Thies/ Thies)	Soce (Near Koungheul - east Kaolack)	Peulh	Wolof
Purchases					
Millet	158	149	--	--	
Rice	169	135	32	6	25
Maize	--	--	--	--	--
Sales					
Millet	118	46	88	29	200
Rice	--	--	--	--	--
Maize	--	--	962	552	249

Source: [Benoit-Cattin, no date]
Results from a survey conducted in 1981/82, 41 carre, 47 production units, 76 families, bi-weekly..
Note: 22 sales by women in Diamsil (455 kg), average was 21 kg/sale. There were 10 sales by men (450 kg), average was 45 kg/sale.
Millet and maize purchase price 63, rice 100 FCFA/kg.

Table 5. Village Cereals Banks in Senegal - Capacity and Use.

Organization	Initial Year	Number of Banks: Total Created	Number of Banks: Number Operating	Operating Banks Only: Capacity Each	Operating Banks Only: Total Capacity	Operating Banks Only: Actual Storage	Operating Banks Only: Capacity Used	Location(s)
		(#)	(#)	(tons)	(tons)	(tons)	(%)	
CRS	1986	250	30	50	1500	300	20%	GB,CAS,Bakel
FIDA/SODEVA	1987	82	15	25	375	25	7%	GB
BIT/ACOPAM	1985	41	41	25	1025	900	88%	Podor,Louga
USE/PIP	1985	41	41	?	2050	1500	73%	Podor
USE/NGANDA	1988	5	5	100	500	175	35%	Kaolack
CWS	1985	14	14	50	700	417	60%	Louga
ARAF/ADAK	1986	10	10	?	500	75	15%	Kaolack,Fatick
SODEFITEX		31	31	?	1550	398	26%	Tambacounda
Maisons Familiales	1987	20	20	?	1000	160	16%	Podor,Kaolack,CAS.
Other (COSAB, AFVP,DG		35	35	?				
Total		529	242		9200	3950	43%	GB=G'nut Basin
Average			46%	50		16		CAS=Casamance

Notes: Estimated 3,000 people per bank [source, pg 15] means average of 5 Kg/person. Banks

50 tons assumed for banks with unknown capacity.

Purchase above market and sell below market (to members).

Average margin 10 FCFA/kg (usually absorbed by overhead).

Source: Derived from [FAO, April 1990] table on page 14 and text.

Table 6. Installation and Operating Costs for Three Types of Small Grain Mills.

Item	Power from National Electrical System	Power from Electrical Generator System	Power from Diesel Fuel System	Life Years	Power from National Electrical System	Power from Electrical Generator System	Power from Diesel Fuel System
		(FCFA)				(FCFA)	
Building	3,200,000	3,200,000	3,200,000	15	213,333	213,333	213,333
Equipment							
Huller	500,000	500,000	500,000	7	71,429	71,429	71,429
	400,000	400,000	400,000	7	57,143	57,143	57,143
	322,000	322,000	322,000	5	64,400	64,400	64,400
	250,000	250,000	250,000	7	35,714	35,714	35,714
	500,000	500,000	500,000	7	71,429	71,429	71,429
	250,000	250,000	250,000	5	50,000	50,000	50,000
	300,000	300,000	300,000	7	42,857	42,857	42,857
Motor	350,000	3,550,000	2,140,000	7	50,000	507,143	305,714
Total B&E	6,072,000	9,272,000	7,862,000	Month	656,305	1,113,448	912,019
Warehouse	40,000	40,000	40,000	12	480,000	480,000	480,000
Miller	40,000	40,000	40,000	12	480,000	480,000	480,000
Assistant	25,000	25,000	25,000	12	300,000	300,000	300,000
Sub-Total Labor	105,000	105,000	105,000		1,260,000	1,260,000	1,260,000
Social Sec.(19%)	19,950	19,950	19,950	12	239,400	239,400	239,400
Total Labor	124,950	124,950	124,950		1,499,400	1,499,400	1,499,400
Fixed Cost					2,155,705	2,612,848	2,411,419
Energy						Cost/Ton Processed	
Electricity KWH/t	60	228	202				
Cost/KWH	81	20.76	20.76		4,860	4,733	4,194
Material							
Lubricant (ltr)		0.47	0.47				
Lubricant FCFA/ltr		1,240	1,240			583	583
Sacks					7,000	7,000	7,000
Abrasive Disks					1,943	1,943	1,943
Insecticides					1,500	1,500	1,500
Maintence					3,500	5,000	5,000
Day Labor					1,500	1,500	1,500
Total Variable					20,303	22,259	21,720
Capacity Used	5% Impurities	76% Meal	19% Bran	Grain (tons)		Fixed Cost/ton	
50% Capacity	6.3	95.0	23.8	125.0	17,246	20,903	19,291
75% Capacity	9.4	142.5	35.6	187.5	11,497	13,935	12,861
100% Capacity	12.5	190.0	47.5	250.0	8,623	10,451	9,646
						Processing Cost/ton processed	
50% Capacity					37,549	43,162	41,011
75% Capacity					31,800	36,194	34,580
100% Capacity					28,926	32,711	31,365
						Grain Cost/ton processed	
Millet Farm Price	71	per kg			74,737	74,737	74,737
Maize Price	71	per kg			74,737	74,737	74,737
						Millet Total Cost/ton Meal	
50% Capacity					147,744	155,130	152,300
75% Capacity					140,180	145,962	143,839
100% Capacity					136,398	141,378	139,605
						Millet Net/ton Meal, Bran= 30 FCFA/k	
50% Capacity					140,244	147,630	144,800
75% Capacity					132,680	138,462	136,339
100% Capacity					128,898	133,878	132,105

Source: [Saccoto, 1990], pg 17]

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Annex V

Institutional Statistics

LIST OF NGO/PVOs WORKING IN AGRICULTURE OR NATURAL RESOURCE MANAGEMENT IN SENEGAL

(Source: CONGAD, "Repertoire des ONG Membres, Dec. 1989)

Senegalese NGOs

1. Association des Bacheliers Pour l'Emploi et le Développement (ABACED)
   Regions: Dakar, Kaolack, Ziguinchor Kolda

2. Association Culturelle d'Aide à la Promotion Educative et Sociale (ACAPES)
   Regions: Dakar, Ziguinchor, St. Louis, Kolda

3. Association d'Entraide Franco-Arabe (AEFAR)
   Regions: Dakar, Kolda

4. Association des Jeunes pour l'Education et le Développement (AJED)
   Regions: Ziguinchor, Tambacounda, Thiès, Fatick, St. Louis, Dakar

5. Association des Jeunes Urbains pour la Promotion de l'Emploi Non Salarie (AJUPENS)
   Regions: Dakar, Diourbel, Thiès

6. Association pour la Promotion Sociale en Milieu Rural et Urbain (APROSOR)
   Regions: Dakar, Thiès

7. Association pour la Renaissance du Pulaar (ARP)
   Regions: All of Senegal

8. Association Sénégalaise d'Aide à la Formation et à l'Insertion des Necessiteux (ASAFIN)
   Regions: Dakar, Thiès, Fatick

9. Association Sénégalaise de Recherche et d'Assistance pour le Développement Communautaire (ASRADEC)
   Regions: Tambacounda, Ziguinchor, St. Louis, Diourbel

10. Secours Catholique Caritas Senegal (CARITAS)
    Regions: All of Senegal

11. Développement Solidaire (DEVSOL)
    Regions: Dakar, St. Louis, Thiès, Kaolack

12. Fédération des Associations du Fouta pour le Développement (FAFD)
    Regions: St. Louis

13. Fédération des Associations Feminines du Sénégal (FAFS)
    Regions: All of Senegal

14. Femmes Développement Entreprise en Afrique (FDEA)
    Regions: Dakar, Louga, Kaolack, St. Louis

15. Fédération des Organisations Non-Gouvernementales du Sénégal (FONGS)
    Regions: All of Senegal

16. Fédération Sénégalaise des Clubs UNESCO (FSCU)
    Regions: Kolda, St. Louis, Thiès, Ziguinchor, Fatick

17. Groupe d'Action pour le Développement Communautaire (GADEC)
    Regions: Tambacounda

18. Office Africain pour le Développement et la Cooperation (OFADEC)
    Regions: St. Louis, Tambacounda

19. Organisation Sénégalaise de Volontaires pour le Développement (OSVD)
    Regions: Thiès, Dakar, Diourbel, Louga

20. SOS Sahel International (SOS SAHEL)
    Regions: All of Senegal

21. Association pour la Renovation de Thilogne 'Bural' (THILOGNE BURAL)
    Regions: St. Louis

22. Union Chretienne de Jeunes Gens du Sénégal (UCJGS/YMCA SENEGAL)
    Regions: Thiès, Kaolack, Fatick, Ziguinchor, Dakar, Kolda

23. Union Pour la Solidarité et l'Entraide (USE)
    Regions: Dakar, Kaolack, St. Louis, Louga

<u>INTERNATIONAL NGO/PVOs</u>

1. Association des Femmes Africaines pour la Recherche Sur le Développement (AFARD)
   Regions: All of Senegal

2. Service International d'Appui à la Formation et aux Technologies en Afrique de l'Ouest (AFOTEC)
   Regions: Dakar, Ziguinchor, Kaolack, Tambacounda, Thiès, Fatick, Kolda, St. Louis

3. Africare Inc. (AFRICARE)
   Regions: Dakar, Ziguinchor, Kaolack, St. Louis, Thiès, Louga

4. Association Française des Volontaires du Progrès (AFVP)
   Regions: Dakar, St. Louis, Tambacounda, Kolda, Ziguinchor, Thiès, Kaolack

5. Mouvement International Aide à Toute Détresse Quart Monde (ATD QUART MONDE)
   Regions: Dakar

6. Christian Children's Fund, Inc. (CCF)
   Regions: Dakar, Thiès

7. Centre Canadien d'Etudes et de Coopération Internationale (CECI)
   Regions: Thiès, St. Louis, Tambacounda, Dakar, Ziguinchor

8. Centre International pour l'Education Permanente et l'Amenagement Concerte (CIEPAC)
   Regions: Ziguinchor, Fatick, St. Louis, Dakar

9. Catholic Relief Services (CRS)
   Regions: All of Senegal

10. Church World Service (CWS)
    Regions: Louga, Ziguinchor

11. Association Allemande d'Aide aux Lepreux (DAHW)
    Regions: All of Senegal

12. Eglise Evalgelique Lutherienne du Sénégal (EELS)
    Regions: Dakar, St. Louis, Louga

13. Fondation Internationale de Secours et d'Amitié (FISA)
    Regions: Dakar, Kaolack

14. Groupe de Recherches et de Réalisations pour l'Ecodéveloppement (GRED)
    Regions: Tambacounda

15. Islamic African Relief Agency (IARA)
    Regions: Dakar, Thiès, Fatick, Diourbel

16. Institut International Pour le Développement des Peuples (INODEP INTERNATIONAL)
    Regions: Fatick, Kaolack, Diourbel

17. Association des Volontaires LAICS Italiens (LVIA)
    Regions: Diourbel, Thiès

18. Lutheran World Relief (LWR)
    Regions: Fatick, Thiès, Tambacounda

19. Mission Baptiste SBC
    Regions: Dakar, Ziguinchor, Kolda, Kaolack, St. Louis, Louga, Thiès

20. National Council of Negro Women (NCNW)
    Regions: Thiès, Dakar, Ziguinchor

21. Overseas Education Fund International (OEFI)
    Regions: Kaolack, Fatick, Kolda, Dakar, Ziguinchor, Diourbel

22. Oxford Committee for Famine Relief (OXFAM)
    Regions: Dakar, Thiès, Louga, Tambacounda, St. Louis

23. Association Panafricaine Pour le Développement Communautaire (PADEC)
    Regions: St. Louis, Tambacounda, Kaolack, Kolda

24. Foster Parents Plan International (PLAN INTERNATIONAL)
    Regions: St. Louis, Louga, Thiès

25. Conseil Oeucumenique des Eglises/Programme de Solidarité pour le Développement au Sahel (PSDS/COE)
    Regions: All of Senegal

26. Researu Africain Pour le Développement Intégré (RADI)
    Regions: Thiès, Diourbel, Tambacounda, St. Louis, Ziguinchor

27. Rodale International (RI)
    Regions: All of Senegal

28. Terre des Hommes France (TDHF)
    Regions: Dakar, Ziguinchor, Kolda

29. Winrock International (WINROCK)
    Regions: Dakar, Thiès, Tambacounda, Kolda, Ziguinchor, Fatick, Kaolack, Louga

30. World Relief International (WORLD RELIEF)
    Regions: Diourbel, Tambacounda, Fatick

31. World Vision International (WORLD VISION)
    Regions: Louga

32. Environnement Développement et Action Tiers Monde (ENDA)
    Regions: All of Senegal

Annex VI

Support Data for Strategic Options

Table 1

Official Rice Prices (Wholesale, Retail), Imported Rice Cost (CIF), Producer Paddy and Millet Prices, Rice Equivalent Paddy Price and Approximate Millet Meal Prices.

