# Evaluation of the Rice Production Project in Guinea-Bissau



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## GLOSSARY OF ACRONYMS AND TERMS

| | | |
|---|---|---|
| AIP | - | AID Accelerated Impact Project |
| *bas-fond* | - | French for low land |
| *bolanha* | - | Portuguese for a crop production area |
| DAI | - | Development Alternatives, Inc. |
| *daba* | - | Portuguese for short-handled hoe |
| DEPA | - | Department of Agricultural Research and Experimentation |
| FAO | - | Food and Agriculture Organization (United Nations) |
| GOGB | - | Government of Guinea-Bissau |
| IRRI | - | International Rice Research Institute |
| PG | - | Guinean currency |
| PIO | - | Project Implementation Order |
| REDSO/WAAC | - | AID's Regional Economic Development Support Office/West Africa Accounting Center |
| REDSO/WCA | - | AID's Regional Economic Development Support Office/West Central Africa |
| RTL | - | returns to labor |
| *tabanca* | - | Portuguese for village |
| tons | - | metric tons |
| WARDA | - | West Africa Rice Development Agency |

# CHAPTER ONE

## SUMMARY

## ACHIEVEMENT OF OUTPUTS

1. The principal development innovation tested was the use of tractors to construct contour dikes. This technology can have immediate and obvious impact on increasing rice production in *bas-fonds*. However, insufficient data are available to determine whether contour diking is sustainable or viable from economic and sociological perspectives.

2. Other water management techniques, such as animal traction to create contour dikes, labor-intensive contour diking, construction of catchments, and use of low-lift pumps utilizing surface water for rice production, were not sufficiently tested. Therefore, the implications of using these techniques cannot be determined.

3. No scientifically based agronomic packages were developed to extend to the farmers.

4. There is serious doubt about the sustainability of the Credit Unit with the departure of the team from Aurora Associates, Inc.

5. The Hydrology Unit is well established, and if adequate financial support is forthcoming from the GOGB for operational costs, this unit can continue to function beyond the departure of the Aurora Team.

6. The Extension Unit will have a difficult time surviving the departure of the Aurora Team given the lack of financial support it receives from the Government of Guinea-Bissau (GOGB).

## AGRICULTURAL INPUTS

1. Current macroeconomic policies make implementation of an agricultural input provision program extremely difficult. The Aurora Team was justified in moving the project's agricultural supply system away from credit and toward reliance on cash sales. Until the GOGB eliminates or drastically reduces the subsidies on agricultural inputs, it will be difficult to institutionalize a self-sustaining input supply system.

2. The availability of agricultural inputs was a major feature attracting farmers to participate in the Rice Production Project.

## TECHNICAL ASSISTANCE/THE AURORA TEAM

The Aurora Team performed in a highly satisfactory fashion. However, its effectiveness was severely constrained by the difficult working environment, the lack of support from USAID/Bissau, the short time horizon in which it was directed to achieve heroic institutional objectives, and the lack of short-term technical resources to support the project.

## THE ECONOMIC SETTING

The GOGB is attempting to introduce wide-ranging modifications in economic policy in an effort to correct market distortions and encourage agricultural production. Some increases in cereals production have already been obtained. Increased supplies of agricultural commodities and consumer goods have begun to appear on the market. It is hoped that the far reaching changes now being negotiated will have an even greater effect in the long run. There is reason for cautious optimism concerning the economic setting for project implementation. It is critical for AID to pursue a policy dialogue aimed at building a better environment for development activities. The GOGB wants U.S. government development assistance and is prepared to take the steps necessary to obtain it.

## RECOMMENDED FUTURE COURSE OF ACTION

The team recommends a bridge activity that would have Aurora Associates, Inc. continue for approximately 12 months to help consolidate the modest institutional gains to date. A follow-on agricultural project is recommended that would support the farming system of the Sahelian farmer in Zone II. This evaluation presents a set of lessons learned during project implementation that should guide the design of any follow-on activity.

## CHAPTER TWO

## SCOPE OF EVALUATION

The terms of the evaluation, according to the Scope of Work prepared by the U.S. Agency for International Development mission to Guinea-Bissau, stated that the team was "to determine what additional actions are needed to attain the project purpose and what actions are required to sustain positive results of the project to date." The Evaluation Team interpreted this to mean that USAID/Bissau was essentially concerned with having the Evaluation Team review the status of accomplishment of the specified outputs of the Rice Production Project and present specific recommendations to move the project in the direction of achieving its specifically stated purpose:

> To increase food production and farm income of about 1,200 small farm families in the Geba River Basin of Guinea-Bissau, and to develop the institutional, experience and information bases which may enable the farming systems developed in the project to spread beyond the immediate beneficiary universe and be replicated elsewhere. (Guinea-Bissau Rice Production Project Paper, Annex B, Logical Framework.)

