Farm Level Cereal Situation in Lower Casamance: Results of a Field Study

by

C.M. Jolly, M. Kamuanga, S. Sall
and J.L. Posner

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SPECIAL NOTE FOR
ISRA-MSU REPRINTS

In 1982 the faculty and staff of the Department of Agricultural Economics at Michigan State University (MSU) began the first phase of a planned 10- to 15-year project to collaborate with the Senegal Agricultural Research Institute (ISRA, Institut Sénégalais de Recherches Agricoles) in the reorganization and reorientation of its research programs. The Senegal Agricultural Research and Planning Project (Contract No. 685-0223-C-00-1064-00), has been financed by the U.S. Agency for International Development, Dakar, Senegal.*

As part of this project MSU managed the Master's degree programs for 21 ISRA scientists at 10 U.S. universities in 10 different fields, including agricultural economics, agricultural engineering, soil science, animal science, rural sociology, biometrics and computer science. Ten MSU researchers, on long-term assignment with ISRA's Department of Production Systems Research (PSR, Département de Recherches sur les Systèmes de Production et le Transfert de Technologies en Milieu Rural) or with the Macro-Economic Analysis Bureau (BAME, Bureau d'Analyses Macro-Economiques) have undertaken research in collaboration with ISRA scientists on the distribution of agricultural inputs, cereals marketing, food security, and farm-level production strategies. MSU faculty have also advised junior ISRA scientists on research in the areas of animal traction, livestock systems and farmer groups.

Additional MSU faculty members from the Department of Agricultural Economics, Sociology, Animal Science and the College of Veterinary Medicine have served as short-term consultants and scientific advisors to several ISRA research programs.

The project has organized several short-term, in-country training programs in farming systems research, farm-level agronomic research, and field-level livestock research. Special training and assistance has also been provided to expand the use of micro-computers in agricultural

research, to improve English language skills, and to establish a documentation and publications program for PSR Department and BAME researchers.

Research conducted under this collaborative project was originally published only in French. Consequently, the distribution of results has been limited principally to West Africa.

In order to make relevant information available to a broader international audience, MSU and ISRA agreed in 1986 to publish selected reports as joint ISRA-MSU International Development Paper Reprints. These reports provide data and insights on critical issues in agricultural development which are common throughout Africa and the Third World. Most of the reprints in this series have been professionally edited for clarity; maps, figures and tables have been redrawn according to a standard format. All reprints are available in both French and English. A list of available reprints is provided at the end of this report. Readers interested in topics covered in the reports are encouraged to submit comments directly to the respective authors, or to Drs. R. James Bingen or Eric W. Crawford, Co-Directors, Senegal Agricultural Research II Project, Department of Agricultural Economics, Michigan State University, East Lansing, MI 48824-1039.

Léopold Sarr
Director
Agrarian Systems and
Agricultural Economics
Research Department
Senegal Agricultural Research
Institute

R. James Bingen/Eric W. Crawford
Co-Directors
Senegal Agricultural Research II
Project
Department of Agricultural
Economics
Michigan State University

...Institute. ...education strategies. ...faculty for ISRA scientists on research in the areas of animal traction, livestock systems and farmer groups.

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*In December 1987 MSU, ISRA and USAID/Dakar negotiated a 2 1/2 year contract (Contract No. 685-0957-C-00-8004-00) to extend MSU's program of research support and training in the social sciences, agronomy, forestry and research planning.

ABSTRACT

This study examines the cereal situation at the farm level in Lower Casamance. It is based on a critical analysis of available time series production data (1960-1982) and a cross sectional analysis of farm level data collected in 1982-1983 and 1983-1984 by the Djibélor Production Systems Team. The objectives are to: (1) evaluate the food crop balance through an examination of cereals produced, stored, consumed and marketed by farmers and, (2) examine various ways for making up a possible cereals deficit. The results indicate that production is insufficient for consumer needs in several villages and that the Lower Casamance farmer is a net buyer in the cereal market. Factors influencing the demand for imported white rice by smallholders are analyzed; transport costs and the daily consumption rate are the most important variables determining the quantities demanded. Diversification of farmer cropping systems is one means to improve the present cereal situation.

FARM LEVEL CEREAL SITUATION IN LOWER CASAMANCE: RESULTS OF A FIELD STUDY

by

C. M. Jolly, M. Kamuanga, S. Sall and J. L. Posner

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FARM LEVEL CEREAL SITUATION IN LOWER CASAMANCE: RESULTS OF A FIELD STUDY

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

FARM LEVEL CEREAL SITUATION IN LOWER CASAMANCE: RESULTS OF A FIELD STUDY[1]

C. M. Jolly, M. Kamuanga, S. Sall and J. L. Posner

INTRODUCTION

Cereals are the staple diet in Senegal. Per capita consumption is estimated to be about 97, 80, 14.4 and 21.5 kg respectively for rice, millet, wheat and maize (SONED, 1977). In all regions, both in towns and in the country, households consume mostly millet and rice. In rural areas, millet consumption is estimated at 110 kg per capita, with slight interregional variations; rice consumption is estimated at 63 kg per capita, with large variations particularly in the Casamance where consumption is 82 kg per capita (SONED, 1983).

Cereal production, however, is insufficient for the population's needs. In 1981, at the end of the Vth Economic and Social Development Plan the average "self-sufficiency production rate"[2] was only 55% in contrast to the planned rate of 81%. According to data from the Ministry of Rural Development (March 1984) the current rate is estimated at 31.5%. The 66% rate anticipated in the VIth Plan (1981-1985) was calculated on the basis of an average cereal production growth rate of 7.2% and the expectation of a different trend in the consumption structure.[3]

The difference between the anticipated and attained rates is in part due to the rainfall deficit, which in 1981 meant that only 43% of production

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[1]The authors would like to thank Mark Newman, Eric Crawford, Madicke Niang, Jim Bingen and Jacques Faye for their useful comments. We also thank all the enumerators attached to CRA-Djibélor for data collection.

[2]The percent of total consumption covered by domestic production.

[3]According to the VIth Plan, a price policy favoring or selectively slowing down the consumption of certain products is a factor determining the evolution of consumption. The example of millet is instructive. Its consumption in urban zones has decreased since 1977 and varies considerably owing to shortages and price increases (SONED, 1983).

objectives were achieved. Since the growing urban demand, however, is being largely met by imports, the self-sufficiency production rate[4] is reduced.

The Casamance has long been seen as Senegal's future grain basket. It produces 60% of rice and provides 22% of Senegal's total cereal production. Production has declined, however, since 1974, even though the region has usually received more rain than the rest of the country.

The Casamance Regional Development Plan (SOMIVAC, 1978) optimistically relies on the expected high agricultural potential of the region and the future exploitation of saline lands created by the large dams at Guidel, Kamobeul, Baïla and Soungrougou. In 1978, for example, the Plan estimated that the regional cereals demand would be entirely covered by 1985.

Unlike the forecast of the Master Plan for the Development of the Casamance and the VIth Four Year Plan (1981-1985) we propose to show in this document the gravity of the cereal situation for the producer a year before the end of these Plans.

PROBLEM STATEMENT AND OBJECTIVES OF THE STUDY

Our study is limited to the Lower Casamance, which has most of the important hydro-agricultural development projects in the region and which is predominantly a rice-growing area.

Although the figures are not exact, the cereals deficit in Lower Casamance appears very high in comparison with the region's agricultural potential. Almost 20,000 tons of rice were imported in 1982, or 6.5% of rice imported outside the Cap-Vert region (Caisse de Péréquation, 1983).

The hungry period has become difficult throughout the Lower Casamance because cereal production covers less and less of the population's needs. This is confirmed by farmer reports on purchases of imported rice and by recent surveys. Marzouk-Schmitz (1980) estimates that post-harvest rice reserves for the village of Kamobeul cover only the household requirements for a period of 2 to 4 months, and that a Kamobeul family buys approximately

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[4]This rate is calculated as the ratio of net production (P) to total quantity of cereals available (D), i.e., net production plus imports (I) less exports (E): (D = P + I - E). All things being equal, the increase in I reduces the P/(P+I-E) ratio.