YEAR*	Official Wholesale Rice Price (FCFA/kg)	Official Retail Rice Price (FCFA/kg)	Imported Price Rice (CIF) (FCFA/kg)	Producer Price Paddy (FCFA/kg)	Paddy Equivalent in Rice (1) (FCFA/kg)	Producer Price Millet/ Sorghum (FCFA/kg)	Approximate Millet Meal Price (2) (FCFA/kg)
1969	37.0	45	32.0	21.0	32.3	20	37.5
1970	37.0	45	27.7	21.0	32.3	20	37.5
1971	37.0	40	24.5	21.0	32.3	17	33.0
1972	37.0	40	24.8	21.0	32.3	17	33.0
1973	57.0	60	49.5	21.0	32.3	18	33.8
1974	57.0	60	86.9	25.0	38.5	25	45.0
1975	94.5	100	58.8	22.0	33.8	30	52.5
1976	74.5	87	43.8	41.5	63.8	30	52.5
1977	74.5	80	45.6	41.5	63.8	35	60.0
1978	74.5	80	52.7	41.5	63.8	35	60.0
1979	74.6	80	42.0	41.5	63.8	40	67.5
1980	74.6	80	59.6	41.5	63.8	40	67.5
1981	74.6	80	79.4	41.5	63.8	40	67.5
1982	97.0	103	74.6	41.5	63.8	50	82.5
1983	120.1	130	89.0	51.5	79.2	50	82.5
1984	120.1	130	91.2	51.5	79.2	55	90.0
1985	147.9	160	81.1	60.0	92.3	60	97.5
1986	148.7	160	50.7	66.0	101.5	70	112.5
1987	149.0	160	45.8	85.0	130.8	70	112.5
1988	132.2	140	75.4	85.0	130.8	64	103.5
1989	120.2	130	85.0	85.0	130.8	74	118.5
1990	120.2	130	61.0	85.0	130.8	71	114.0

Source: Rice prices - CPSP; Producer Prices MDRH; (pri:-riz)

(1) Paddy equivalent in rice = (farm price/.65)

(2) Approximate millet meal price = (farm price-5)*1.5. Transportation cost = 5 FCFA/kg transformation costs estimated as 50% of raw material cost (See Chapter IV, Table 18).

* Calender year for imports, retail and wholesale prices.
Crop year beginning in the previous year for producer prices.

Table 2

Groundnut Prices: Producer, Crude Oil Unit Export Value, and Official Retail Groundnut Oil-(FCFA)

Year	Producer Price	Crude Oil Export Value	Official Consumer Price	Oil Equivalent Producer (1)	Official Consumer Price (2)
	(kg)	(kg)	(ltr)	(kg)	(kg)
1961	22.5	91.4	98	66.2	90.5
1962	22.5	91.2	98	66.2	90.5
1963	21.5	91.0	98	63.2	90.5
1964	21.5	90.8	98	63.2	90.5
1965	21.5	90.7	98	63.2	90.5
1966	21.5	88.3	98	63.2	90.5
1967	20.5	87.0	98	60.3	90.5
1968	18.0	66.7	98	52.9	90.5
1969	18.0	79.4	98	52.9	90.5
1970	18.5	87.5	98	54.4	90.5
1971	19.5	95.9	98	57.4	90.5
1972	23.1	84.4	98	67.9	90.5
1973	23.0	103.9	98	67.6	90.5
1974	29.5	241.5	140	86.8	129.3
1975	41.5	154.7	200	122.1	184.7
1976	41.5	163.8	200	122.1	184.7
1977	41.5	209.0	200	122.1	184.7
1978	41.5	247.1	200	122.1	184.7
1979	41.5	223.9	200	122.1	184.7
1980	45.5	180.5	240	133.8	221.6
1981	44.0	287.0	330	129.4	304.7
1982	60.0	215.4	330	176.5	304.7
1983	50.0	243.6	393	147.1	362.9
1984	50.0	457.2	500	147.1	461.7
1985	60.0	466.3	500	176.5	461.7
1986	90.0	208.3	565	264.7	521.7
1987	90.0	150.2	565	264.7	521.7
1988	90.0	165.4	565	264.7	521.7
1989	70.0		380	205.9	350.9
1990	70.0		380	205.9	350.9

Source: MEF/DS

(1) (Producer price)/0.34 (2) (Price/lt)*0.923

Table 3

Calory Requirements Satisfied, by Arrondissement, Selected Land and Productivity Development

Arrondissement AROND	Code CODE	Ecozone ECOZO	1990 % Calory Needs Met 1987-89 Yields (%) CAP 90	2000 % Calory Needs Pnomy-food Maximum Land (%) CAP 20M	2000 % Calory Need 89 MIX Maximum Land (%) CAP 20MX	2000 % Calory Needs Pnomy-food 0 Soil +4% Prod. CAP 20P4	2000 % Calory Need Pnomy-food 0 Soil 0 Prod. CAP 20Z	2000 % Calory Needs Pnomy-food 1% Erosion -4% Yields CAP 20B
DAKAR	1000	1	0	0	0	0	0	0
DAKAR	1100	1	0	0	0	0	0	0
PIKINE	1200	1	0	0	0	0	0	0
SEBIKOTANE	1300	1	1	1	1	0	0	0
DIOURBEL	3000	1	74	88	69	123	88	78
BAMBEY	3100	1	53	67	44	94	67	59
BABA GARAGE	3110	1	71	96	64	134	96	85
LAMBAYE	3120	1	49	62	38	87	62	54
NGOYE	3130	1	39	43	29	60	43	38
DIOURBEL	3200	1	68	88	62	123	88	78
NDINDY	3210	1	96	135	96	189	135	121
NDOULO	3220	1	39	41	28	57	41	36
MBACKE	3300	1	117	109	101	153	109	96
KAEL	3310	1	198	178	178	250	178	159
NDAME	3320	1	36	40	23	57	40	34
ST. LOUIS	4000	1	30	32	26	45	32	28
DAGANA	4100	1	17	14	13	20	14	13
MBANE	4110	1	29	27	23	37	27	23
RAO	4120	1	1	1	1	2	1	1
ROSS-BETHIO	4130	1	21	15	15	22	15	14
MATAM	4200	1	30	31	26	43	31	27
KANEL	4210	1	15	[illegible]	11	17	12	10
OUROSSOGUI	4220	1	19	18	14	25	18	15
SEMME	4230	1	14	12	11	17	12	10
THILOGNE	4240	1	71	82	67	114	82	72
PODOR	4300	1	42	52	40	72	51	46
GAS-GAS	4310	1	30	40	32	52	37	36
NDIOUM	4320	1	38	43	37	60	43	38
SALDE	4330	1	46	61	43	85	61	54
THILLE BOUBAC	4340	1	56	63	48	89	63	55
TAMBACOUNDA	5000	1	54	51	45	[illegible]	51	45
BAKEL	5100	1	54	51	45	72	51	45
DIAWARA	5120	1	54	51	45	72	51	45
THIES	7000	1	34	51	31	[illegible]	51	45
MBOUR	7100	1	41	52	33	73	52	46
FISSEL	7110	1	63	83	53	116	83	73
NGUEKOKH	7120	1	20	22	14	30	22	18
THIES	7200	1	36	44	28	62	44	39
NOTTO	7210	1	55	79	45	110	79	69
POUT	7220	1	3	3	2	5	3	3
THIENABA	7230	1	49	51	36	71	51	44
TIVAOUANE	7300	1	37	58	31	81	58	51
MEOUANE	7310	1	29	56	20	79	56	48
MERINA DAKHA	7320	1	39	55	31	77	55	49
NIAKHENE	7330	1	51	91	51	128	91	82
PAMBAL	7340	1	27	29	20	40	29	25
LOUGA	8000	1	45	63	41	87	62	56
KEBEMER	8100	1	46	70	43	97	69	63
DAROU MOUSTI	8110	1	58	91	53	127	91	81
NDANDE	8120	1	36	59	36	82	59	53
SAGATA	8130	1	44	61	42	82	59	55
LINGUERE	8200	1	60	64	40	89	64	54
BARKEDJI	8210	1	156	159	97	223	159	133
DAHRA	8220	1	47	54	38	76	54	47
DODJI	8230	1	23	28	15	39	28	22
YANG-YANG	8240	1	13	13	10	19	13	12
LOUGA	8300	1	41	57	39	76	55	51
KOKI	8310	1	66	105	72	135	96	95
KEUR MOMAR SA	8320	1	59	62	50	87	62	55
MBEDIENE	8330	1	11	16	9	22	16	14
SARAL	8340	1	27	44	24	62	44	39

Table 3 (continued)

Calory Requirements Satisfied, by Arrondissement: Selected Land and Productivity Development

Arrondissement ARND	Code CODE	Erosion ECOZO	1990 % Calory Needs Met 1987-89 Yields (%) CAP_90	2000 % Calory Needs Pnomy-food Maximum Land (%) CAP_20M	2000 % Calory Need 89 MDX Maximum Land (%) CAP_20MX	2000 % Calory Needs Pnomy-food 0 Soil +4% Prod. CAP_20P4	2000 % Calory Need Pnomy-food 0 Soil 0 Prod. CAP_20Z	2000 % Calory Needs Pnomy-food 1% Erosion -4% Yields CAP_20B
ZIGUINCHOR	2000	2	92	155	152	122	99	63
BIGNONA	2100	2	82	174	174	121	117	77
DIOULOULOU,	2110	2	109	184	184	153	109	93
SINDIAN,	2120	2	93	271	271	130	181	109
TENDOUCK,	2130	2	66	151	151	120	86	52
TENGHORI,	2140	2	62	90	90	79	93	56
OUSSOUYE	2200	2	145	151	151	171	122	77
CABROUSSE,	2210	2	193	154	154	215	154	92
LOUDIA OUOLOF,	2220	2	97	148	148	126	90	62
ZIGUINCHOR	2300	2	50	140	131	76	58	35
NIAGUIS,	2310	2	9	37	19	23	16	10
NIASSIA,	2320	2	91	243	243	128	100	60
TAMBACOUNDA	5000	2	78	607	602	129	102	82
BAKEL	5100	2	87	1062	1062	146	112	75
BALA,	5110	2	45	1026	1026	136	97	58
GOUDIRI,	5130	2	88	1230	1230	123	112	67
KIDIRA,	5140	2	128	931	931	179	113	99
KEDOUGOU	5200	2	63	408	394	106	97	56
BANDAFASSI,	5210	2	52	194	194	71	81	49
FONGOLIMBI,	5220	2	73	130	73	102	130	69
SALEMATA,	5230	2	55	948	948	106	75	45
SARAYA,	5240	2	70	361	361	144	103	62
TAMBACOUNDA	5300	2	85	349	349	135	96	108
KOUMPENTOUM,	5310	2	112	254	254	157	112	175
KOUSSANAR,	5320	2	40	146	146	54	39	41
MAKACOLIBANT	5330	2	123	373	373	172	123	150
MISSIRAH,	5340	2	63	624	624	157	112	67
KAOLACK	6000	2	112	146	146	154	138	95
KAFFRINE	6100	2	214	215	215	268	191	118
BIRKELANE,	6110	2	221	176	176	246	176	145
KOUNGHEUL,	6120	2	201	295	295	282	201	121
MALEME HODAR	6130	2	213	194	194	272	194	104
NGANDA,	6140	2	220	193	193	270	193	103
KAOLACK	6200	2	131	100	100	141	100	69
GANDIAYE,	6210	2	23	17	17	24	17	10
NDIEDIENG,	6220	2	204	151	151	211	151	100
NDOFFANE,	6230	2	166	134	134	187	134	97
NIORO-DU-RIP	6300	2	172	123	123	173	123	110
MEDINA SABAKH	6310	2	167	121	121	170	121	111
PAOSKOTO,	6320	2	174	121	121	170	121	100
WACK NGOUNA,	6330	2	176	127	127	178	127	120
THIES	7100	2	42	42	42	42	42	42
THIADIAYE,	7130	2	42	42	42	42	42	42
FATICK	9000	2	83	93	76	104	98	60
FATICK	9100	2	91	84	68	114	85	48
DIAKHAO,	9110	2	139	110	110	154	110	69
FIMELA,	9120	2	89	85	57	120	85	43
NAKHAR,	9130	2	66	78	44	109	78	40
TATTAGUINE,	9140	2	69	61	61	75	67	40
FOUNDIOUGNE	9200	2	77	76	59	83	76	53
DJILOR,	9210	2	93	122	72	100	122	64
NIODIOR,	9220	2	0	0	0	0	0	0
TOUBACOUTA,	9230	2	137	106	106	148	106	95
GOSSAS	9300	2	81	120	100	114	134	79
COLOBANE,	9310	2	85	112	112	119	146	88
KAHONE,	9320	2	88	153	93	124	146	83
OUADIOUR,	9330	2	71	95	95	99	106	65

Table 3 (Continued)

Calory Requirements Satisfied, by Arrondissement, Selected Land and Productivity Development

Arrondissement ARONO	Code CODE	Ecozone ECOZO	1990 % Calory Needs Met 1987-89 Yields (%) CAP_90	2000 % Calory Needs Pnonty-food Maximum Land (%) CAP_20M	2000 % Calory Need 89 MDX Maximum Land (%) CAP_20MX	2000 % Calory Needs Pnonty-food 0 Sol +4% Prod. CAP_20P4	2000 % Calory Need Pnonty-food 0 Sol 0 Prod. CAP_20Z	2000 % Calory Needs Pnonty-food 1% Erosion -4% Yields CAP_20E
KOLDA	10000	2	133	279	276	187	138	100
KOLDA	10100	2	158	321	321	213	152	106
DABO,	10110	2	166	356	356	232	166	143
DIOULACOLON,	10120	2	109	125	125	128	92	55
MEDINA YORO F	10130	2	199	483	483	279	199	116
SEDHIOU	10200	2	100	200	190	154	125	101
BOUNKILING,	10210	2	95	353	353	133	171	102
DIATTACOUNDA,	10220	2	50	97	47	136	97	52
DIENDE,	10230	2	95	166	166	134	96	105
MARSASSOUM,	10240	2	134	228	278	188	134	103
TANAFF,	10250	2	126	157	157	176	126	145
VELINGARA	10300	2	140	316	316	193	138	94
BONCONTO,	10310	2	109	373	373	153	109	99
KOUNKANE,	10320	2	135	264	264	180	128	77
PAKOUR,	10330	2	176	313	313	247	176	106
SENEGAL	0		60	91	83	77	58	44
EXCLUDED	1	1	28	25	17	35	25	22
INCLUDED	2	2	109	192	186	142	110	78

Note: ECOZONE = 1 for the area less than 400mm usable rainfall and 2 for areas at or above.

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Table 4

Moderate Agricultural Potential Land Area by Arrondissement

Arrondissement AROND	Code CODE	Ecozone ECOZO	Total Land Area (000 ha) ALL LAND	Land Area With No Agric. Potential (000 ha) NON AO	All Moderate Potential Land (000 ha) ALL MODP	Reserved Land Area (000 ha) RES LAND	All Mod. Potential Outside Reserves (000 ha) MOD NRES	Adjusted Potential Outside Reserves (000 ha) ABS LAND	Permitte Use (000 ha) MAX U	89-[illegible] Plan (000 [illegible] PLA
DAKAR	1000	1	57.358	42.739	14.569	4.757	9.905	[illegible]	[illegible]	[illegible]
DAKAR	1100	1	8.3	4.2	4.2	0.0	4.2	3.6	0.0	
PIKINE	1200	1	8.1	8.1	0.0	0.8	0.0	0.0	0.4	
SEBIKOTANE	1300	1	40.9	30.5	10.4	3.9	9.7	8.3	1.6	
DIOURBEL	3000	1	302.134	35.459	266.675	0	266.675	[illegible]	[illegible]	[illegible]
BAMBEY	3100	1	134.934	14.969	119.985	0	119.985	107.98725	66.794	66
BABA GARAGE	3110	1	40.3	14.8	25.6	0.0	25.6	21.7	21.8	
LAMBAYE	3120	1	44.5	0.2	44.4	0.0	44.4	37.7	22.7	
NGOYE	3130	1	50.1	0.0	50.1	0.0	50.1	42.6	22.3	
DIOURBEL	3200	1	125.8	8.714	117.086	0	117.086	99.5231	64.315	64
NDINDY	3210	1	60.8	2.3	58.5	0.0	58.5	49.7	30.7	
NDOULO	3220	1	65.0	6.4	58.6	0.0	58.6	49.8	33.6	
MBACKE	3300	1	167.18	20.49	146.69	0	146.69	124.6865	115.943	115
KAEL	3310	1	69.2	7.3	61.8	0.0	61.8	52.6	48.4	
NDAME	3320	1	98.0	13.2	84.8	0.0	84.8	72.1	67.5	
ST. LOUIS	4000	1	4510.856	4217.479	293.377	1073.545	92.248	78.4108	[illegible]	[illegible]
DAGANA	4100	1	653.36	653.36	0	70.638	0	0	63.8	
MBANE	4110	1	242.8	242.8	0.0	36.5	0.0	0.0	2.0	
RAO	4120	1	82.9	82.9	0.0	10.5	0.0	0.0	3.3	
ROSS-BETHIO	4130	1	327.6	327.6	0.0	23.7	0.0	0.0	0.9	
MATAM	4200	1	2523.369	2229.992	293.377	747.660	92.248	78.4108	18.479	[illegible]
KANEL	4210	1	603.3	544.5	58.8	3.6	58.1	49.4	3.4	
OUROSSOGUI	4220	1	1461.0	1242.1	218.9	744.1	18.5	15.8	9.2	
SEMME	4230	1	261.2	245.7	15.5	0.0	15.5	13.2	3.1	
THILOGNE	4240	1	197.8	197.7	0.1	0.0	0.1	0.0	2.8	
PODOR	4300	1	1334.127	1334.127	0	255.038	0	0	10.475	[illegible]
CAS-CAS	4310	1	333.0	333.0	0.0	8.9	0.0	0.0	2.8	
NDIOUM	4320	1	434.3	434.3	0.0	120.6	0.0	0.0	1.9	
SALDE	4330	1	237.7	237.7	0.0	0.6	0.0	0.0	3.5	
THILLE BOUBAC	4340	1	329.2	329.2	0.0	125.0	0.0	0.0	2.4	
TAMBACOUNDA	5000	1	140.102	75.477	64.625	0	64.625	54.53125	[illegible]	[illegible]
BAKEL	5100	1	140.102	75.477	64.625	0	64.625	54.53125	10.305	[illegible]
DIAWARA	5120	1	140.1	75.5	64.6	0.0	64.6	54.9	10.3	
THIES	7000	1	591.482	291.8	299.682	77.054	286.468	243.49	[illegible]	[illegible]
MBOUR	7100	1	116.095	37.04	79.055	15.183	75.621	64.277[illegible]	47.347	[illegible]
FISSEL	7110	1	48.8	7.8	41.0	0.0	41.0	34.8	23.2	
NOUEKOKH	7170	1	67.3	29.3	38.1	15.2	34.6	29.4	23.9	
THIES	7200	1	152.122	74.498	77.624	17.579	76.984	65.4364	47.259	[illegible]
NOTTO	7210	1	50.5	23.8	26.7	6.3	26.5	22.5	17.6	
POUT	7220	1	49.9	39.9	10.0	11.3	9.6	8.1	5.9	
THIENABA	7230	1	51.8	10.8	40.9	0.0	40.9	34.8	23.8	
TIVAOUANE	7300	1	323.265	180.262	143.003	44.292	137.863	113.78353	[illegible]	[illegible]
MEOUANE	7310	1	111.9	82.8	29.1	28.0	26.2	22.3	35.7	
MERINA DAKHA	7320	1	64.6	30.7	33.9	0.6	33.3	28.3	33.7	
NIAKHENE	7330	1	71.3	17.2	54.1	0.4	53.8	45.7	32.5	
PAMBAL	7340	1	75.5	45.6	29.9	15.2	20.6	17.5	16.0	
LOUGA	8000	1	2855.148	[illegible]	1062.608	1115.774	650.294	[illegible]	[illegible]	[illegible]
KEBEMER	8100	1	393.927	115.871	278.056	17.808	270.916	180.9786	86.944	85
DAROU MOUSTI	8110	1	161.1	35.0	126.0	5.7	120.9	102.8	41.3	
NDANDE	8120	1	148.1	69.4	78.6	12.1	78.6	66.8	22.3	
SAGATA	8130	1	84.8	71.4	13.4	0.0	13.4	11.4	23.3	
LINGUERE	8200	1	1989.06	1141.45	847.61	1014.738	421.985	358.68725	89.343	89
BARKEDJI	8210	1	826.6	140.7	685.9	443.1	304.4	258.7	46.6	
DAHRA	8220	1	304.9	166.6	138.3	72.7	94.2	80.0	27.0	
DODJI	8230	1	433.5	413.2	20.2	281.1	20.2	17.2	12.9	
YANG-YANG	8240	1	424.1	420.9	3.2	217.8	3.2	2.7	2.8	
LOUGA	8300	1	572.161	555.219	16.942	83.228	15.397	13.08745	[illegible]	[illegible]
KOKI	8310	1	85.3	85.3	0.0	0.0	0.0	0.0	28.1	
KEUR MOMAR SA	8320	1	285.2	285.2	0.0	47.6	0.0	0.0	15.6	
MBEDIENE	8330	1	81.1	81.0	0.1	0.5	0.1	0.1	15.2	
SAKAL	8340	1	120.6	103.7	16.9	35.1	15.3	13.0	10.4	

Table 4 (continued)

Moderate Agricultural Potential Land Area by Arrondissement

Arrondissement AROND	Code CODE	Ecozone ECOZO	Total Land Area (000 ha) ALL LAND	Land Area With No Agric. Potential (000 ha) NON AG	All Moderate Potential Land (000 ha) ALL MODP	Reserved Land Area (000 ha) RES LAND	All Mod. Potential Outside Reserves (000 ha) MOD NRES	Adjusted Potential Outside Reserves (000 ha) ABS LAND	Permitted Use (000 ha) MAX U	Sub-Lar Plants (000 ha) PLANT
BIGUINCHOR	2000	2	729.435	380.408	349.027	79.559	288.559	245.09015	164.1635	65
BIGNONA	2100	2	525.704	267.086	258.618	69.327	206.731	175.72135	117.7333	45.85
DIOULOULOU,	2110	2	185.9	122.8	63.1	22.2	47.0	40.4	27.1	10.9
SINDIAN,	2120	2	144.2	39.5	104.6	17.8	91.3	77.6	52.0	16.3
TENDOUCK,	2130	2	90.5	56.4	34.1	2.9	31.4	26.7	17.9	7
TENGHORI,	2140	2	105.2	48.4	56.8	26.4	36.5	31.0	20.8	10
OUSSOUYE	2200	2	89.446	63.073	26.373	0	26.373	22.41705	15.01942	9.87[illegible]
CABROUSSE,	2210	2	42.1	31.1	11.1	0.0	11.1	9.4	6.3	5.1
LOUDIA OUOLOF,	2220	2	47.3	32.0	15.3	0.0	15.3	13.0	8.7	4
ZIGUINCHOR	2300	2	114.285	50.249	64.036	10.232	55.155	46.88175	31.41077	9.51
NIAGUIS,	2310	2	72.2	26.4	45.8	9.3	37.7	32.0	21.5	6.
NIASSIA,	2320	2	42.1	23.9	18.2	0.9	17.5	14.9	10.0	3.0
TAMBACOUNDA	5000	2	5761.984	2899.792	2862.192	1017.345	2115.303	1801.35255	1208.391	160.051
BAKEL	5100	2	2098.669	992.507	1106.162	134.049	1018.578	865.7913	580.0802	26.36
BALA,	5110	2	889.0	259.2	629.9	104.0	554.7	471.5	315.9	10
GOUDIRI,	5130	2	692.5	393.3	299.2	30.1	286.8	243.8	163.3	8.5
KIDIRA,	5140	2	517.1	340.0	177.1	0.0	177.1	150.5	100.9	10.5
KEDOUGOU	5200	2	1664.298	1366.426	297.872	226.459	171.733	151.92305	101.2932	17.67
BANDAFASSI,	5210	2	539.3	406.8	162.5	227.3	46.4	39.5	26.5	5
FONGOLIMBI,	5220	2	234.2	228.4	5.8	0.0	5.8	5.0	4.8	4.8
SALEMATA,	5230	2	198.3	121.3	77.1	5.2	74.0	62.9	42.1	2.5
SARAYA,	5240	2	662.5	610.0	52.4	0.0	52.4	44.6	29.9	4
TAMBACOUNDA	5300	2	1999.017	540.859	1458.158	716.837	921.892	783.6082	525.0175	113.01
KOUMPENTOUM,	5310	2	606.7	97.4	509.4	203.0	336.0	285.6	191.3	58.9
KOUSSANAR,	5320	2	309.7	94.4	215.3	100.4	141.5	120.3	80.6	14.6
MAKACOLIBANT	5330	2	253.5	41.3	212.2	3.5	209.1	177.8	119.1	29
MISSIRAH,	5340	2	829.1	307.8	521.3	409.9	235.3	200.0	134.0	9
KAOLACK	6000	2	1526.575	188.009	1338.57	244.165	1111.347	[illegible]	75.0[illegible]	59.[illegible]
KAFFRINE	6100	2	1115.571	130.05	985.521	232.952	764.478	649.8063	464.6725	333.349
BIRKELANE,	6110	2	139.9	33.1	106.7	6.3	100.4	85.3	84.5	84.[illegible]
KOUNGHEUL,	6120	2	437.1	37.2	399.9	84.2	315.3	268.0	179.6	83
MALEME HODAR	6130	2	421.4	57.3	364.1	120.3	244.1	209.2	140.2	112
NGANDA,	6140	2	117.2	2.5	114.7	12.1	102.6	87.2	58.4	50.5
KAOLACK	6200	2	187.017	43.973	143.044	5.063	142.484	121.1114	97.[illegible]	97.126
GANDIAYE,	6210	2	51.4	19.2	32.2	0.1	32.2	27.4	18.3	17
NDIEDIENG,	6220	2	61.7	10.7	51.0	2.9	50.5	42.9	41.4	41
NDOFFANE,	6230	2	73.9	14.1	59.8	2.1	59.7	50.8	38.1	38.1
NIORO-DU-RIP	6300	2	223.991	13.986	210.005	6.09	204.385	173.7725	167.113	167.113
MEDINA SABAKH	6310	2	58.0	2.3	55.7	2.3	53.4	45.4	42.6	42
PAOSKOTO,	6320	2	96.7	7.1	89.6	1.5	88.1	74.9	68.3	68
WACK NGOUNA,	6330	2	69.3	4.6	64.7	2.3	62.9	53.5	56.2	56.2
THIES	7100	2	79.537	17.537	62	2.658	59.574	50.6379	33.57739	19.363
THIADIAYE,	7130	2	79.5	17.5	62.0	2.7	59.6	50.6	33.9	19
FATICK	9000	2	865.071	304.559	557.512	60.821	565.435	428.61575	300.3389	142.30
FATICK	9100	2	266.412	132.024	134.388	1.891	133.667	113.61695	83.617	83.61[illegible]
DIAKHAO,	9110	2	55.9	13.5	42.4	1.3	42.3	36.0	27.9	27.9
FIMELA,	9120	2	112.7	84.5	28.2	0.6	27.6	23.4	18.0	18.[illegible]
NAKHAR,	9130	2	37.6	6.8	30.8	0.0	30.8	26.2	19.6	19
TATTAGUINE,	9140	2	60.2	27.2	33.0	0.0	33.0	28.0	23.1	23
FOUNDIOUGNE	9200	2	302.33	137.1	165.23	26.143	142.014	120.7119	85.8765	74.31[illegible]
DJILOR,	9210	2	92.2	27.5	64.6	6.5	58.6	49.8	33.4	25.[illegible]
NIODIOR,	9220	2	64.1	64.1	0.0	0.0	0.0	0.0	0.0	0
TOUBACOUTA,	9230	2	146.1	45.5	100.6	19.7	83.4	70.9	47.5	44
GOSSAS	9300	2	293.329	35.435	257.894	32.787	226.754	192.2909	132.8419	82.387
COLOBANE,	9310	2	159.1	17.4	141.7	27.9	114.2	97.1	65.0	40.1
KAHONE,	9320	2	70.9	17.5	53.3	0.9	52.7	44.8	30.0	23
OUADIOUR,	9330	2	63.3	0.5	62.9	0.0	62.9	53.5	35.8	21

Table 4 (Continued)

Moderate Agricultural Potential Land Area by Arrondissement.