200 kg of white rice per year and receives almost a hundred kgs as a gift. Another study[5] in four Kalounayes villages shows that 36% of the households are self-sufficient in cereals. The rate increases to 60% when including white rice purchased before the following harvest (financed from savings). In other words, earned income from sources such as groundnut sales and off-farm employment cover up to 40% of a family's cereal needs.

The objective of the PSR Team survey is similar: to estimate the extent of the cereal production shortage and to evaluate the ensuing farmer strategies to cope with this situation. The specific objectives of this study, as discussed in this paper, are:

1) To evaluate the cereals situation in different agricultural zones of Lower Casamance by examining the quantities produced, stored, consumed and marketed;
2) To examine alternatives for making up a possible farm-level cereals deficit;
3) To analyze the factors which influence farmer demand for cereals;
4) To evaluate the implications of the cereals situation for agricultural policy and research.

SURVEY METHODOLOGY AND FARM CHARACTERISTICS

Sampling and Organization

The Production Systems Research Team at the Djibélor Agricultural Research Center divides the Lower Casamance into five agricultural zones according to the organization of work (essentially the division of labor by gender), the use of animal traction and the relative importance of transplanted rice (see figure 1). The Team works in ten villages; two villages are representative of each zone.

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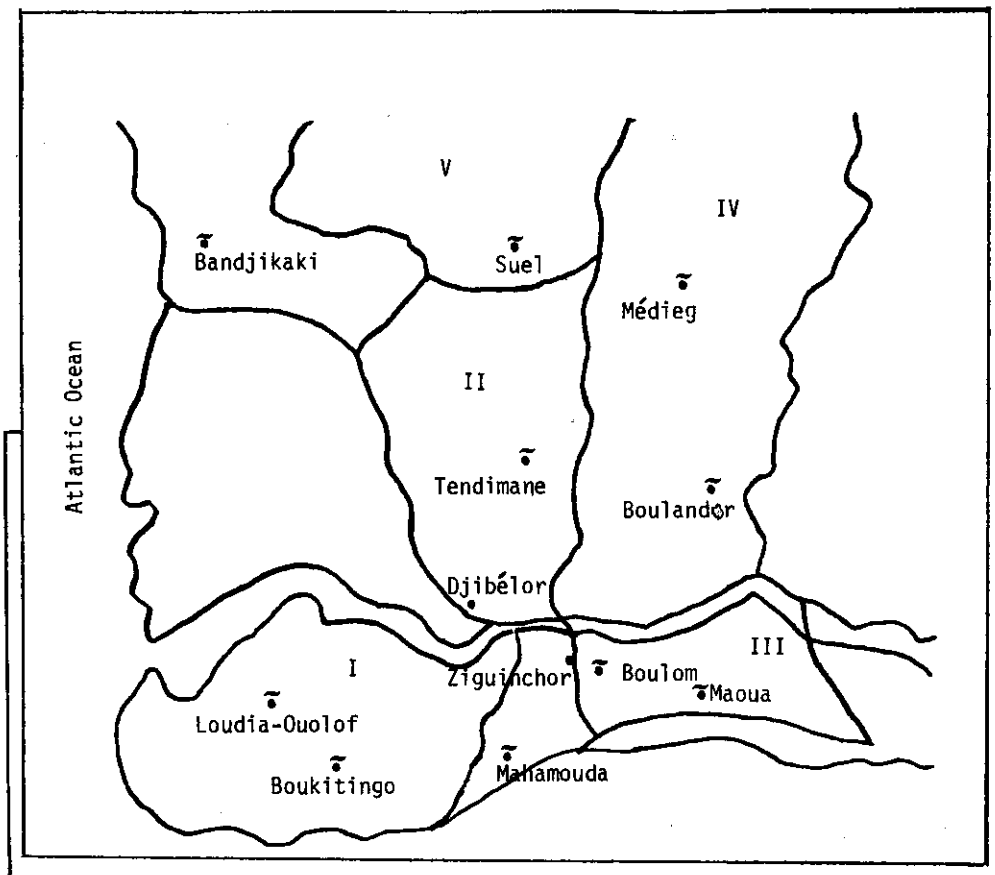
[5]Albrecht, et. al., 1983.

FIGURE 1. MAP OF AGRICULTURAL ZONES



Notes:

Zone I: Diola labor pattern, no animal traction, predominance of transplanted rice.

Zone II: Diola labor pattern; upland crops and direct-seeded rice relatively important.

Zone III: Mandingue labor pattern in the east, but with Diola villages interspersed in the center and west. Little animal traction. Direct-seeded rice relatively important.

Zone IV: Mandingue labor pattern, animal traction somewhat developed, upland crops very important.

Zone V: Diola labor pattern, animal traction developed, and aquatic rice relatively important.

In each village, crop plots and farm family households[6] of 25 compounds, chosen randomly during the 1982 rainy season, was monitored by village-level research assistants throughout the year. (The sample of 125 compounds comprises of 235 farm families.)

Cereals production was estimated by setting yield sampling plots. Estimates of groundnut production are derived from sales to the cooperatives. The survey on cereal availability and marketing was started immediately after the harvest. Some farmers were interviewed more than once to ensure the validity of the responses. The same survey was repeated during the 1983-1984 rainy season on a reduced sample of 150 farms. Detailed input-output data was collected on a sub-sample of 30 representative farms grouped by 6 farms per agricultural zone.

Characteristics of the Sample Farms

The main characteristics of the surveyed farms are presented in tables 1 and 2. One noticeable contrast is between the Oussouye and Sindian-Kalounayes Zones with respect to the total area cultivated per smallholding.

In villages using animal traction, the farm size is larger and the ratio of cultivated uplands to lowlands is also higher. The total farm population is greater in villages of Mandingue influence (Boulandor, Médieg and Maoua).

About 0.55 ha of land is available per working man in all of the villages, but this ratio varies from zone to zone. It is considerably higher than the average in the Sindian-Kalounayes and Fogny-Combo Zones, despite the larger number working men per farm south of the river (table 1).[7]

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[6]A farm family is composed of members who produce and consume together. A farm family can include one or several households, but generally is autonomous with regard to the use of rainfed and irrigated fields.

[7]In general there is less cultivable land available per working person than among the Serer or in the Sine-Saloum where holdings range from 3 to 12 ha (Benoit-Cattin, et. al., 1982).

TABLE 1

DEMOGRAPHIC CHARACTERISTICS OF FARMS IN THE LOWER CASAMANCE[a]

Zones	Villages	Average Holding (ha)[b]	Total Population (Average 83-84)	Number of Working Adults	Cultivated Area (ha) per/capita	Cultivated Area/Working Adult (Average)
Oussouye	Boukitingo	1.42	5.5	3.4	0.26	0.42
	Loudjia-Ouolof	1.80	7.5	4.4	0.24	0.41
Bloof	Mahamouda	2.0	9.7	5.6	0.21	0.36
	Tendimane	1.54	7.4	4.6	0.21	0.33
Niaguiss	Maoua	3.3	11.1	6.5	0.19	0.51
	Boulom	1.88	8.1	5.0	0.23	0.38
Sind.-Kalou.	Boulandor*	5.01	11	6.3	0.45	0.79
	Médieg*	4.01	10.7	6.0	0.37	0.67
Fogni-Combo	Bandjikaki	3.20	9.1	5.0	0.35	0.64
	Suel*[c]	4.41	7.5	4.4	0.59	1.0
Averages		2.86	8.7	5.1	0.32	0.55

Source: Survey 1982-1984.

[a]All averages are calculated on the basis of data from the sample monitored over two seasons (82-83 and 83-84).

[b]This refers to the average cultivated areas during two rainy seasons. Extreme values are disregarded.

[c]Suel was only monitored during the 83-84 rainy season.

*Villages where animal traction is widespread.