Arrondissement AROND	Code CODE	Ecozone ECOZO	Total Land Area (000 ha) ALL_LAND	Land Area With No Agric. Potential (000 ha) NON_AG	All Moderate Potential Land (000 ha) ALL_MODP	Reserved Land Area (000 ha) RES_LAND	All Mod. Potential Outside Reserves (000 ha) MOD_NRES	Adjusted Potential Outside Reserves (000 ha) ABS_LAND	Permitted Use (000 ha) MAX_L	89-Land Planted (000 ha) PLANT
KOLDA	10000	2	2070.481	442.149	1628.332	341.081	1373.983	1167.86835	782.4779	266.442
KOLDA	10100	2	824.39	143.948	680.442	164.416	541.942	460.6507	308.636	105.161
DABO,	10110	2	242.8	34.1	208.7	21.5	189.0	160.6	107.6	37.2
DIOULACOLON,	10120	2	107.8	73.3	34.5	8.3	77.4	65.8	44.1	27.1
MEDINA YORO F	10130	2	473.8	86.6	387.3	132.6	275.6	234.2	156.9	40.8
SEDHIOU	10200	2	722.333	193.38	528.953	83.687	471.763	400.99855	268.669	96.945
BOUNKILING,	10210	2	282.8	66.3	216.5	0.0	219.5	186.6	125.0	25.6
DIATTACOUNDA,	10220	2	71.3	23.4	47.9	6.4	43.8	37.2	24.9	16.5
DIENDE,	10230	2	196.3	51.4	144.9	40.3	113.7	96.7	64.8	24.5
MARSASSOUM,	10240	2	69.3	24.1	45.3	16.4	35.7	30.3	20.3	9.8
TANAFF,	10250	2	102.6	28.2	74.3	20.5	59.0	50.2	33.6	20.2
VELINGARA	10300	2	523.758	104.821	418.937	92.978	360.258	306.2193	205.1669	64.356
BONCONTO,	10310	2	271.9	75.1	196.8	78.3	151.6	128.9	86.3	18.7
KOUNKANE,	10320	2	144.7	5.3	139.4	3.2	136.2	115.8	77.6	28.3
PAKOUR,	10330	2	107.2	24.5	82.8	11.5	72.5	61.6	41.3	17.3
SENEGAL	0	0	19,713	10,777	8,936	4,076	6,949	5,398	3,578	2,716
EXCLUDED	1	1	8,683	6,544	2,139	2,271	1,491	1,268	759	759
INCLUDED	2	2	11,030	4,232	6,798	1,806	5,458	4,639	2,819	1,957

Note: ECOZONE = 1 for the area less than 400mm usable rainfall and 2 for areas at or above.

Table 5

Populations and Land Use Statistics by Arrondissement

Arrondissement AROND	Code CODE	Exclusion ECOZO	1990 Population Total (000's) POP_T90	1990 Population Rural (000's) POP_R90	1990 Land Per Rural Person LAND_RUR	2000 Population Total (000's) POP_T20	2000 Population Rural (000's) POP_R20	1990 Density Persons Per Planted Hectare D_PTD_90
DAKAR	1000	1	[illegible]	0	0.0	[illegible]	0	830.3
DAKAR	1100	1	768.5	0.0	0.0	1026	0	0.0
PIKINE	1200	1	732.5	0.0	0.0	1219	0	1715.5
SEBIKOTANE	1300	1	216.9	0.0	0.0	317	0	132.1
DIOURBEL	3000	1	485.2	424.7	0.4	687.421	588.075	[illegible]
BAMBEY	3100	1	220.4	200.6	0.3	292.026	249.618	3.3
BABA GARAGE	3110	1	46.7	46.7	0.5	52	52	2.1
LAMBAYE	3120	1	76.0	76.0	0.3	99	99	3.3
NDOYE	3130	1	97.7	77.9	0.3	132	99	4.4
DIOURBEL	3200	1	203.3	115.2	0.6	254.646	133.175	3.2
NDINDY	3210	1	52.7	52.7	0.6	53	53	1.7
NDOULO	3220	1	150.6	62.5	0.5	206	80	4.5
MBACKE	3300	1	262.8	224.1	0.5	405.395	339.057	2.3
KAEL	3310	1	37.6	37.6	1.3	42	42	0.8
NDAME	3320	1	231.2	186.5	0.4	364	297	3.4
ST LOUIS	4000	1	[illegible]	514.4	0.1	898.062	615.531	30.3
DAGANA	4100	1	317.8	136.3	0.0	418.517	161.584	50.3
MBANE	4110	1	53.3	35.3	0.1	67	40	26.0
RAO	4120	1	174.9	46.4	0.1	229	61	52.5
ROSS-BETHIO	4130	1	89.6	54.6	0.0	122	61	95.4
MATAM	4200	1	246.1	234.6	0.1	325.538	310.998	13.3
KANEL	4210	1	50.0	50.0	0.1	67	67	14.9
OUROSSOGUI	4220	1	106.7	95.2	0.1	149	137	11.6
SEMME.	4230	1	53.9	53.9	0.1	70	70	17.5
THILOGNE.	4240	1	35.5	35.5	0.1	38	38	12.6
PODOR	4300	1	151.5	113.5	0.1	156.007	146.949	14.5
GASGAS.	4310	1	41.5	41.5	0.1	39	39	14.8
NDIOUM.	4320	1	57.0	49.0	0.0	58	49	30.7
SALDE.	4330	1	26.6	26.6	0.1	29	29	7.7
THILLE BOUBAC	4340	1	26.4	26.4	0.1	31	31	11.2
KAOLACK	5000	1	48	35.3	0.3	61.446	50.526	[illegible]
KAOLACK	5100	1	48	35.3	0.3	61.446	50.526	4.7
DIAKARA.	5120	1	48.0	35.3	0.3	61	51	[illegible]
THIES	7000	1	664.1	615.9	0.3	[illegible]	[illegible]	4.5
MBOUR	7100	1	226.8	135.3	0.3	349.462	182.759	4.8
FISSEL.	7110	1	55.5	55.5	0.4	66	66	2.4
NGUEKOKH.	7120	1	171.3	83.8	0.3	243	116	7.2
THIES	7200	1	416.1	204.4	0.2	589.515	274.651	8.8
NOTTO.	7210	1	44.2	44.2	0.4	54	54	2.5
POUT.	7220	1	276.4	75.3	0.1	407	107	47.0
THIENABA.	7230	1	95.5	84.9	0.3	129	113	4.0
TIVAOUANE	7300	1	371.2	276.2	0.4	[illegible]	349.628	2.7
MEOUANE.	7310	1	92.1	92.1	0.4	131	131	2.6
MERINA DAKHA	7320	1	78.4	64.7	0.5	97	78	2.3
NIAKHENE.	7330	1	45.8	49.8	0.7	50	50	1.5
PAMBAL.	7340	1	100.9	69.6	0.2	140	91	6.3
DIOURBEL	8000	1	[illegible]	445	0.6	[illegible]	[illegible]	[illegible]
KEBEMER	8100	1	170	158.8	0.5	[illegible]	[illegible]	2.0
DAROU MOUSTI.	8110	1	60.2	60.2	0.7	65	65	1.5
NDANDE.	8120	1	51.5	51.5	0.4	52	52	2.3
SAGATA.	8130	1	58.3	47.1	0.5	61	45	2.5
LINGUERE	8200	1	149.9	139	0.6	[illegible]	198.039	[illegible]
BARKEDJI.	8210	1	41.1	41.1	1.1	66	66	0.9
DAHRA.	8220	1	52.9	52.9	0.5	66	66	2.0
DODJI.	8230	1	34.3	23.4	0.6	52	39	2.7
YANG-YANG.	8240	1	21.6	21.6	0.1	27	27	[illegible]
LOUGA	8300	1	206.5	147.2	0.5	236.202	154.975	[illegible]
KOKI.	8310	1	35.9	35.9	0.8	33	33	1.3
KEUR MOMAR SA	8320	1	36.0	36.0	0.4	42	42	2.3
MBEDIENE.	8330	1	96.4	37.1	0.4	118	37	6.3
SAKAL.	8340	1	38.2	38.2	0.4	42	42	2.3

Table 5 (Continued)

Population and Land Use Statistics by Arrondissement

Arrondissement AROND	Code CODE	Ecozone ECOZO	1990 Population Total (000's) POP_T90	1990 Population Rural (000's) POP_R90	1990 Land Per Rural Person LAND_R/R	2000 Population Total (000's) POP_T20	2000 Population Rural (000's) POP_R20	1990 Density Persons Per Planted Hectare D_PTD_90
ZIGUINCHOR	2000	2	402.3	271.5	0.2	582.925	341.235	0.8
BIGNONA	2100	2	204.3	178.8	0.3	254.309	215.609	4.5
DIOULOULOU,	2110	2	47.6	47.6	0.2	70	70	4.4
SINDIAN,	2120	2	45.9	45.9	0.4	50	50	2.8
TENDOUCK,	2130	2	39.8	39.8	0.2	60	60	5.1
TENGHORI,	2140	2	71.0	45.5	0.2	94	55	6.6
OUSSOUYE	2200	2	40	35.6	0.3	53.152	44.289	4.0
CABROUSSE,	2210	2	15.6	15.6	0.3	24	24	3.1
LOUDIA OUOLOF,	2220	2	24.4	20.0	0.2	29	22	5.1
ZIGUINCHOR	2300	2	198.6	58.5	0.2	272.868	73.341	20.0
NIAGUIS,	2310	2	180.0	39.9	0.2	250	56	26.1
NIASSIA,	2320	2	18.6	18.6	0.2	23	23	6.1
TAMBACOUNDA	5000	2	381.1	319.8	0.5	518.035	435.041	2.4
BAKEL	5100	2	76.6	76.6	0.4	107.146	107.146	2.7
BALA,	5110	2	32.2	32.2	0.3	44	44	3.1
GOUDIRI,	5130	2	22.1	22.1	0.4	30	30	2.6
KIDIRA,	5140	2	25.3	25.3	0.4	33	33	2.4
KEDOUGOU	5200	2	77.3	64.2	0.3	90.772	73.3	4.4
BANDAFASSI,	5210	2	34.1	27.3	0.3	44	27	6.2
FONGOLIMBI,	5220	2	12.9	12.9	0.4	13	13	2.7
SALEMATA,	5230	2	12.4	12.4	0.2	12	12	5.0
SARAYA,	5240	2	17.9	17.9	0.3	21	21	3.7
TAMBACOUNDA	5300	2	224.2	175.7	0.6	320.174	244.595	2.0
KOUMPENTOUM,	5310	2	65.5	45.5	0.9	94	94	1.1
KOUSSANAR,	5320	2	72.3	23.8	0.6	110	34	4.9
MAKACOLIBANT	5330	2	48.5	48.5	0.6	64	64	1.6
MISSIRAH,	5340	2	37.9	37.9	0.3	52	52	3.8
KAOLACK	6000	2	900.2	700.5	0.5	1241.085	945.851	1.2
KAFFRINE	6100	2	347.2	347.2	1.0	499.114	477.543	1.1
BIRKELANE,	6110	2	83.3	83.3	1.0	104	104	1.0
KOUNGHEUL,	6120	2	97.8	97.8	0.9	143	143	1.2
MALEME HODAR	6130	2	129.0	109.6	1.0	176	149	1.1
NGANDA,	6140	2	57.1	57.1	0.9	75	75	1.1
KAOLACK	6200	2	327.6	154.6	0.4	444.823	196.106	3.4
GANDIAYE,	6210	2	234.0	41.0	0.4	297	49	12.2
NDIEDIENG,	6220	2	55.2	55.2	0.8	75	75	1.3
NDOFFANE,	6230	2	58.4	58.4	0.7	73	73	1.5
NIORO-DU-RIP	6300	2	211.4	97.9	0.8	266.956	270.152	1.3
MEDINA SABAKH	6310	2	52.5	52.5	0.8	72	72	1.2
PAOSKOTO,	6320	2	93.0	75.5	0.9	133	112	1.4
WACK NGOUNA,	6330	2	65.9	65.9	1.9	92	92	1.2
THIES	7100	2	86.9	64.8	0.3	121.146	85.225	4.5
THIADIAYE,	7130	2	86.9	64.8	0.3	121	85	4.5
FATICK	9000	2	542.3	500.7	0.5	718.257	652.801	2.2
FATICK	9100	2	224.4	202.7	0.4	300.297	263.125	2.5
DIAKHAO,	9110	2	50.5	50.5	0.6	64	64	1.8
FIMELA,	9120	2	47.5	47.5	0.4	75	75	2.6
NAKHAR,	9130	2	54.8	54.8	0.4	87	87	2.8
TATTAGUINE,	9140	2	71.6	49.9	0.5	80	43	3.1
FOUNDIOUGNE	9200	2	155.2	145.4	0.5	217.948	196.868	2.1
DJILOR,	9210	2	60.5	50.7	0.6	89	75	2.1
NIODIOR,	9220	2	22.6	22.6	0.0	31	31	0.0
TOUBACOUTA,	9230	2	72.1	72.1	0.6	99	99	1.6
GOSSAS	9300	2	162.9	152.6	0.6	200.297	187.808	1.3
COLOBANE,	9310	2	65.4	65.4	0.6	87	87	1.6
KAHONE,	9320	2	42.0	42.0	0.6	57	57	1.8
OUADIOUR,	9330	2	55.5	45.2	0.5	69	56	2.6