TABLE 2

AREA PLANTED AND FARM INCOME FOR REPRESENTATIVE FARMS

Zones / Villages	Oussouye	Blouf	Niaguis	Sindian-Kalounayes	Fogny-Combo
	Zones				
Total Area/Farm[a]	1.77	2.0	2.98	5.34	4.12
Gross Farm Income (FCFA)					
- Total	75,700	99,473	150,270	356,456	274,268
- Cash income	45,183	88,200	123,900	308,960	230,652
Variable Costs (FCFA)					
- Total	6,997	7,500	20,600	35,100	20,683
- Cash cost	867	2,140	1,853	20,435	1,442
Net Income (FCFA)					
a) Per hectare					
- Total	38,875	45,986	43,520	60,159	61,550
- Cash	25,037	43,000	40,900	54,031	55,634
b) Per day's work					
- Total	294	380	405	603	659
- Cash income	191	320	380	541	595

Source: Surveys 1982-1984.

[a]These farms were deliberately chosen in each village during the season 1983-84. Selection criteria favored characteristics whose values were modal or average when the standard deviations were low. Data regarding the input/output ratios were gathered during weekly visits to each farm (see Sall et al., 1984).

Despite the differences in farm holding sizes between the North area and Southern sides of the River, which can be attributed mainly to animal traction, there is still very little agricultural equipment in Lower Casamance. One survey shows that even in the best equipped Sindian-Kalounayes Zone, no farmer owns a complete set of equipment (1 pair of oxen, 1 cart, 1 seeder, and 1 weeder).

The amount of agricultural income also reflects the difference in farm resource endowment (table 2). This income is higher in the animal traction zones (Sindian-Kalounayes, Fogny-Combo) where the estimated labor productivity varies between 600 and 700 FCFA per day. It is relatively lower (300 FCFA or less) for smallholdings in Oussouye and Blouf. This can be partly explained by the absence of crop diversification, the small area cultivated, and the concentration on aquatic rice, which has low and unstable yields during drought years.[8] The low agricultural revenue in these zones helps to explain the importance given to other activities like fishing, gathering, hunting and artisanal work.

CEREAL SITUATION AT THE FARM LEVEL

The Regional Situation

Figures 2 and 3, based on regional statistics collected by the Agriculture Service, represent the evolution of cereal production in the Casamance and Lower Casamance. Apart from large annual variations, overall production has not markedly increase between 1970 and 1982. With the favorable rainfall (1,300 to 1,400 mm) in 1974 and 1978, production increased considerably, and in these two years, the Lower Casamance supplied 37% and 35% of the agricultural production in the Casamance region. The ten year average has been about 27%.

Annual fluctuations in rice production in the Casamance and, in the Lower Casamance specifically, are more noticeable than for the total cereal production. In the Lower Casamance in particular the July-August rainfall

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[8]Aquatic rice yields can vary enormously (200 to 1200 kg/ha) from one year to another depending on the location of the rice field and the importance of land improvements.

FIGURE 2. EVOLUTION OF CEREALS PRODUCTION AND CONTRIBUTION OF THE CASAMANCE TO NATIONAL PRODUCTION

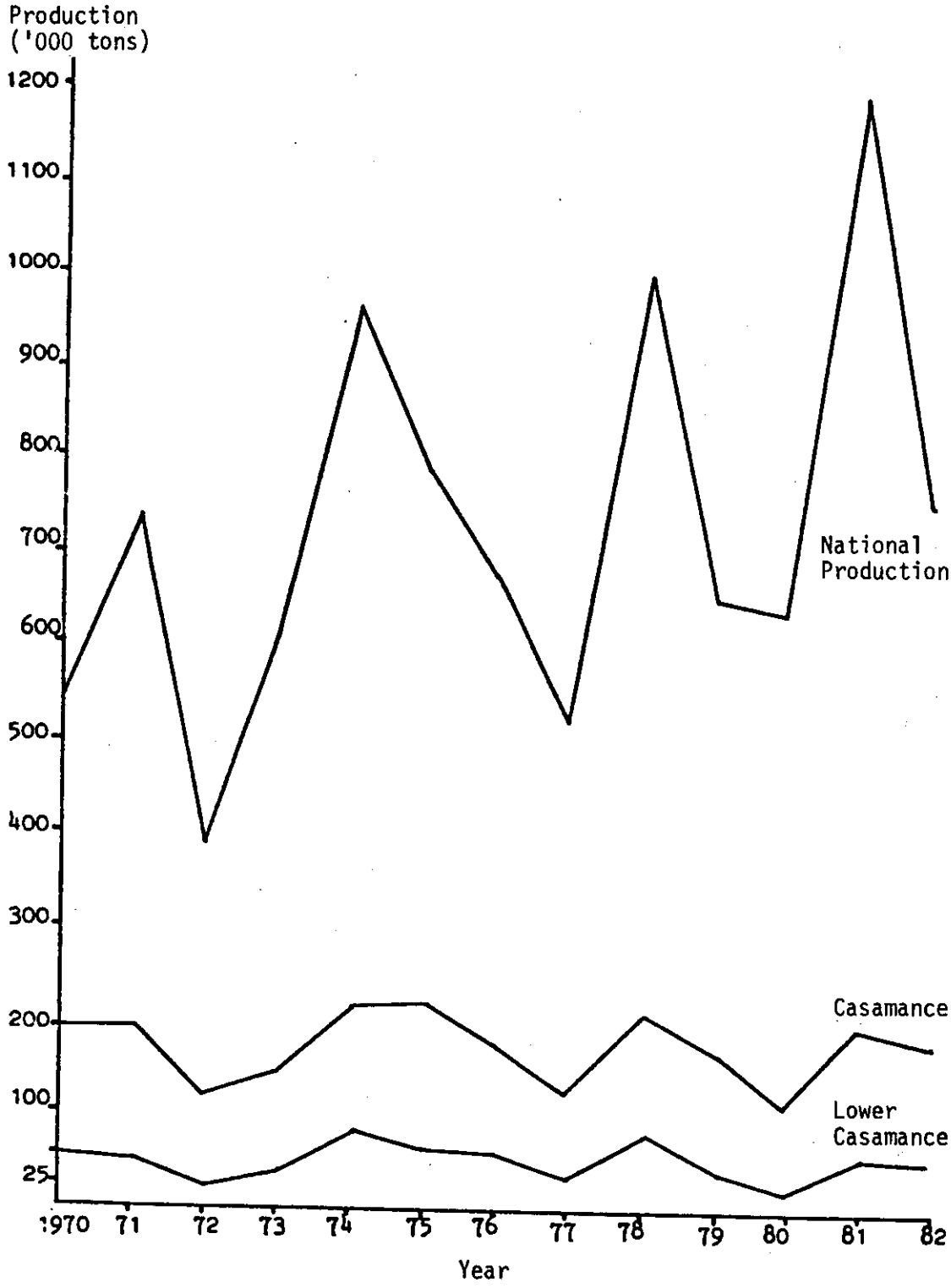
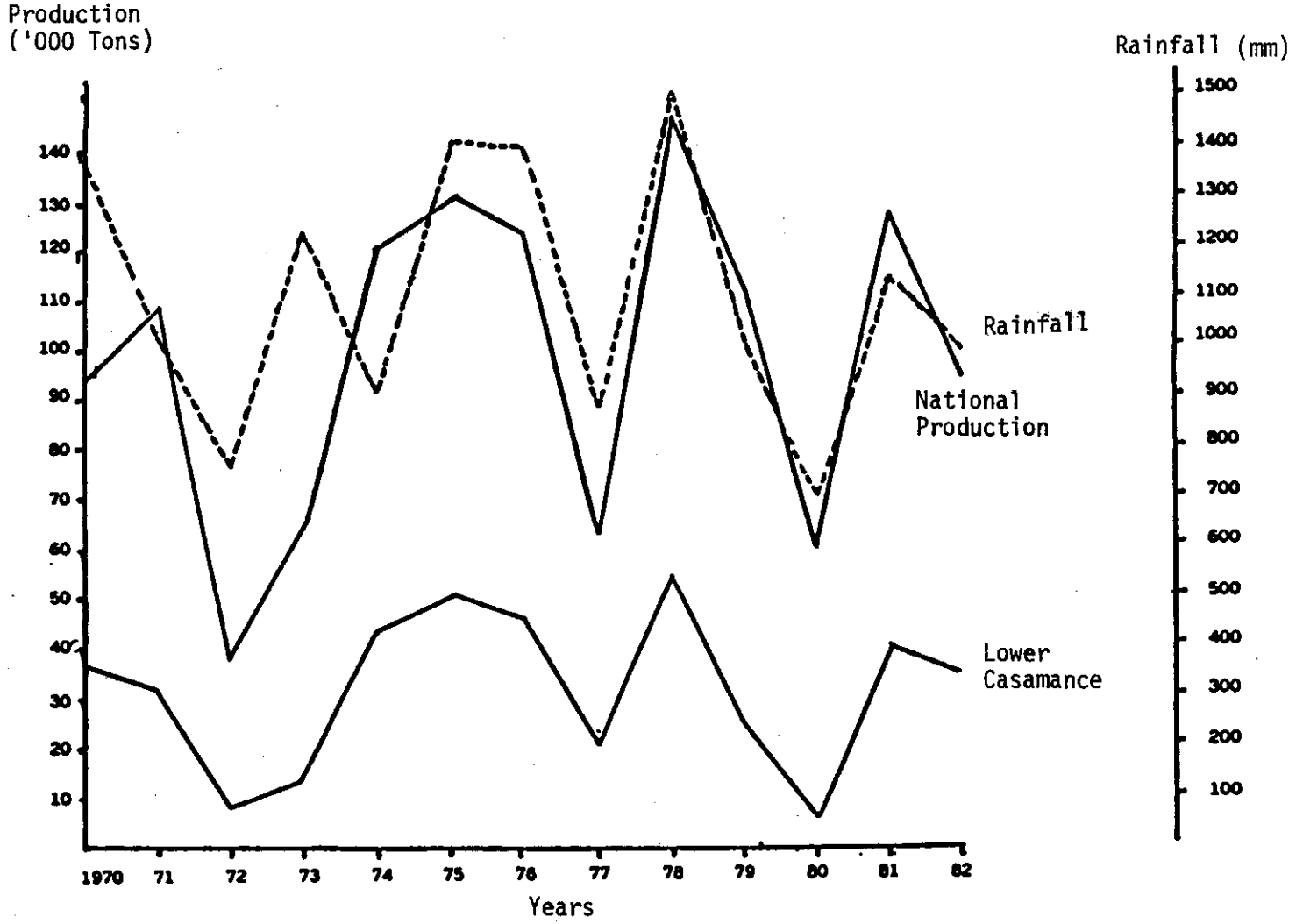


FIGURE 3. ANNUAL RICE PRODUCTION FOR THE LOWER CASAMANCE AND SENEGAL PLOTTED AGAINST AVERAGE REGIONAL RAINFALL



limits the area of rice cultivated. The absence of subsidies for agricultural inputs and agricultural credit since 1978 has also limited areas brought into production.

Millet-sorghum production trends have been similar to those for rice. Maize is the only crop in the Lower Casamance that has grown 19% per year during the 1970 to 1982 period (see Appendix tables).[9]

Although the quantities of cereal marketed in Casamance have always been small, for 1971, 0.55% and 0.16% of paddy and millet production, respectively (Dione, 1975), the region has had a deficit since 1978 (SONED, 1983). These overall statistics give a concise picture of the gravity of the cereals situation in the region, but they need to be completed by an examination of deficits at the level of the smallholder.

Cereal Balance at the Farm Level

The cereal balance is calculated by relating the total cereal production to the number of persons per farm family and comparing the minimum needs per person. Table 3 shows significant variations in the quantities produced per family, which result from differences in the areas cultivated per farm and in yields within the zones. Sixty-five percent of the smallholders produce less rice than the average for the Lower Casamance (117.7 kg). The combined production of maize, millet and sorghum is 225 kg per farm family; however, 77% of the farms produce less than 700 kg per farm.[10]

Table 4 summarizes the cereal situation during 1982-1983 and 1983-1984 for the surveyed farms. To evaluate correctly the quantity of cereals produced and potentially available for consumption by a farm family, the total number of persons is converted into a consumption unit (CU), which accounts for the difference in caloric needs between different age groups

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[9]Production increased from 1,723 MT in 1970 to almost 6,000 MT in 1982.

[10]Averages are calculated over the master sample size.

TABLE 3

CEREAL PRODUCTION PER FARM IN THE LOWER CASAMANCE, 1983 (KG)

Agricultural Zones	Villages	Paddy Rice				Maize				Millet				Sorghum			
		Average Per Farm	C.V.	Min.	Max.	Average Per Farm	C.V.	Min.	Max.	Average Per Farm	C.V.	Min.	Max.	Average Per Farm	C.V.	Min.	Max.
		(kg)				(kg)				(kg)				(kg)			
I. Oussouye	Boukitingo	594.2	88	107	1306	181	139	12	128	-	-	-	-	-	-	-	-
	Loudia Ouolof	619.2	184	144	2073	11.9	149	11	114	-	-	-	-	-	-	-	-
II. Blouf	Mahamouda	156.5	62	15	284	71.1	184	27	465	-	-	-	-	-	-	-	-
	Tendimane	545.2	73	53	1489	-	-	-	-	17.8	204	17	195	-	-	-	-
III. Niaguis	Maoua	772.4	141	116	3282	375.5	111	174	1010	94.3	194	19	480	-	-	-	-
	Boulom	1482.2	72	378	3603	97.5	185	37	560	-	-	-	-	-	-	-	-
IV. Sindian-Kaloun.	Boulandor	1019	52	373	2582	329	154	178	2265	49.9	241	47	1098	19.8	244	18	160
	M dieg	1432	49	523	2801	315.7	107	244	2192	618.7	82	1007	2607	85.8	217	22	716
V. Fogny-Combo	Bandjikaki	1798.6	61	541	3020	105.4	120	147	1123	-	-	-	-	-	-	-	-
	Suel	-	-	-	-												
Average		1117.7	114			121.1	177			89.6	301			13.8	204		

TABLE 4

ESTIMATE OF CEREAL QUANTITIES POTENTIALLY AVAILABLE PER CONSUMPTION UNIT

Agricultural zones	Villages	Cereal Production (kg)[a]		Number of Consumption Units[b]		Quantity Produced per C.U.	
		1982-83	1983-84	1982-83	1983-84	1982-83	1983-84
I. Oussouye	Boukitingo	344.5	414.1	3.6	6.5	95.7	63.7
	Loudja Ouolof	497.2	440	5.4	4.8	92.1	59.6
II. Blouf	Mahamouda	224.7	114.8	7.4	8.1	30.4	14.2
	Tendimane	497.8	197.8	5.5	5.5	90.5	35.9
III. Niaguis	Maoua	816.2	869.3	9.9	7.8	82.4	111.4
	Boulom	1853.3	822.5	6.9	7.7	268.6	106.8
IV. Sindian-Kalou.	Boulandor	1497.1	520.2	8.3	7.7	180.4	67.6
	Médieg	1880.8	8977	7.1	8.7	264.9	103.1
V. Fogny-Combo	Bandjikaki	1304.3	1214.3	7.1	7.2	183.7	168.6
	Suel	-	901.5	-	6	-	150.3

[a]The figures represent cereal quantities in a directly consumable form. A coefficient of 0.65 was used for the conversion of paddy quantities to white rice and 0.85 for the other cereals.

[b]These values are adjusted to take into account migrants' temporary stay.

(see for examples Crawford and Thorbecke, 1981).[11] The figure obtained is adjusted for temporary absences from each farm family.[12] The result obtained is compared to the minimum quantity needed per person according to the FAO norm, (200 kg of cereals per year).[13]

This quantity does not consider the nutritional value of what is available (given the nature of the survey and data limitation). In addition, we are discussing the deficit from the production side and not from the consumption viewpoint.

The production deficit has been more or less general throughout the Lower Casamance, except for the villages of Boulom and Médieg in 1982/1983. Furthermore, the situation deteriorated in all villages between 1982/1983 and 1983/1984 because of the marked rainfall deficit.[14] Changes in the size of the households and other factors have also affected the quantities available per CU.[15]

Villages can be grouped according to the size of the production deficit. Figure 4 indicates that the lowest deficit per CU is in Boulom, and in Boulandor, Médieg and Bandjikaki where animal traction is widespread. The Oussouye and Blouf villages (except Tendimane in 1982/1983) show a production deficit per CU. This is due to the importance of transplanted

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[11]The Consumption Unit in this context represents an adjustment of the numbers to be fed. The following coefficients have been used: 0.25 for infants (under 5 years of age); 0.50 for children from 5 to 14 years of age and 1.0 for adults. No distinction has been made between men and women.