Table 5 (Continued)

Population and Land Use Statistics by Arrondissement

Arrondissement ARCND	Code CODE	Ecozone ECOZO	1990 Population Total (000's) POP_T90	1990 Population Rural (000's) POP_R90	1990 Land Per Rural Person LAND_RUR	2000 Population Total (000's) POP_T00	2000 Population Rural (000's) POP_R00	1990 Density Persons Per Planted Hectare D_PTD_90
KOLDA	10000	2	671.9	600.3	0.4	856.425	836.512	2.3
KOLDA	10100	2	206.2	168.8	0.6	300.956	231.977	2.0
DABO,	10110	2	66.1	66.1	0.6	89	89	1.8
DIOULACOLON,	10120	2	85.8	45.4	0.6	121	54	3.2
MEDINA YORO F	10130	2	57.3	57.3	0.7	91	91	1.4
SEDHIOU	10200	2	318.7	304.7	0.3	452.847	432.026	3.3
BOUNKILING,	10210	2	81.6	81.6	0.3	108	108	3.2
DIATTACOUNDA,	10220	2	69.8	69.8	0.2	112	112	4.2
DIENDE,	10230	2	82.4	67.4	0.4	120	101	3.3
MARSASSOUM,	10240	2	34.7	34.7	0.3	42	42	3.5
TANAFF	10250	2	51.2	51.2	0.4	68	68	2.5
VELINGARA	10300	2	143	120.8	0.5	190.247	170.359	2.3
BONCONTO,	10310	2	48.8	48.8	0.4	66	66	2.6
KOUNKANE,	10320	2	64.0	47.8	0.6	90	64	2.3
PAKOUR,	10330	2	30.2	30.2	0.6	41	41	1.7
SENEGAL	0	0	696	4,617	2.3	11,342	7,590	3.6
EXCLUDED	1	1	4,664	2,159	0.4	6,411	2,714	6.1
INCLUDED	2	2	3,032	2,459	0.6	4,130	3,282	2.2

Note ECOZONE = 1 for the strata less than 400mm annual rainfall and 2 for areas at or above.

Table 6

Calculation of Land Carrying Capacity

Food Priority Crop Choices

TCN= Total calory needs Calculated as 2300 calories per day of which 80% is provided by food grains, times total population.

RCN= Rural calory needs Calculated as 2300 calories per day of which 80% are to be satisfied by grains (paddy, millet, maize, sorghum and cowpeas), times rural population.

LR= Land required to meet rural calory needs Calculated as RCN divided by average per hectare calory production 1987-89.

UL= Usable land (moderate potential) is calculated as all moderate potential land less 15% (for inclusions), then less 33% for fallow reserve and natural vegetation. If this is less than the actual area planted in 1989, UL is set to the 1989 area.

LP= Land planted is calculated two ways:

Determined by rural population growth
LP= average planted per rural person in 1989 times 2000 rural population. If this is greater than UL then LP=UL.

Determined by total usable available
LP= All usable land (UL)

LPF= Land planted to food grains is calculated two ways:

Determined by food production priority:
LPF= lowest of rural calory needs divided by per hectare calory production (LR) or UL (but retain at least 10% of 1989 cash crop area)

Determined by 1989 crop mixture
LPF= percent of land planted to food grains in 1989 times LP.

Annex VII

Farm Technology
Research Recommendations
and
Results

ANNEX VII: An Inventory of Technologies Available to Senegalese Farmers

In the preparation of the Senegal Agricultural Sector Analysis an assessment of technologies -- their availability, suitability, impact, and potential for adoption -- was necessary. This annex contains a brief review of other technology assessments, and a partial inventory of agricultural technologies, technical packages, or recommendations available to Senegalese farmers. This inventory is only illustrative, and preference was given to technologies that a) have been tested on-farm in Senegal, and b) have economic analyses and/or yield data. When analysis of certain technologies in Senegal is scarce, references from other Sahelian countries (notably Mali and Burkina Faso) have been used.

Other assessments of technologies available to Senegalese farmers exist, most notably Sène (1985[1] and 1987[2]) and Miller et al. (1988)[3]. While all three assessments conclude that technologies, technical packages and cultural recommendations exist in Senegal for the majority of crops, as well as animal health/traction/nutrition, the documents give little or no interpretation of potential impact on yield, productivity, or adoption rates by farmers. These technology assessments are merely long lists of available technologies, without reference to primary or even secondary data sources. The assumption is that if the technology exists and is 'farmer-ready', its impact on yield, production, etc., must be positive.

Sène (1985) reviewed agricultural research results in Senegal from 1959-84 and evaluated the type, quality, and number of finished agricultural technologies ready to transmit to the Senegalese extension services and farmers. The successful research results cited include technologies for recessional agriculture (sorghum along the Senegal River), peanuts in the Peanut Basin (although noting little progress in the period 1969-84), cowpeas in low rainfall zones, horticulture, animal nutrition and equipment for mechanized row seeding and peanut harvesting. Sène also cited examples of research stagnation where little progress has been made: irrigated rice and maize,

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[1] Sène, D.; Abril, 1985. Etude de l'impact de la recherche agronomique sur le développement au Sénégal. Dakar: CORAR/CIRAD.

[2] Sene, D.; Abril, 1987. Aperçu sur les technologies disponibles en matière agricole au Sénégal. Unpublished draft.

[3] Miller, David; Crookston, K.; Brandstetter, R.; Tout, E.; Ray, M.; McClure, G. 1988. Identification and assessment of stage of readiness for diffusion to farmers of agricultural technologies and technology systems in Senegal. Communication for Technology Transfer in Agriculture Project (AID/S&T 396-5826).

fertilizer use (without subsidies and with reduced credit), plowing, and animal disease control. Although this document is somewhat dated, Sene's criticism of ISRA's crop production research program's lack of attention to socioeconomic factors or to problems faced by farmers and the extension services remains valid, although this situation is changing[4].

In the document by Miller et al. technologies and constraints to adoption are only superficially described. The main conclusion of this report is that technologies exist in Senegal that could make a difference in agricultural production, but communication linkages between the national agricultural research system and farmers are weak (i.e., the extension services do not function efficiently or well).

The annexes from the World Bank agricultural research and extension projects[5] which present, in tabular form, the results of ISRA research and the technical recommendations ready for extension to farmers (Tables 4 and 5). The original sources of data are not cited.

As stated before the following inventory is only illustrative and not definitive. Many of the technologies included were generated by the ISRA/Djibélor (Casamance) Farming Systems Research Team during and following the AID-financed Agricultural Research and Planning Project (685-0223) with Michigan State University. The original data (1983-85) from some of the trials has been reevaluated using updated production costs and is included here.

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[4]The AID-financed Agricultural Research II Project (685-0957), and the World Bank's two projects that work with ISRA (Senegal Agricultural Services and Second Agricultural Research Projects) are making a concerted effort a) to encourage better coordination between the crop production and farming systems research departments as well as with the extension services and farmers, b) to give priority to on-farm trials, and c) to include agro-economic analysis of field trials in the research protocols.

[5]World Bank Report No. 8079-SE, Staff Appraisal Report: Senegal Agricultural Services Project, February 1, 1990, Annex 1, pp.1-3; and World Bank Report No. 7675-SE, Staff Appraisal Report: Senegal Second Agricultural Research Project, February 26, 1990, Annex 6, pp.1-2.

1. CASAMANCE RAINFED RICE

TYPE OF TECHNOLOGY: Fertilizer recommendations

LOCATION: Fadiga, Kolda Region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: ISRA/CRA-Djibélor Rice Research and Production Systems Research Programs on-farm trials to test fertilizer recommendations at 0, 25%, 50% and 100% of the recommended dose. The recommended dose per hectare is 200 kg NPK (8-18-27) and 150 kg urea per hectare.

IMPACT:

Fert. Dose	Yield	% Increase
0	1,517 kg/ha	-
25%	2,603 kg/ha	72%
50%	2,139 kg/ha	41%
100%	3,555 kg/ha	134%

ECONOMICS: Results of economic analysis summarized in Tables 1 and 2. Marginal rate of return (MRR) between use of no fertilizer and 25% of the recommended dose is 633%.

MRR is the ratio of additional benefits to additional costs between each pair of technological options, expressed as a percentage. Marginal analysis is used to assess the relative profitability among alternative treatments.

CONSTRAINTS TO ADOPTION: Information at the farm-level. Availability and affordability of fertilizer.

RESEARCH REQUIREMENTS: Updates of farm budgets. Evaluation of farmer constraints to adoption.

DOCUMENTATION: Mbodj, Y., G. Demay, et al. 1984. "Résultats analytiques des actions multilocales d'évaluation des variétés de riz en prévaluation des variétés de riz en présence de différentes doses d'engrais." Djibélor, Senegal:ISRA/CRA.

Broughton, D., E. Crawford, M. Krause, B. H. de Frahan. 1990. "Economic analysis of on-farm trials: A review of approaches and implications for research program design." East Lansing, Michigan:Michigan State University, Dept. of Agricultural Economics.

COMMENTS: The Broughton, et al. paper illustrates a very clear method for developing a recommendation from agronomic date, using the CIMMYT approach. (CIMMYT. 1988. From agronomic date to farmer recommendations: An economics training manual. Mexico:CIMMYT).

TABLE 1

FERTILIZER TRIAL FOR RAINFED RICE (VARIETY 144B/9) AT FADIGA (KOLDA REGION), 1984-1985: PARTIAL BUDGET

Item	Fertilizer Level			
	A_0	A_1	A_2	A_3
Average yield (kg/hectare)	1,517	2,603	2,139	3,555
Adjusted yield (-10%)[a]	1,365	2,343	1,925	3,200
Monetary variable costs (CFA francs)				
Quantity of 8-18-27 (kg)	0	50	100	200
Quantity of area (kg)	0	37.5	75	150
Unit cost of 8-18-27[c]	107	107	107	107
Unit cost of area[c]	112	112	112	112
Monetary cost of fertilizer	0	9,550	19,100	32,200
Other costs	0	0	0	0
Total monetary variable costs	0	9,550	19,100	38,200
Opportunity variable costs (CFA francs)				
Labor (days) Fertilizer spreading[d]	0	1	1.5	2
Average daily wage (CFA francs)[d]	500	500	500	500
Total opportunity costs	0	500	750	1,000
Total variable costs (CFA francs)	0	10,050	19,850	39,200
Net benefit (CFA francs)	106,493	170,110	130,308	201,365

[a]The adjustment factor represents an estimate of farmer management and possible harvest losses.

[b]Up to a level of 2,000 kg/hectare the yield is valued at the paddy rice equivalent of the 1990 consumer price (135 CFA francs/kg times .67 (paddy milling coefficient) less harvest cost/kg (.025 days/kg times 500 F/day = 12.5 F/kg) = 90.5). It is assumed that up to 2,000 kg serves as a substitute for purchased rice, given the deficit situation of most farmers. Any yield above 2,000 kg/hectare is valued at the official 1990 producer price (85 CFA francs/kg) less harvest cost/kg less farm to market transport cost (2 F/kg) = 70.5.

[c]Source: DPCS, SENCHIM/Ziguinchor.

[d]Estimated from surveys conducted by the Production Systems Team in the Casamance region in 1982-1984. The daily wage represents average returns per day of agricultural work.