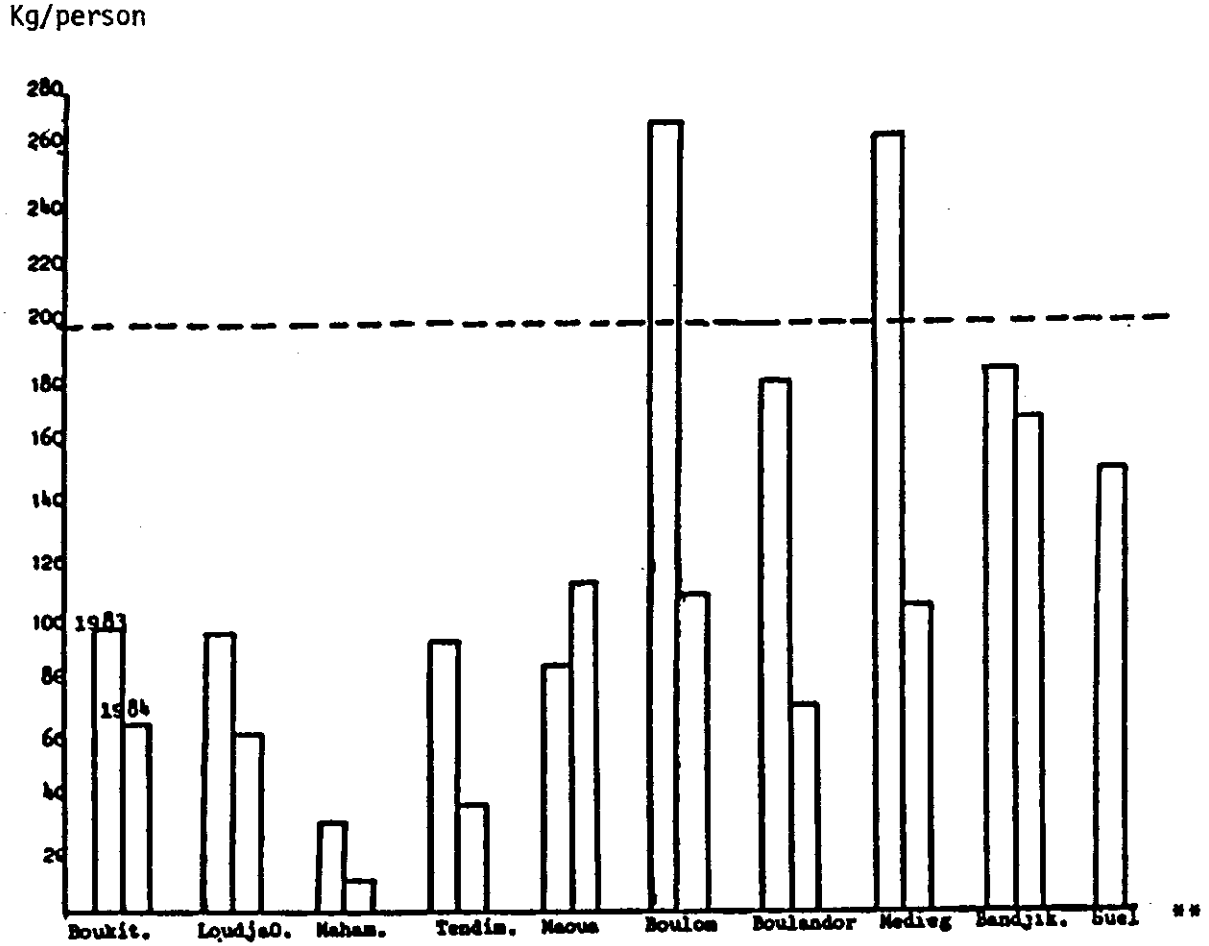
[12]The average absence of migrants is 3.2 months out of 12. In Boulandor, Tendimane and Medieg, one farm family out of two has at least one migrant every year.

[13]This norm represents the quantity required for one consumption unit.

[14]Total average rainfall has fallen from 944 mm in 1982-1983 to 834 mm, with the lowest recorded in Mahamouda (640 mm).

[15]In Bandjikaki, for example, the circumcision ceremony had slowed down the normal calendar of agricultural activities. According to farmers, these ceremonies reduced the expected level of production.

FIGURE 4. CEREAL BALANCE AT THE HOUSEHOLD LEVEL



*In 1983, Boulom farmers carried out seed multiplication of maize under the supervision of PIDAC.

**Not studied in 1983.

rice, little or no production of millet/sorghum and maize (substitutes for rice) and particularly the only efficient in rainy years.[16]

This grouping of territories into two zones--one to the North of the River (Sindian-Kalounayes and Fogny-Combo) with a small production deficit, and the other further Southwest (Oussouye and Blouf) with a large deficit also reflects the difference in resources available at household level. This difference is fundamental since the deficit is small where the population per farm family (and consequently the number of CUs) is higher. It can also be partly attributed to the potentially larger areas given to cereals that result from cultivating with oxen traction.

The estimate of the production deficit in terms of the quantity of cereals produced per CU does not accurately reflect the actual consumption deficit. In addition to using the current production, farmers use their grain reserves or allocate earnings from cash crop sales or non-agricultural activities in order to purchase cereals to cover families' needs. While the distribution and purchase of food and cereals crops are being studied,[17] it is possible to estimate how potential stocks and agricultural and off-farm revenue make up the consumption cereals deficit.

Grain Reserves and Their Duration

Cereal stocks are the quantities of cereals stored before a harvest (1982-1983). The quantities stored varies widely. Average storage of rice is 34.7 kg per farm (CV = 148%).

More than 80% of farm families did not have cereal reserves and none had stored millet, sorghum or maize before the 1983 harvest. The low cereal production in the Lower Casamance in part accounts for this, but these crops

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[16]In a dry year, the households must diversify their agricultural production, engage in off-farm activities, or even change the division of labor.

[17]The sociological studies at ISRA/Djibélor. As an example of such studies, Gastellu (1981) has shown in the case of the Serer of Senegal that male heads of household earn higher cash incomes as compared to women and other family members in lower standing.

are also the first to be consumed since they are the source of food during the "hungry period" before the rice harvest.[18]

The duration of the available stock (current harvest plus previous stock) is also extremely variable. It depends first and foremost on a family's daily cereal consumption rate, which in turn is related to its size (total population) and structure (distribution per age group and sex). Daily household consumption could not be measured but was based on estimates of family needs made by heads of households (table 5).[19] Variations in average rice consumption are related to differences in size of the households. An estimate of the consumption of other cereals was not made.

The duration of the total rice stock, based on a normal and regular consumption pattern,[20] is approximately 6 months. Other cereals last even shorter periods: 27 days for maize; a little more than a month for millet; and 3 to 4 days for sorghum. Only 19% of the households heads estimate that their total available rice stock (production plus storage) could cover more than 10 months' consumption (see table 6).

The only households with some rice stocks, however low, are found in Oussouye, Bandjikaki and Boulandor. Except in the latter villages the Diola production system dominates in these areas; and stocks exist not from higher production, but from traditional practices associated with:

1. The social prestige of having locally produced rice in storage; in order to keep a stock of local rice, households commonly buy rice on the market to meet daily needs
2. The belief that the local Diola rice has a higher nutritional value, and should be stored until reduced at the beginning of agricultural activities, with imported rice consumed prior to this time

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[18]In our sample only 37% of farmers had grown maize and 26% had grown millet/sorghum.

[19]The low coefficients of variation in each size group lend support to the view that these estimates are objective and that farmers' assessment of their family needs is fairly reliable.

[20]That is, not accounting for levels of consumption at particular social events (ceremonies, circumcision feasts, etc.).

TABLE 5

DAILY RICE CONSUMPTION PER FARM

Agricultural Zones	Zones	Average	Minimum	Maximum	Coefficient of Variation (%)	Average Size Total Population
I. Oussouye	Boukitingo	3,421	1.5	5.0	29.9	5.5
	Loudja. Ouolof	2,485	0.5	5.5	72.8	7.5
II. Blouf	Mahamouda	3,100	2.0	5.0	38.6	9.1
	Tendimane	2,298	1.0	6.4	57.4	7.4
III. Niaguis	Maoua	5,900	3.0	12.0	42.6	11.1
	Boulom	3,375	1.5	6.0	48.0	8.1
IV. Sindian-Kalou.	Boulandor	3,568	1.5	7.0	46.6	11.0
	Médieg	5,191	2.0	15.0	48.3	10.7
V. Fogny-Combo	Bandjikaki	4,045	1.5	8.0	48.3	9.1
	Suel	-	-	-	-	7.5
Overall Average[b]		3,331	0.5	15.0	61.5	8.7

[a]Estimated from information provided by heads of family regarding the number of calabashes normally consumed per day.

[b]Calculated from responses of 196 heads of family.

TABLE 6

FREQUENCY DISTRIBUTION OF DURATION OF RICE STOCKS, ESTIMATED BY HOUSEHOLD HEADS (MONTHS)

Number of Months	Frequency	Frequency (%)	Cumulative Frequency
0 to 2	41	20,9	20,9
2 to 4	49	25	45,9
4 to 6	28	14,3	60,2
6 to 8	25	12,8	73
8 to 10	26	13,3	86,3
10 to 12	17	8,7	95
More than 12	10	5,0	100
Total	196	100	

Source: Surveys 1983.

3. The voluntary restriction of consumption as insurance against periods of shortage

In sum, cereals production for the last two years has been insufficient compared to standard food requirements. Stocks accumulated before the current year's harvest are very small and the total rice reserves run out generally before the 7th month, often earlier for other cereals. Most heads of households purchase milled rice for the hungry period, but in some Diola villages, cereals are bought before the stocks run out. In other words, the Lower Casamance farmer is presently a buyer rather than a seller of cereals.[21]

Some Scenarios for Making up the Food Crop Cereal Deficit

To make up the cereal deficit, it is possible to envisage some scenarios regardless of whether or not these can be actually feasible (in terms of access to cash income by family members with different status). Possible scenarios can be designed using the following assumptions:

1) Groundnut revenue can be used to purchase cereals for the hungry period (rice in particular);
2) Purchases can be made at official consumer prices;[22]
3) The residual deficit can also be made up either by using off-farm revenues or by planting cereals according to the potential of the crop system considered.

After examining the deficit situation (see figure 3) two general categories of farm families can be identified: Category A groups the

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[21]In the following section, the main factors influencing cereals demand at the farm level are analyzed in detail. In order to assess farmers' financial resources necessary to make-up their cereal deficit, we converted total cash crop production into monetary terms and estimated off-farm revenue. This exercise is only indicative of the potential financial resources at farmers' disposal for making up any food deficit.

[22]This may seem unrealistic, since some purchases are made at usurious prices. According to our marketing survey, however, most farmers in the Lower Casamance purchase imported rice at official consumer prices. Marketing profit margins are affected by transport costs, state warehouse storage costs, and delivery costs to local centers.

smallholdings in the Oussouye and Blouf areas that have a deficit of more than 120 kg of cereals per CU;[23] Category B represents the smallholdings of Boulom and of the Mandingue villages to the North of the river where the average deficit is low (34 to 40 kg per CU). The three possible strategies are simulated in table 7.

Total groundnut production converted into monetary revenue cannot make up the food deficit in the category A. If all the off-farm revenues were used to purchase cereals, the deficit would only be reduced by one-half (from 636 to 344 kg).[24] If the production of direct seeded rice (dry land and phreatic rice) is considered as a strategy adapted to the production system in these zones, it would be necessary to plant almost one hectare per farm in order to make up the deficit. The situation seems less serious for farm families in Category B: high groundnut yields bring enough revenue to make up the production deficit while leaving a small surplus. Growing millet would only require an additional 0.23 and 0.6 ha of cultivated land to make up the deficit.

In both cases it is necessary to adapt the technical solutions to real opportunities for farm equipment use, agricultural credit available, and the adaptation of technological packages to local farmer conditions.

FARMER DEMAND FOR CEREALS IN LOWER CASAMANCE

Explanatory Factors

Widespread cereals imports in the sub-region[25] can be explained by a deteriorating food crop situation at the village farm-level and the recent high level of urbanization. Most farm families intend to buy rice and, on

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[23]Compared with the standard 200 kg of cereal a year per CU.

[24]Considerable village to village variation must be noted; estimated revenues for example are about 89,520 CFA per farm in Loudia-Ouolof and 39,500 CFA per farm in Boukitingo (Equipe Systemes, 1984).

[25]According to recent statistics, rice imports in the Lower Casamance were 28,623 MT between October 1982 and 1983 (Price Stabilization Board, Casamance Regional Office, Ziguinchor, 1983).

TABLE 7

STRATEGIES FOR ACHIEVING A CEREAL BALANCE AT THE FARM LEVEL

Strategies	Deficit Areas	
	Category A	Category B
1. Use of Groundnut Revenues		
Cereal Production/Farm (kg)[a]	341.4	1248.8
Present Deficit/Farm (kg)[b]	(-) 824.2	(-) 243.2
Average Groundnut Production/Farm (kg)[c]	476	1620
Valued at 50 FCFA/kg	23,800	99,000
Equivalent Rice/Farm (kg)[d]	(+) 198	(+) 675
Cereal Balance (kg)[e]	(-) 626	(+) 432
2. Use of Off-Farm Revenue		
Off-Farm Monetary Revenue/Farm (kg)[f]	57.500	-
Equivalent Rice (FCFA)	(+) 488.3	
Cereal Balance (kg)[g]	(-) 336	
3.	Upland Rice	Maize or Millet
Average Yield (kg/ha)	1010	1040 423
Required Supplement (ha)[h]	0.82	0.23 0.6

[a]Average Production (consumable form) per farm during 1982-1984.

[b]Average Deficit by Consumption Unit (see table 4) multiplied by the average number of CUs/farm over two growing seasons.

[c]Average yields multiplied by average area in groundnuts/farm over two growing seasons.

[d]The cash income from groundnuts is divided by the average consumer price of hulled rice over two growing seasons (120 F/kg).

[e]The difference between the actual deficit and the potential quantity of rice that could be purchased with the cash income from groundnuts.

[f]The average cash income/farm for the 3 zones monitored at Oussouye (Loudia-Ouoloff, Boukitingo, Mahamouda) for 1983-1984.

[g]The difference between the actual deficit (824.2 kg/farm) and the potential quantity of rice that could be purchased with total off-farm income.

[h]Based on average yields during two growing seasons.

the average a farm family buys 360 kg of white rice per year to make up for its food deficit.

Let us first examine the factors which theoretically affect farmers' demand for rice (D_r, the dependent variable). Rice demand was estimated for each farmer, based on the quantity of white rice they said they planned to buy during the rest of the season. The survey was administered just after farmers had sold or were in the process of selling their groundnut harvest.[26] All of them had an idea of their overall agricultural earnings (approximately 70% from groundnut sales) and of the total quantity of cereals at their disposal (current production plus amounts in storage). The quantities given[27] are used to estimate a demand curve that indicates the intent to purchase at a given period (all things being equal). This function is estimated by means of a multiple regression.[28] The main variables affecting D_r are discussed below.

Total Quantity of Rice Available for Consumption During the Year (Q_r)

This is defined as one year's net production plus rice in stock. Production is estimated either by using the yield sampling plot method or by counting bundles produced. Net total production is calculated, (after accounting for possible losses and gifts) and increased by estimates of the previous stock. Total quantity available (Q_r) is assumed to be negatively correlated to the demand for (purchased) rice.

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[26]The analysis is limited to rice, the most consumed cereal in the region. Most heads of households interviewed (86%) stated that they will need to purchase rice before the next harvest to cover their family needs. Only 15, 12 and 10% intend to buy maize, millet and sorghum respectively.

[27]Their answers were related to estimates of daily quantity consumed.