Source: Boughton, D., E. Crawford , M. Krause, and B.H. de Frahan. 1990. "Economic Analysis of On-Farm Trials: A Review of Approaches and Implications for Research Program Design." Michigan State University, Dept. of Agricultural Economics, p.9

TABLE 2

SENSITIVITY ANALYSIS:
FADIGA RICE FERTILIZATION TRIAL

Part A[a]	A_0	A_1	A_2
Average yield (kg/ha)	1,517	2,603	3,555
Adjusted yield (kg/ha)	1,365	2,343	3,200
Gross field benefit (FCFA/ha)	106,493	180,160	240,565
Fertilizer cost (FCFA/ha)	0	9,550	38,200
Labor opportunity cost (FCFA/ha)	0	500	1,000
Total opportunity cost (FCFA/ha)	0	10,050	39,200
Net benefit (FCFA/ha)	106,493	170,110	201,365
Marginal rate of return	633%	107%	

Part B[b]	A_0	A_1	A_2
Average yield (kg/ha)	1,517	2,603	3,555
Adjusted yield (kg/ha)	1,365	2,343	3,200
Gross field benefit (FCFA/ha)	106,493	180,160	240,565
Fertilizer cost (FCFA/ha)	0	14,325	57,300
Labor opportunity cost (FCFA/ha)	0	500	1,000
Total variable cost (FCFA/ha)	0	14,825	58,300
Net benefit (FCFA/ha)	106,493	165,335	182,265
Marginal rate of return	397%	39%	

Part C[c]	A_0	A_1	A_2
Average yield (kg/ha)	1,517	2,603	3,555
Adjusted yield (kg/ha)	1,365	2,343	3,200
Gross field benefit (FCFA/ha)	96,254	165,160	225,565
Fertilizer cost (FCFA/ha)	0	9,550	38,200
Labor opportunity cost (FCFA/ha)	0	500	1,000
Total opportunity cost (FCFA/ha)	0	10,050	39,200
Net benefit (FCFA/ha)	96,254	15,5110	186,365
Marginal rate of return	586%	107%	

[a]Original prices and costs.
[b]Fertilizer cost increased 50%.
[c]Rice valued at official producer price of 85 CFA/kg, less costs of harvest labor and transport to market.

Source: Broughton, D., E. Crawford, M. Krause, and B.H. de Frahan. 1990. "Economic Analysis of On-Farm Trials: A Review of Approaches and Implications for Research Program Design." Michigan State University: Dept. of Agricultural Economics, p. 15.

2. CASAMANCE - RAINFED RICE

TYPE OF TECHNOLOGY: Good soil preparation, seeding in lines, two manuel weedings; Seeding at 80 kg/ha

LOCATION: Ziguinchor Region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: Production Systems Research, ISRA/CRA-Djibelor; on-farm trials.

IMPACT: Production data (i.e., yield increases) not available

ECONOMICS: Net daily return to labor equals
a. Good soil prep + 2 weedings + seeding with 'semoircasa' = 730 FCFA per day
b. Good soil prep + 2 weedings + seeding with 'SuperEco" = 1020 FCFA per day

CONSTRAINTS TO ADOPTION: Availability of seeders and labor for weedings. Information at the farm level.

DOCUMENTATION: ISRA/CRA-Djibélor Production Systems Team. 1988. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

COMMENTS: Although not stated, assumption that farmers use local varieties and change only cultural practices. Assumptions for calculation of net daily return to labor are not stated.

3. CASAMANCE - RAINFED LOWLAND RICE

TYPE OF TECHNOLOGY: Weed control

LOCATION: Ziguinchor Region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: Farming systems methodology to evaluate the agronomic and economic benefits of herbicide use (Ronstar 250 CE (Oxadiazon) at level of 4 liters/hectare) for weed control in rainfed lowland rice.

IMPACT: 1) Herbicide use significantly increased yields over no herbicide (1,416 kg/ha vs. 1,651 kg/ha). However, yield response to herbicide use showed great variation over the test plots.
2) Significant reduction in the number of labor days/hectare (71 labor days/ha. vs. 22 labor days/ha.). The average weeding time on treated plots was reduced to one-third that on untreated plots.
3) Weeding after more than 35 days (versus less than 35 days) increased average weeding time by 63%.
4) With herbicide use, weeding time required in broadcast fields was significantly less than weeding time in row-seeded fields.
5) Use of improved varieties was associated with a 53% increase in weeding time.

ECONOMICS: In the average of all tests, the net gain to herbicide use represented an 87% return on the additional costs incurred. Analysis implies that herbicide use is profitable for any value of weeding labor above 13 cfa/day.

CONSTRAINTS TO ADOPTION:
1) Availability and affordability of herbicide and pulverisers.
2) Financial risk. In 9 of 26 tests, herbicide costs exceeded the benefits.
3) Information at the farm level.

RESEARCH REQUIREMENTS: 1) Need to revise pre-emergence herbicide recommendations for different soil types; 2) Comparison of benefits of pre-emergence vs. post-emergence herbicides to develop guidelines that would help farmers use herbicides only on fields where the greatest labor savings would result.

DOCUMENTATION: 1) Posner, J. and E. Crawford. 1988 (Revised June 1989). "Agro-economic analysis of field trials from a farming systems research perspective: Weed control in rainfed lowland rice, Ziguinchor, Senegal". Staff Paper No. 88-91. East Lansing, Michigan:Michigan State University, Dept. of Agricultural Economics.

2) ISRA/CRA-Djibélor Production Systems Team. 1988. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

COMMENTS: Women weed the rice fields in the Ziguinchor region. The variation in yield response with herbicide use was related to the ways in which women used the time-savings. In some villages women used the weeding time saved in the rainfed rice fields to cultivate their aquatic rice fields. In other villages, where the aquatic rice fields were too salty to cultivate, the women devoted more time to their rainfed rice fields, increasing yields above the average. The delay in weeding (>35 days) effected weeding time but did not effect yields. This is because women weed the weediest fields first, then the less weedy fields, which tends to equalize the impact of weeds across fields.

4. CASAMANCE - AQUATIC RICE

TYPE OF TECHNOLOGY: Improved varieties with saline resistance: With and without fertilizer

LOCATION: Ziguinchor region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: Production Systems Research, ISRA/CRA-Djibelor; on-farm trials.

IMPACT: Not given

ECONOMICS:
1) Varieties ITA-123 and TOS 103 - Marginal rate of return without fertilizer = 389%. Both varieties need lightly flooded conditions.

2) Variety BW-2481 - MRR without fertilizer = 389%
   - MRR with 25% of recommended fertilizer= 117%
   - Variety needs medium flooded conditions.

3) Variety BKN-6986-38-1 - MRR with or without fert. = 389%
   - Needs heavy flood.

4) Variety BW-2481 - MRR without fertilizer = 389%
   - Needs heavy flood.

CONSTRAINTS TO ADOPTION:
1) Availability of improved seeds and certification of quality.
2) Information at the farm level.

DOCUMENTATION: ISRA/CRA-Djibélor Production Systems Team. 1983. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

COMMENTS: Fertilizer recommendations for the improved varieties cited above are 200 kg/ha of 8-18-27 and 150 kg/ha urea.

5. CASAMANCE - RAINFED RICE - Diola Rice Production System

TYPE OF TECHNOLOGY: Cultural practices -- Transplanting date
a. Variety DJ12-519, Maturity=105 days, Transplant at 21 days
b. Variety DJ684D, Maturity-120 days, Transplant at 21 days
N.B. Traditional transplanting age of seedlings is 30-60 days.

LOCATION: Ziguinchor region, Casamance.

RESEARCH OBJECTIVES/METHODOLOGY: Varieties developed by ISRA/Djibelor. Farmer adoption plots supervised by Peace Corps-Winrock On-Farm Seed Project.

IMPACT: Compared to local varieties:
a. DJ12-519: Year One data - avg. yield 43% higher than avg. yield with local variety (Yield range of improved variety = 554-3618 kg/ha). Year Two data (preliminary results) - Yield increases of 100% compared to local varieties, produced on the same plot last year.

b. DJ684D: avg. yield 88% higher than avg. yield with local variety (Yield range of improved variety = 1471-2912 kg/ha).

ECONOMICS: Seed purchased at 130 FCFA/kg.
Modification of traditional practice. Only timing, not amount of labor, changes. No other 'extra' inputs.

CONSTRAINTS TO ADOPTION: If farmers are planting large plots, nurseries must be staggered so that 21-day old seedlings are being transplanted.

RESEARCH REQUIREMENTS: None.

DOCUMENTATION: Osborn, T. 1990. "Multi-institutional Approaches to Participatory Technology Development: A Case Study from Senegal". Agricultural Administration (Research and Extension) Network Paper 13. London:Overseas Development Institute.

COMMENTS: This ISRA/Peace Corps/On-Farm Seed Project represents a potentially successful effort on the part of research and extension entities (PVOs) to work with farmers on their terms, responding to their needs.

6. CASAMANCE - MANDINK RICE PRODUCTION SYSTEM (direct seeding)

TYPE OF TECHNOLOGY: Cultural practices: Seeding in rows vs. broadcasting; Improved variety (DJ12-519); Timely planting and weeding

LOCATION: Ziguinchor region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: Demonstrations based on ISRA/Djibelor research results. Farmer adoption plots supervised by Peace Corps-Winrock On-Farm Seed Project.

IMPACT: Traditions yields in Mandink rice production system range from 800-1000 kg/ha. Results based on demonstrations ranged between 235-1675 kg/ha. Variability of results due to disrespect for recommended planting date (after 100 mm rainfall) and for weeding dates of 20 and 40 days after seeding.

ECONOMICS: Farmers purchased improved seed. No analysis of economic benefits.

CONSTRAINTS TO ADOPTION: Labor is a major constraint in the Mandink production system. These demonstration plots illustrated that seeding in rows and weeding twice (at 20 and 40 days) takes less time than weeding a broadcast field once. With row seeding, weeds can be distinguished early and removed more efficiently. For a variety of reasons, however, the women involved in these demonstration plots planted an average of 12 days later than recommended and weeded only once (average 49 days after planting). The women planted after 500mm rainfall, when only 100mm is necessary. The higher rainfall allowed weeds to be established even before seeding of the rice, and the subsequent late weeding detrimentally affected rice growth.

RESEARCH REQUIREMENTS: An extension/farmer education problem in collaboration with research.

DOCUMENTATION: Osborn, T. 1990. "Multi-institutional Approaches to Participatory Technology Development: A Case Study from Senegal". Agricultural Administration (Research and Extension) Network Paper 13. London:Overseas Development Institute.

COMMENTS: Women grow the rice in the Mandink production system. Seeding in rows rather than broadcasting seed allows for more efficient weeding. Early weeding is not possible with broadcasting seed because weeds cannot be distinguished from young rice plants.

7. CASAMANCE MAIZE

TYPE OF TECHNOLOGY: Organic fertilizer (manure) on household fields ('champs de case'); Raised ridges + manual weeding

LOCATION: Ziguinchor region, Casamance

RESEARCH OBJECTIVES/METHODOLOGY: Production Systems Research, ISRA/CRA-Djibelor; on-farm trials.

IMPACT: Not stated

ECONOMICS: Daily net return to labor = 647 FCFA (ridges + manual weeding)

CONSTRAINTS TO ADOPTION:
1) Availability and size of household fields
2) Availability of manure (from traction animals)
3) Information at the farm level.

DOCUMENTATION: ISRA/CRA-Djibélor Production Systems Team. 1988. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

8. CASAMANCE - MAIZE

TYPE OF TECHNOLOGY: Mineral fertilizer
a. Household fields: 120 kg/ha urea; Ridges/mechanical weeding.
b. Fields (after fallow): 120 kg/ha urea; No ridges + mounding
c. Fields (following maize): NPK 100 kg/ha; Urea 100 kg/ha; No ridges - mounding

LOCATION: Ziguinchor region, Casamance

IMPACT: Not stated.

ECONOMICS:
a. MRR = 130%; Net daily return to labor = 1578 FCFA
b. MRR = 49%; Net daily return to labor = 1060 FCFA
c. MRR = 300%; Net daily return to labor = 1060 FCFA

CONSTRAINTS TO ADOPTION: Availabilty of fertilizers. Information at the farm level.

DOCUMENTATION: ISRA/CRA-Djibélor Production Systems Team. 1988. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

COMMENTS: Maize varieties not specified.

9. CASAMANCE - MAIZE

TYPE OF TECHNOLOGY: Cultural practices: a) Ridged plowing (BBG); b. Flat plowing

LOCATION: Ziguinchor region, Casamance

IMPACT: Not stated

ECONOMICS: Net daily return to labor:
a. Ridged plowing (BBG)+manual weeding+fertilizer = 1640 FCFA
b. Flat plowing (UCF)+Ridging(BBG)+fertilizer = 1909 FCFA

CONSTRAINTS TO ADOPTION: Availability of equipment and traction animals. Information at the farm-level.

DOCUMENTATION: ISRA/CRA-Djibélor Production Systems Team. 1988. "Propositions de themes techniques à tester en Basse Casamance dans le cadre du programme d'appui aux agriculteurs (PAGRI)". ISRA:CRA-Djibélor.

10. MAIZE - ZONES FROM DIOURBEL AND SOUTH

TYPE OF TECHNOLOGY: Improved seed + chemical fertilizer Package recommended by Projet Mais:
- Plowing depth 10-15cm
- Seed in rows after 25mm rainfall
- Density:
  a) 90cm between rows/20cm betw. hills -- one plant per hill
  b) 85cm betw. rows/22cm betw. hills -- one plant per hill
  c) 80cm betw. rows/35cm betw. hills -- two plants per hill
- Fertilizer: (kg/ha)

	Low	Semi-intensive	Intensive
NPK 8-18-27	100	200	250
Urea	50	200	250

NPK applied as side-dressing at seeding. Urea applied in two applications: at 3-4 weeks after seeding and at 7 weeks after seeding.