[28]In a regression model, a dependent variable (y) is explained in terms of independent variables $x_1, x_2 \ldots x_n$ with a linear equation of the type $y = a_0 + a_1x_1 + a_2x_2 + \ldots + a_nx_n + e$. The coefficients $a_1, a_2, \ldots a_n$ are determined to minimize variance in the disturbance terms (e). The ratio of each coefficient to its standard deviation indicates the significance of the coefficient. The coefficient of multiple determination (R^2) indicates the proportion of variation in Y explained by all the independent variables. The F test helps to confirm the nonnullity of the regression coefficients.

Other Available Cereals (Q_a)

During shortages of maize, millet and sorghum can be substituted for rice (the normal substitute for maize). The quantities available are calculated using the same procedures as for rice and then added to the total net production. In some Diola villages and in many Mandingue villages, too, these cereals are consumed regularly for breakfast and dinner (SONED, 1979). Thus, there should be a negative correlation between the quantity of white rice required and the availability of other cereals. The coefficient of multiple determination (R^2) indicates the proportion of variation in Y explained by all the independent variables; the F test helps to confirm the nonnullity of the regression coefficients.

Rice Acquisition Price (P_r)

This is an adjusted price at which farmers bought the rice on the market during the off-season of 1983. P_r is linked to the official price as follows:

$P_r = P_a + P_t + C$ in which P_t represents the unit price per kilo of transport a time from the shop to the village and C the opportunity cost of transport to the sales point.

Since the official price (P_a) is constant, $P_c + C$ varies and affects the demand for white rice demanded (negative correlation).[29] Since the value of C is difficult to estimate, we treat it as negligible during the off-season.[30] Thus, distance and transport costs (P_t) account almost entirely for the variation in the quantity demanded. P_r was estimated by asking the farmers the transport cost of one bag of purchased rice; the price per kilo was calculated on this basis and added to the official price (P_a).

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[29]There are slight variations in the official price according to the location of the sales points and the official margin established to cover the transport costs, but they have not been taken into account.

[30]The opportunity cost of transport can be relatively low at the end of the season, assuming that the farmer has few alternative occupations.

Total Revenue and Cash Income from Groundnut Sales (R_t and R_a)

These revenues are positively correlated to the quantity of rice demanded. Revenue from groundnut sales is estimated from sales to the cooperative during 1983. Total revenue includes groundnut revenue and earnings from sales of other products, as well as from off-farm activities. The data were collected during a cost-route survey of a sample of farms in Oussouye and from farmers' estimates in other villages.

Daily Consumption (C_j)

This is the quantity regularly consumed by members of a farm family, except for unusual circumstances (feasts, parties and occasional visitors, etc.).[31] This the most important factor affecting the quantity of rice to be purchased (D_r) in order to make up for production deficits. A high correlation between these two variables is expected.

Demand Model and Interpretations[32]

Since the size of farm families varies considerably, the rice demand per head is estimated. Theoretically, this relation is given by the following equation with the expected signs of coefficients:

$D_r = a_0 - a_1Q_r - a_2Q_a - a_3P_r + a_4R_t + a_5C_j + e$ in which: a_0 is the intercept value,

R_d = the quantity of milled rice (kg per capita) that the family purchases to make up the deficit during the production year 1982-1983 (see above for the method used to estimate Dr).

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[31] Farmers were asked how many calabashes of rice were used for regular daily meals. These were weighed on the researcher's visits to find objectively the average quantity.

[32] Commonly, historical data (quantities actually bought by consumers) are used to estimate a demand model. In this study, data are from a one-shot survey of farmers' projections of purchases.

Q_r = The quantity of milled rice available (kg per capita) in 1982-1983; a coefficient of 0.65 is used to convert paddy rice into milled rice.

Q_a = The quantity of other cereals (millet, maize, sorghum) available in kg per capita during the production year 1982-1983, with a coefficient of 0.85 to account for the transformation into a directly consumable form.

P_r = Adjusted price for a kilo of milled rice in FCFA (official price plus transport costs) charged in Casamance during the 1982-1983 production year.

R_t = Per capita revenue in 1982-1983 (in FCFA) including the revenue from groundnut sales.

R_a = Average revenue (in FCFA) from groundnut sales per capita in 1982-1983.

C_j = Quantity consumed per capita per day (in grams).

Statistical Results

Several functional forms are tried. The semi-logarithmic form is satisfactory because of the conformity of the expected signs and the quality of linear estimators (without bias). The following equation was estimated:

$$\text{Log } D_r = 1.8842 - 0.00723P_r - 0.0074Q_r + 0.00154C_j - 0.0003Q_a + 0.00001R_t$$

$$t = \quad (-7.86)^* \quad (-0.75) \quad (4.59)^* \quad (0.40) \quad (1.32)$$

$$F = (5,183) = 21.8$$

$$R^2 = 0.374$$

We notice that for a 95% confidence interval (i.e., at 5% of level significance) only the coefficients of the acquisition price P_r and the daily consumption C_j are significantly different from zero. The coefficient for total revenue R_t is only significant at the 20% level. Coefficients for the quantity of rice available (Q_r) and other cereals (Q_a) are not significant. The coefficient signs are as expected. In order to forecast, the variables R_t, Q_r and Q_a in the model should be retained because of their contribution to the economic explanation of the rice demand at the farmer level.

All the coefficient are significantly different from zero ($F = 21.8$; d.f. = 5;183). The goodness of the fit is expressed by the value of the coefficient of determination (R^2). This indicates that 37.4% of the variations in the quantities of milled rice required can be attributed to the variations of the independent variables Q_r, Q_a, P_r, C_j and R_t.

Farm-level demand for rice is determined by the annual rice price, the daily per capita consumption, the quantity of rice available per capita per farm family, the per capita availability of other cereals, and the total revenue per capita. The price elasticity of demand was estimated using a semi-logarithmic function.[33] Its value is -0.886. This implies that a 10% price increase would lead to a nearly 9% reduction in the quantity of rice demanded.[34] The difference between our estimate and others' can be attributed to: (1) the difference in the specification of the model; 2) the working hypotheses we used; (3) the inclusion of transport costs in the model as an integral part of the price of a kilo of rice; and, (4) the fact that the sample we used was that of farmers, who already produce part of their rice needs, and not consumers.

The total revenue per capita Rt positively affects the quantity of rice demanded. The income elasticity is very low, around 0.1, which implies that a 10% increase in per capita revenue would result in a 1% increase in milled rice purchases. Ross' income elasticity estimate is 1.3, which is very high for a cereal product. His study, however, was conducted on a sample of urban consumers, where a wide range of food substitutes exists. Our low estimate is undoubtedly due to the fact that the study was done in a rural setting, where rice is the staple diet. We have already mentioned that farmers spend an average of 67% of their groundnut revenue on rice purchases.

Milled rice demand by smallholders must be considered as a "residual" demand to distinguish it from conventional demand, since what is demanded, is the quantity of rice necessary to make up the annual deficit. For this

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[33]Log. y = a +bx in which by is the slope and bx the elasticity.

[34]Ross (1979) found a price elasticity coefficient of -0.85 for the Casamance. Jabara (1979) estimated this coefficient for rice at -0.745 for Senegal as a whole.

reason, this quantity (D_r) varies inversely with the quantity of rice (Q_r) and other cereals (Q_a) available to the household. These two variables, however, do not significantly affect the demand of milled rice. The variation of other factors such as the daily consumption rate and the price of rice significantly influences the quantities demanded.

The model was based on a one shot survey (cross-section analysis) for the growing season ending in June 1983. Cereal production for this year was low compared to the previous year. The estimated coefficients would have been slightly different during a year with above average rainfall. The value of the coefficient of determination (R^2), however, and particularly the F value, are within reasonable limits given the specification of the model.

SUMMARY AND CONCLUSIONS

Despite the forecasts of the latest development plans for the Casamance to attain food self-sufficiency in 1985, cereal production in the region over the last 10 years has not increased. Production fluctuations largely follow the annual rainfall variation. Maize is the only cereal that shows a sustained growth (19% per year) between 1970 and 1982.

The decline in cereal production since 1978 can be explained by climatic factors, the economic situation and the absence of technical improvements in rice and other cereal production. The government subsidies and agricultural credit, and the absence of increased cultivation on upland areas requiring less water (Sall, et. al., 1983) also play a role.