LOCATION: See Maize Variety Map (Figure 1). Synthetic C, a white corn variety, can be grown Senegal-wide. Four white corn varieties recommended for rainfed cultivation (Synthetic C, EVC-8, HVB1, Mayo Galke TZESR-W). Five yellow corn varieties recommended for rainfed cultivation (JDB, Maka, EVC-J, Early Thai, GP75).

RESEARCH OBJECTIVES/METHODOLOGY: Results of multilocational on-farm trials conducted by the Projet Mais and ISRA. The majority of the improved varieties recommended by the Projet Mais originated at CIMMYT or IITA and were adapted to Senegal by ISRA.

IMPACT: White corn varieties yield range: 1.5-3.9 T/ha
Yellow corn varieties yield range: 1.5-3.0 T/ha
Local varieties yield range (estimate): 1.0-1.5 T/ha

ECONOMICS: Projet Mais estimates the break-even point for semi-intensive maize cultivation at 400 kg/ha. Certified seed sold at 180 CFA/kg. Break-even price per kilogram for producers of certified seed is estimated to be 300 CFA/kg.

CONSTRAINTS TO ADOPTION: Technical package assumes availability of seeds and fertilizers. Projet Mais experience has shown that farmers or farmer groups will obtain credit for maize production, but will use some of the fertilizer (estimates as high as one-half the recommended dosage) on other crops (i.e., millet, peanuts). The demand and adequate markets for corn are assumed to exist by the Projet Mais.

RESEARCH REQUIREMENTS:
1) Economic evaluation of field trials needed, using actual costs of production without Projet Mais subsidized inputs.
2) Marketing study for corn is needed to estimate demand (human and animal consumption) and commercial opportunities for increased corn production.

3) Transformation of corn into consumer acceptable products is necessary.
4) Optimum fertilizer dosages need to be determined.

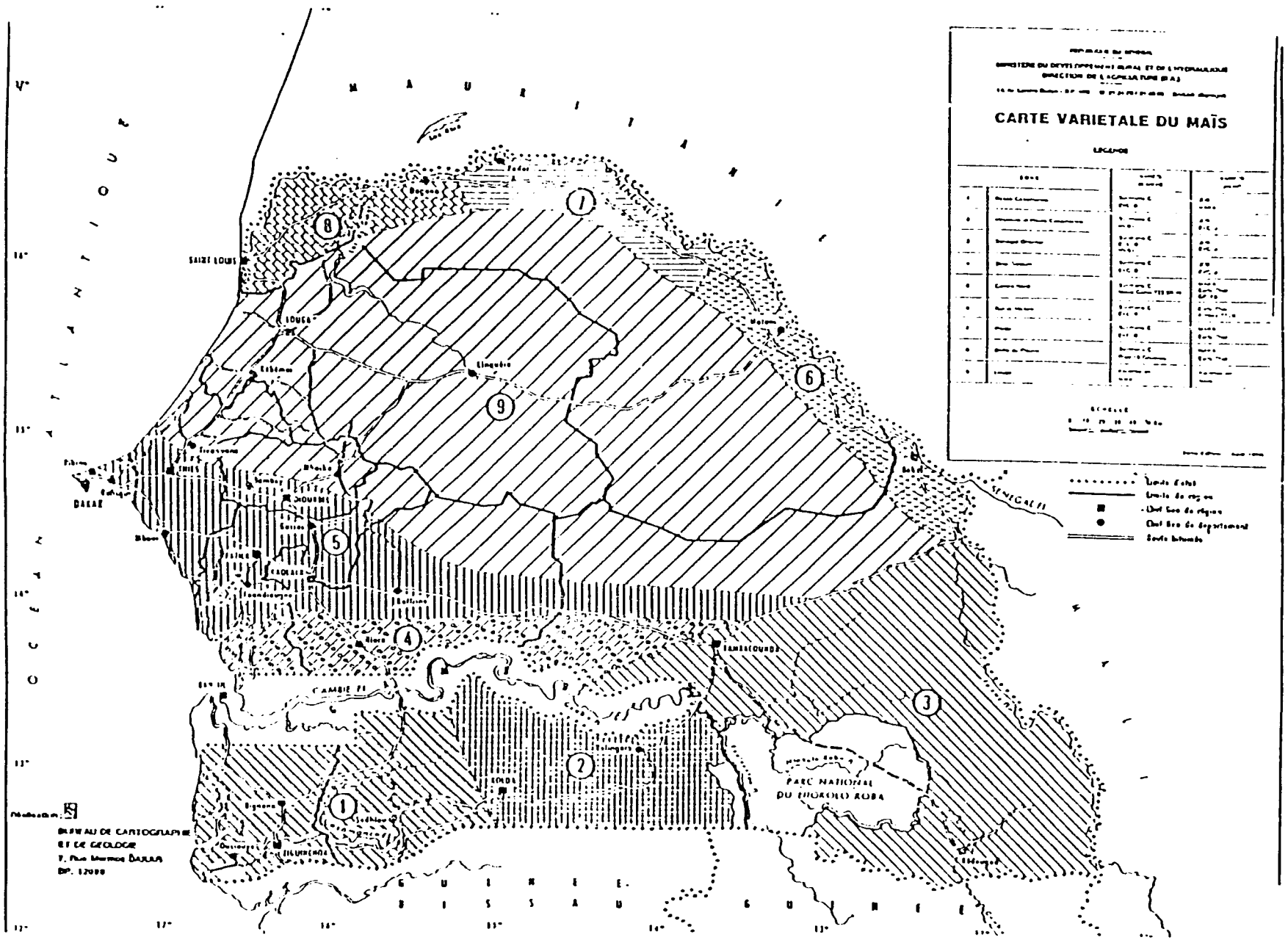
DOCUMENTATION:

1. "Essais multilocaux et demonstration varietale dans la culture du mais au Senegal, 1989/1990", by ISRA/CNRA-Bambey and Projet encouragement de la culture du Mais.
2. Gaudio, B. "Plan de marketing des semences de mais au Senegal", Marketing, Management, Conseil, Paris, July 1989.
3. ENDA-TM, Evaluation of Projet encouragement de la culture de Mais. 1990.
4. Metzger, M. "Les clefs du succès de la demonstration varietale", Projet Mais, Keur Samba Gueye, July 1, 1990.

COMMENTS:

1. Because neither economic evaluation nor marketing studies of maize production have been completed, the potential demand for increased corn in Senegal is difficult to estimate. The Germans invested 10 years in developing certified seed for improved maize production in Senegal betting that either the demand for corn exists or will develop.
2. Without an economic evaluation of the field trials, returns on investments are unknown.
3. Projet Mais has used inputs that are beyond the reach of most Senegalese farmers (tractors, high levels of fertilizer, etc) and perhaps will not be sustainable.

FIGURE 1 - MAIZE VARIETY MAP



11. MILLET/SORGHUM - POTENTIAL WITH IMPROVED MANAGEMENT

TYPE OF TECHNOLOGY+IMPACT: Sorghum grain yields with improved management

Improved management component

Cultivar	Plowing	Fertilizer	Tied-ridges	Irrigation	Grain yield (KG/HA)
Local variety/trad. practices					500-700
+					400-800
	+				600-950
		+			700-1200
	+	+			900-1500
	+	+	+		1000-2000
+	+	+	+		1500-3000
	+	+		+	2000-3500
+	+	+		+	3000-4500

Source: Matlon, P. "Prospects for improving productivity in sorghum and pearl millet systems in West Africa", paper prepared for the Rencontre Regionale pour un Meilleur Equilibre Socio-ecologique en milieu rural sahelien", Mali, March 1989.

a. Use of improved cultivars. Greatest potential is in improved local varieties. Constraints: a) Under on-farm conditions (low input) in years of adequate rainfall, improved cultivars alone can increase yield up to 15%, but improved cultivar alone can often show no yield difference from local varieties. b) Seed multiplication and extension services are weak so that promising materials face major obstacles between the research station and farmers' fields.

b. Fertilizer.
b.1. Constraints: Deficiences in phosphorous and nitrogen constrain increased millet and sorghum production on most soil types. Typical grain yield responses (below) from on-station trials overestimate actual responses on farmer fields by one-third to one-half.

Typical grain yield responses to nitrogen and phosporous
(kg grain/kg nutrient - Research station results)

Nutrient	Rice	Maize	Sorghum	Millet
NPK	NA	13.5	10.3	3.1
N	21.4	20.4	9.9	5.9
PeO_3	8-15	5-12	4-8	4-8

Source: Matlon, P. 1989.

b.2. Economics of fertilizer use on millet and sorghum. In higher rainfall zones (>600 mm), on-farm trials in Burkina Faso conducted by ICRISAT demonstrated that at unsubsidized costs and

when applied to local sorghum at profit maximizing doses, compound fertilizers gave an average benefit to cost ratio of two or greater. Under lower rainfall regimes (<600mm), fertilizer use on millet showed negative returns.

Without increases in soil organic matter, research results from long-term soil fertility experiments in Senegal have shown that continuous use of commonly available compound and nitrogenous fertilizers can reduce the soil's production potential, favoring the emergence of the detrimental effects (acidification, aluminum toxicity, micro-nutrient deficiencies) of chemical fertilizers.

Sources:

1. Matlon, P. 1989. "Prospects for improving productivity in sorghum and pearl millet systems in West Africa", paper prepared for the Rencontre Regionale pour un Meilleur Equilibre Socio-ecologique en milieu rural sahelien".

2. Ange, A. 1984. Les contraintes de la culture contonnière dans le système agraire de Haute Casamance au Sénégal. Paris: Institut National Agronomique.

12. SOUTHERN PEANUT BASIN: Soil conservation

TYPE OF TECHNOLOGY: Land conservation technologies/Slowing runoff
- Earthen bunds
- Tied ridges
- Live fences/windbreaks
- Rock terraces
- Plowing perpendicular to slope

LOCATION: Thyssé-Kaymor watershed management area

RESEARCH OBJECTIVES/METHODOLOGY: To improve soil and water resources and their use on different geographical levels (zone topography, watershed, parcel, square meter). Methodology is on-farm research with cooperating farmers, using a variety of applied/appropriate techniques.

IMPACT ON SOIL LOSS: Research results showed specific flow rates for runoff water in the watershed area to be 3520 liters/second/km2. When calculated into erosion caused by runoff, approximately 1 ton/hectare/year of soil is lost in the watershed area.

a.

Slowing soil loss:	Soil retained
Rock terraces	5-60mm
Earthen bunds/fascines	8-24mm
Live fences/grass rows	8-20mm

b. Combined with rock terraces, grass strips and hedge rows, plowing perpendicular to slope/harrowing before rains start resulted in a reduction in soil loss from 1000 kg/ha/yr (1986-7) to 225 kg/ha/yr (1988).

c. With above techniques, water stocking capacity of the soil is increased 10-15mm.

IMPACT ON GRAIN YIELDS: Table __ illustrates potential impact on crop yields. While no yield data is available from the ISRA/Kaolack research area, similar research (over a 5 year period) in three agroclimatic zones of Burkina Faso using impeameable earthen bunds resulted in an average grain yield increase of 30% (+170 kg/ha) on farmers' sorghum fields and 43% (+90 kg/ha) on farmers' millet fields.

Other research in northern Burkina Faso with similar rainfall/runoff patterns to Thyssé-Kaymor showed yield gains of almost 55%.

Also in Burkina Faso (rainfall >600mm) a technical package including permeable bunds, low dose compound fertilizer and an improved sorghum cultivar showed yield increases of 180% (+300 kg/ha) over controls.

ECONOMICS: ICRISAT economic analyses of bunding packages in Burkina Faso showed that a break even annual sorghum yield increment of only 155 kg would assure a return of 15% on the

labor and cash investment. This increment was exceeded by 67% of farmer participants in the 350-600mm rainfall zone, but by only 20% of farmer participants in the 800-1100 mm rainfall zone.

CONSTRAINTS TO ADOPTION: Availability of information at farmers' level.

TECHNICAL REQUIREMENTS: ISRA/Kaolack Research Team needs to evaluate the economics of the technical interventions in terms of returns to labor and investment as well as in terms of improved yields.

DOCUMENTATION:

a. Recherches d'appui, ISRA/Kaolack. February 1990. "Programme gestion des ressources naturelles Sine-Saloum".

b. Albergel, J., P. Perez, and M. Vaksmann. 1990. "Gestion agricole des pluies au Sahel: Une méthode d'estimation du ruissellement dans le bilan hydrique des cultures". Les journées hydrologiques de Montpellier 1990.

c. Sene, M, and M. Diatta. August 1990. "La place de l'arbre et le role des techniques culturales dans l'amenagement du terroir au Sud-Est du Bassin Arachidier du Sénégal". ISRA/Kaolack.

c. Albergel, J., M. Diatta, E. Juncker, P. Perez, P. Ruelle, and M. Sene. September 1989. "Thème: Methodes pour ameliorer l'infiltration et reduire le ruissellement. Presentation du cas du Sine-Saloum (Senegal)". Recherches d'appui, ISRA/Kaolack.

d. Sene, M. and P. Garin. 1988. "Le travail à la dent sur sol gravillionnaire au Sénégal". In proceedings from the West Africa Animal Traction Network, 1988 Workshop.

e. Sene, M. February 1989. "Quelques caracteristiques de l'enracinement de l'arachide dans le sud-est du Bassin Arachidier du Sénégal. ISRA/Kaolack.

f. Ruelle, P., M. Sene, E. Juncker, M. Diatta, P. Perez. 1990. "Defense et Restauration des Sols". Collection Fiches Techniques. ISRA/Departement de Recherches sur les Systèmes agraires et l'Economie agricole.

g. Matlon, P. 1989. "Prospects for improving productivity in sorghum and pearl millet systems in West Africa", paper prepared for the Rencontre Regionale pour un Meilleur Equilibre Socio-ecologique en milieu rural sahelien.

TABLE 3

PERCENTAGE YIELD INCREASES WITH INTERVENTIONS

INTERVENTIONS	PERCENT INCREASE IN CROP YIELDS(a)	PERCENT INCREASE IN CROP YIELDS(b)	PERCENT SOIL RESTORATION (a)	FARM CALENDAR FOR INTRODUCTION OF INTERVENTION	YEAR YIELD INCREASE TAKES EFFECT	LABOR REQUIREMENTS PERSON DAYS PER HECTARE	
						(a)	(b)
WINDBREAKS	18		2.5	ONSET RAINY SEASON	5	4	4
ACACIA ALBIDA	24	152	6.0	ONSET RAINY SEASON	6	10	
LIVE FENCES	5		2.5	ONSET RAINY SEASON	4	16	44
AGRIC. CHEMICALS	75		5.0	PLANTING SEASON	1		
COMPOST/ORG. FERT	80		6.0	PLANTING SEASON	1	11	
CONTOUR RIDGES	6	50	8.0	OFF-SEASON	1	142	150
DRY PLOWING		22		OFF-SEASON	1		0.4
LIVE FENCE + RIDGES		30		ONSET RAINS-OFF SEASON	1		163
RIDGES+GULLY CONTROL		50		OFF-SEASON	1		4.5/meter

(a) Christoppersen, K. 1988. Opportunities for Sustained Development, Vol. III, Financial Analysis, E/DI Washington, DC. p. 8-9.

The annual crop yield reduction caused by soil depletion under the traditional farming system is estimated at 6%. The soil restoration rates define the extent to which the 6% yield decline (base case scenario) is offset by the interventions. For example, windbreaks slow the rate of decline to 3.5% per year (6 - 2.5% = 3.5%). The 3.5% rate of decline becomes the base on which the annual (assumed) yield increases are calculated. Labor requirements are the base case scenario assumptions.

(b) Per cent yield increases for this column are numbers from sources other than those cited by Christoppersen and represents a broader range of the possible effects of any one intervention. Also the combination of interventions should provide greater total physical benefits than the sum of the two separately.

Sources:

Acacia Albida: Charreau, C. 1974. Soils of tropical dry and dry-wet climatic areas of West Africa and their use and management. A series of lectures. Agronomy Mimeo 74-26. Ithaca, NY. USA:Cornell University, Dept. of Agronomy. Note: The 152% yield increase was reported for millet. Charreau reported a 44% increase groundnut yields due to Acacia Albida.

Contour ridges: Dezillieau, D. and Mincza, F. 1988. "Experience No. 13: Rissiam/Bam Burkina Faso (Digues filtrantes)" pp. 239-260 in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989.

Dry plowing: Juncker, E., and Sene, M. 1990. "Comparaison de plusieurs dents pour le travail du sol en sec en traction bovine." ISRA/R3S/IRAT:Kaolack, Senegal.

Live fence plus contour ridges: Rodriguez, L. "Experience No. 19 Recherche-Developpement a Diga/Yatenga Burkina Faso (Lutte anti-erosive et amenagement de terroir)" pp. 249-258. in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989. Note: Rodriguez reported an average yield increase as 30%. However, the range of increases was between -20% to 200%. This yield variability is the subject of ongoing research.

Contour ridges plus gully control: Schmitt, P.A.C. 1987 "Experience No. 14: Ho-Rounou/Bam - Burkina Faso (Collecte et epanage des eaux de crue et de ruissellement)", pp. 261-280 in Le Sahel en Lutte Contre la Desertification: Lecons d'Experiences, Rochette, R.M., editor. CILSS/PAC/GTZ. Weikersheim:Margaf, Germany, 1989.

TABLE 4 - TECHNICAL RECOMMENDATIONS AVAILABLE PER REGION AND FOR THE MAIN CROPS.

SENEGAL

Agricultural Services Project

Technical Recommendations Available per Region and for the Main Crops 1/

	Groundnut Basin					Fleuve Region		Casamance			Niayes (Maraichage)
CROPS	Groundnuts	Cowpeas	Maize	Millet	Sorghum	Rice	Tomatoes	Rice	Groundnuts	Maize	Vegetables/Fruits
Technical Recommendations											
Soil preparation						X			X	X	
Seed quality (germination test selection and treatment of seed)	X	X	X			X					X
Plant population	X			X		X				X	
Sowing in Line/transplanting of rice						X		X			
Fertilizers (date, dose, mode of application)	X					X	X			X	
Thinning				X	X					X	
Weeding (manual or using herbicides)		X									X
Treatment		X									X
Post-harvest conservation		X									
Crop associations		X		X							
Water management						X		X			
Land levelling						X		X			X
Varieties (short-cycle)		X	X			X	X	X			X
Management of seed nurseries (vegetables, fruits and rice)						X		X			X

1/ Technical recommendations that require further testing by research and that are part of ISRA's adaptive research program are: a) mixed cropping (cereals with leguminous crops); agricultural practices (date of sowing, plant population in light of changing climatic conditions; b) updating of varietal map for different crops; c) response rate to fertilizers in different agroecological zones; d) testing of labor saving, small-scale, agricultural equipment (seed disks, rice transplanters, rice threshers); e) forage production, and f) development of integrated farming systems (agriculture, livestock, forestry).

Source: World Bank, Report No. 8079-SE, Staff Appraisal Report: Senegal Agricultural Services Project, Feb. 1, 1990, pp. 47-48.

TABLE 4 - continued

CROPS	Groundnut Basin					Fleuve Region		Casamance			Niayes (Maraichage)
	Groundnuts	Cowpeas	Maize	Millet	Sorghum	Rice	Tomatoes	Rice	Groundnuts	Maize	Vegetables/Fruits
Technical Recommendations											
Non-crop specific recommendations:											
Better integration agriculture/ livestock (production of manure and compost), soil conservation measures, animal traction, feeding of work animals (production and storage of fodder crops)											
Better adapted agricultural equipment - New disk for sowing millet Crop rotation Agroforestry - production of small trees (caddo) tree nursery management for reforestation (erosion control, and animal feed production)											

TABLE 4 - continued

SENEGAL

Agricultural Services Project

Technical Recommendations Available/to be Tested for Livestock
(formulated according to geographic regions, type of animals,
and type of herd ownership and management

Technical Recommendations	Readily available	To be tested/ further developped
Animal nutrition/feed supply (forage production, mineral supplements, crop by-products)	X	
Animal health protection (vaccinations, treatment of internal and external parasitic diseases)	X	
Improved feed quality in dry season (fodder bank technology - a low input system of establishing high quality leguminous fodder reserves for the dry season for selected categories of livestock)		X
Herd management (selection of breeding animals, castration, 'destockage', weaning)	X	
Range management practice	X	X
- Animal-drawn agricultural equipment for constitution of forage reserves		X
- Anti-erosion measures, including alley farming	X	X
Manure production	X	
Market price information		X
Organization of producer groups to take on simple veterinary care and to handle input supply and marketing	X	X

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TABLE 5 - RESULTS OF AGRICULTURAL RESEARCH (1974-1988)

RESULTS OF AGRICULTURAL RESEARCH (1974 - 1988)

Sector	Commodity	INFORMATION: Research	INFORMATION: Available for Extension	PRODUCTS AVAILABLE: Technology	FOR USE BY FARMERS: Product details
CROP	Millet	Identification & biology of pests and pathogens	Advice on control and dev. of pest/disease scoring system	Plant husbandry recommendations Fertilization Storage	Varieties: SOUNA 3, GAM 8203(HT so) 8301,8601,IBV 8001,8004,IBMV 8401
	Sorghum	Identification of pests (insect and other) and mildews	Pest detection in field	Plant husbandry recommendations Storage Varieties tolerant to mildew	Varieties: CE90,CE 145 66, 612 AX 8029, 612 AX 73200, 612 AX 7614
	Maize	Pest identification	Pest detection in field	Fertilization Storage	Varieties: Hybrid HVB 1 & 2, Composites(early) CP76,Variety LPM, Synthetic C
	Irrigated Rice	Locust & grasshopper control Agronomic value of Azolla	Dose & frequency of application of Furadan(multi-purpose pesticide)	Plant husbandry recommendations	Varieties: IKP & JAYA
	Rainfed rice	Integrated pest control Varieties & mineral nutrition Weed control	Identification of pests & diseases	Varieties Plant husbandry recommendations	Varieties: BJ 12510, BJ8840 IRAT 10, IRAT 135
	Cowpea	Detailed analysis of all charact. of old cv.CB6 with new cv.B21 Biological control vs.storage weevils	Replacement of CB6 by B21 Spraying program vs.pests Storing system vs.pests & diseases	Plant husbandry recommendations Phytosanitary treatments Intercropping recommendations Storage	Varieties: Bamboy 21 (short cycle) 68.67, Ndiambour,Mougne (med.cycle) Collection of rhizobium strains
	Groundnut	Genetic material resistant to diseases and drought (shorter seasons)	Forecast system for main diseases Post-harvest recommendations Seed treatment	Post-harvest protection & storage Dev. of shelling & threshing equip. Fertilization Rotation cereals/groundnuts	Collection of rhizobium strains Basic seed of imp.cvs available for national seed service (oil & confect
	Cotton	Analysis of genetic material Knowledge of insect pest profile Analysis of cotton farming systems	cv.resist. to bacterial leaf spot Pest control program	Formul.of NPK3B (8-18-27-6-1)fert. Herbicide treat.(Cotadon/paraquat) Pyrethroids spray program (ULV)	Variety L299-18 to replace IRMA 96-...,
	Fruit crops	Inventory of pests & diseases	Pest & disease identification	Spraying programs	Varieties: Citrus 10 selected cvs Mango 8 selected cvs
	Vegetables	Agronomy and pest control	Training and extension	Pest and disease control Cultural recommendations	Selected cvs.of onion,potato,tomato, sweet potato,cassava,gombo,jaxato et. Cultural notes Publ.of Horticultural Manual (Senega..
	Forage crops	Plant habit & productivity of diff. forage crops in diff.areas of Senegal Estab. of feeding value	Development of seed farms	Dev.of different forage systems for stock feeding in different areas	Avail.of seed:Panicum maximum H1878 cowpea and sorghum Woody forage legumes (eg Leucaena)

Source: World Bank, Report No. 7675-SE, Staff Appraisal Report: Senegal Second Agricultural Research Project; Feb. 26, 1990, pp. 41-42.

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TABLE 5 - continued

Sector	Commodity	INFORMATION: Research	INFORMATION: Available for Extension	PRODUCTS AVAILABLE FOR USE BY FARMERS: Technology	PRODUCTS AVAILABLE FOR USE BY FARMERS: Product details
FORESTRY	Local spp	Species performance & habits Vegetative propagation Symbiosis identification	Recomm.of spp. for diff.zones Inventory of natural forests	Planting techniques Direct seeding for few spp.	Seed: Acacia raddiana-senegal-albida, balanites. Production:volume table - Acacia senegal
	Exotic spp	Species performance & habits Symbiosis identification	Zonification of diff.spp	Nursery & plantation techniques	Production: volume table for teak
	Eucalyptus	Study:spp performance in diff.zones Selection of sources of E.camaldulensis	Choice of species and sources Zonification	Nursery & plantation techniques Manag. of E.helosoricus plantations	Selected seed: E.camaldulensis E.tortilicornis,E.jensenii Production:volume tables
LIVESTOCK	Sheep & Goats	Genetic potential Breeding Productivity parameters	Selection system	Management of breeding	Manag.of improved breeding stock Peul,Djallonke & Touabir
	Dairy	Identification of production problems Performance analysis of local stock	Transfer of results to producers	Technical/economic prodn.follow-up Tech.reco for estab.of dairy units Production of feedstuffs Dairy technology	Imported stock & semen (AI) Feedstuffs
	Beef cattle	Genetic potential Breeding Productivity parameters	Selection system		Diffusion of imp.breeding stock Gobra and Ndama
	Feeding	Eval.of sources of natural forage Indust. crop & agro-indust.by-products Nutrition physiology	Conservation & utilis. of pastures Pasture manag. & regeneration Availability & nutritive value Inventory of natural pastures Proposed management systems	Manag.systems natural pastures Feeding systems for traditional, semi-int.& intensive livestock man.	Feeding rations by species & manag. Molasses-urea blocks (MELUR)
	Pathology	Knowledge of the pathogenic complex Specialised knowledge rel.to intensif. Effects of pathogens on productivity Technical & economic data	Support to develop.projects Diagnostic services Efficiency of diff.pharmaceuticals	Integrated disease control Specialised pest/disease control, (Ticks, tsetse flies etc.)	Vaccine production (32 types)