One of the consequences of the production drop is the gradual disappearance of farm-level cereal reserves. During the 1983 off-season, these reserves were about 35 kg of rice per smallholder. There was no stock of millet, sorghum or maize. We have shown that if the farmer and his family consume a regular amount daily, the rice supply will be finished six months after the harvest. Other cereals last less than one month.

Farmers, however, often buy and consume imported rice, before their own harvest is depleted, with the cash revenue from groundnut sales. If there is no cereals shortage in the local market, personal rice stocks are kept until the following rainy season. On the average a smallholder buys 360 kg

of white rice per year to cover the household food requirements. That is, the Lower Casamance farmer is a purchaser of cereals.

The government should take more interest in those factors that influence the demand for imported rice and the quantities purchased at the smallholder level. A farmer's purchasing power depends on the retail price of rice which varies according to the transport cost. It does not depend on the official consumer price, which remains relatively stable throughout the region.[35] Consequently, if deliveries are reliable and buying centers close and accessible to the farmers, they will have little incentive to produce rice beyond their current needs. Even additional investment (labor time and production costs), made necessary by the adoption of more efficient farming techniques, is weighed against the possibility of using other sources of revenue for white rice purchases.

Farmers with rice, millet, sorghum or maize reserves are less inclined to buy large quantities of milled rice. Since it is the first crop harvested, maize plays a very important role during the hungry period, followed by millet and sorghum (harvested from October to November) and consumed regularly in the morning and the evening.

In villages where millet, sorghum and maize are not widely cultivated, the farmer usually has a cereal deficit. Thus, in the Oussouye region this deficit is around 120 kg of cereals per head, i.e., only 80 kg per head are available as compared with the 200 kg per head norm determined by FAO. Total area planted is also smaller here, since plowing is manual (1 to 2 ha per smallholding compared to 4 to 6 ha in the Sindian-Kalounayes and Fogny-Combo zones). Labor productivity and total revenue per farm are also low. Although income is positively correlated to the quantity of milled rice demanded, its real impact is negligible (income elasticity of -0.1).

It is useful to explore the quantitative importance of milled rice purchases. The average amount purchased, 360 kg per farm, represents about 67% of the cash income from groundnut sales. Since the production and marketing of groundnuts is a substantial source of income for the farmer, it should be perceived as an integral part of a farmer's food self-sufficiency

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[35]See also Craven, (1982) who states that the transport cost considerably affects the farmers' evaluation of the price of imported rice compared with production costs.

strategy. Two-thirds of this income leave the region and the country (as more imported rice is purchased), thereby reducing the country's foreign exchange reserves. Furthermore if we assume that the total revenue from groundnuts could be used to buy cereals, it is still insufficient to make up the farmer's food deficit (even if rice is valued at official consumer prices).

Farmers use several strategies to make up this deficit: off-farm activities (gathering, palm oil and wine-tapping, fishing, hunting) and vegetable production in the off-season to obtain additional income.

In view of the drought, research and development policy adopted a new orientation. Agricultural research in Lower Casamance has long been concentrated on the selection of rice varieties that are drought-resistant and moderately tolerant to salinity. The experimentation with more efficient farming techniques must continue. In view of the encouraging results of the off-farm trials program of the Production Systems Research Team, millet, sorghum and maize must also be tested in regions South of the river and West of Ziguinchor. To assess the contribution of off-farm activities and revenues, a systems approach must be used to define actions aimed at encouraging farmers to invest part of these revenues in cereal crop productivity improvements.

The salt-water intrusion dams and the costly hydro-agricultural schemes in place are concrete proof of the government strategy to make production more secure in face of climatic risks. Their impact has not yet been felt; and one year before the end of the VIth Plan (1985) food self-sufficiency is far from being achieved. Should animal traction or motorized farming be promoted everywhere in the region?

Since groundnut cultivation is seen as part of a subsistence strategy for a large number of farmers, should agricultural production be diversified in support of their own efforts? Our answer is affirmative and particular attention must be given to maize, which at present plays the important role as the hungry period food. Diversification is now indispensable in zones where transplanted rice has long been the main crop.

APPENDIX 1

EVOLUTION OF CEREAL PRODUCTION AND THE CONTRIBUTION OF THE CASAMANCE AND THE LOWER CASAMANCE TO NATIONAL PRODUCTION ('000 MT)

	Years													
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Lower Casamance	55.7	54.2	22.9	36.7	78.5	61.7	59.1	33.3	77.6	46.9	21.2	59.0	55.7	15.8
Casamance Region	190.1	193.1	115.2	145.8	212.8	223.7	176.7	122.7	209.3	173.7	109.7	195.2	179.4	67.8
National Production	528.8	728.5	380.1	609.6	964.1	791.4	677.0	516.1	1007.8	655.3	643.4	1207.9	762.5	-
Comparison Lower Casa./Casa. (%)	29.2	28.0	17.9	25.1	36.8	27.6	33.5	27.2	34.6	27.0	19.3	30.2	31.0	23.3
Comparison Lower Casa./Nat. Prod. (%)	10.5	7.4	6.0	6.0	8.1	7.8	8.7	6.4	7.2	7.2	3.3	4.8	7.3	-
Comparison Casa./ Nat. Prod. ((%)	35.9	30.3	23.9	22.0	26.8	26.1	23.7	20.7	20.7	26.5	17.0	16.2	23.5	-

Source: Annual Reports of the Regional Agriculture Office (Ziguinchor) MDR/DGPA, DEEP (SOMIVAC, 1983).

APPENDIX 2

ANNUAL RICE PRODUCTION IN THE CASAMANCE AND THE LOWER CASAMANCE AND CONTRIBUTION TO NATIONAL PRODUCTION ('000 MT)

	Years													
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Lower Casamance	35.4	31.9	8.0	13.3	42.5	50.5	45.2	19.7	53.8	24.9	5.3	38.6	34.8	6.3
Casamance	69.5	82.1	28.3	45.7	86.4	97.4	80.6	41.8	108.4	70.9	26.1	76.7	64.2	18.3
Total Senegal	93.5	108.2	37.9	65.6	120.6	130.5	126.4	62.9	146.4	112.7	59.2	127.0	95.0	-
Comparison Lower Casa./Casamance	50.9	38.8	28.2	29.1	49.2	51.8	56.1	47.5	49.6	35.2	20.3	50.3	54.3	34.4
Comparison Lower Casa./Nat. Prod. (%)	37.8	29.6	21.0	20.3	35.3	38.6	35.7	31.3	37.7	22.1	8.9	30.4	36.7	-
Comparison Casa./ Nat. Prod. ((%)	74.3	75.8	74.6	69.7	71.6	74.6	70.2	54.2	74.0	62.0	44.1	60.4	67.5	-

Source: Annual Reports of the Regional Agriculture Office (Ziguinchor); the MDR/DGPA, DEEP (SOMIVAC, 1983).

APPENDIX 3

MAIZE PRODUCTION (1970-1982) AND CONTRIBUTION OF THE CASAMANCE AND LOWER CASAMANCE TO NATIONAL PRODUCTION ('000 MT)

	Years												
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Lower Casamance	1.7	4.1	1.04	3.2	5.7	0.49	0.85	0.86	1.4	1.9	3.7	5.0	5.9
Casamance	18.4	16.2	9.7	13.9	16.4	14.9	19.3	11.1	19.1	23.2	21.9	23.6	24.8
Senegal	33.0	37.6	20.2	33.8	43.3	44.5	43.4	33.1	59.4	46.5	53.2	94.8	82.2
Comparison Lower Casamance (%)	9.3	25.4	10.6	22.9	35.1	3.3	4.4	7.8	7.4	8.6	17.0	21.4	24.0
Comparison Lower Casamance/Senegal (%)	5.2	10.9	5.1	9.4	13.3	1.1	2.0	2.6	2.4	4.3	7.0	5.3	7.2
Comparison Casamance/ Senegal (%)	55.8	43.2	48.1	41.1	37.9	35.5	44.6	34.4	32.1	49.9	41.1	24.9	30.1

Source: Regional Agriculture Office (Ziguinchor); MDR/DGPA, 1983.

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