Because of a positive trend in the economic environment of Guinea-Bissau, the Team was encouraged by the U.S. Ambassador and the Acting USAID/Bissau Representative to broaden the scope of work to include assessing the development environment within which the project was being implemented. The Ambassador's mandate was underscored by the the Government of Guinea-Bissau (GOGB) announcing on May 4, 1987, the same day the Evaluation Team arrived in Bissau, the devaluation of the Guinean peso (PG) by 145 percent in a move aimed at restructuring the economy. Additionally, the Evaluation Team was able to attend the GOGB-sponsored Agricultural and Fisheries Sector Consultations held during the first week in May, which signaled once again an improving environment for development activity. In the wake of these significant events, being on the spot provided the Evaluation Team a better understanding not only of the economy in general but also of the state of the agricultural sector in particular and of the role of the donor community in that sector.

In the absence of documents to describe the context for the Rice Production Project, and because of the numerous changes that were taking place in Guinea-Bissau, the Evaluation Team developed "Chapter Five: Background," which describes the economic, agricultural, and institutional settings. · It is hoped that this material will be useful to USAID/Bissau as it conducts a review of its country development strategy.

# CHAPTER THREE

# COMPOSITION OF THE EVALUATION TEAM

## DEVELOPMENT ALTERNATIVES, INC. (DAI)

**Lawrence C. Heilman - Evaluation Team Leader**

Ph.D. in History and Anthropology with concentration in Development Studies; Consultant to Agency for International Development for assisting in the designing and instructing of its Project Design Courses; Foreign Service Officer with AID for 19 years.

**L. Dale Haws - Agronomist**

Ph.D. in Entomology and Agronomy, Cornell University; Full Professor at the University of Tennessee Institute of Agriculture; Head of the Applied Research and Training Department at International Rice Research Institute, Los Baños, Philippines, for 13 years; nine years residential experience in international development work including university development programs in Afghanistan, Egypt, and India.

**Christopher R. Pardy - Agricultural Economist**

M.S., Agricultural Economics, Texas A&M, 1983; Analysis of Grain Marketing Behavior by Farm Households in Burkina Faso for University of Wisconsin; Farming System Economist, Burkina Faso, Purdue University, AID Contract.

## USAID/BISSAU

**Eve L. Crowley - Anthropologist**

M.Phil., Yale University, 1984 in Anthropology with concentration in African Studies; Ph.D. fieldwork (1986-1987) in Cacheu Region, Guinea-Bissau, funded by a Fulbright Grant, a Wenner Gren Grant, and Yale University.

## APPROACH

The evaluation was conducted using the three elements: documentation, site visits, and interviews.

### Document Review

AID project documentation was reviewed including the Project Paper and the Supplement to that document, Project Implementation Orders (PIOs) pertaining to commodities and participant training, and the 1984 Evaluation Report prepared by REDSO/WCA. Beyond that, little documentation in AID/Washington or USAID/Bissau was available to the Evaluation Team. The lack of Project Implementation Letters, implementation plans, and project reports made it difficult for the Evaluation Team to measure the role of USAID/Bissau in monitoring the Rice Production Project.

The Aurora Technical Assistance Team provided the Evaluation Team with a complete set of monthly, quarterly, and annual reports. The Evaluation Team was unable to review any GOGB documentation.

### Site Visits

The Evaluation Team visited the Geba River Valley including project sites in that area and DEPA offices at the Contuboel Center. GOGB personnel at the Contuboel Center and the Aurora Technical Assistance Team were always available to accompany the Evaluation Team to project sites and explain ongoing project activity.

### Interviews

A critical part of the evaluation was the many verbal exchanges that the Evaluation Team had with GOGB personnel working at the Contuboel Center, ranging from draftsmen working in the Hydrology Unit to the Head of DEPA itself, Carlos de Silva. The Aurora Technical Assistance Team was always available to the Evaluation Team, and their openness and candor were critical to the Evaluation Team's understanding of this project.

Several interviews were held in the *tabanca* setting with the entire range of personalities that make up the Sahelian farm family in Zone II. The U.S. Ambassador to Guinea-Bissau and his Political/Economic Officer also provided the Evaluation Team with valuable insights about the situation in Guinea-Bissau. The Program/ Evaluation Officer and the Participant Training Officer, neither of whom had a direct relationship to the project, provided the Evaluation Team with an overview of the project from their own perspectives. Unfortunately, there were no direct-hire USAID employees at the time of the evaluation who had direct first-hand experience with the Rice Production Project. This was due to the recent departure of the Agricultural Development Officer and the USAID/Bissau Representative.

## SUMMARY

The Evaluation Team used standard, accepted methodology. The documentation review, plus site visits and interviews, all conducted in a systematic way as dictated by the outline developed by the Team Leader, resulted in the production of the Evaluation Report. The only new element is the economic and social overview provided in Chapter Five. The influence of external forces on project activities was so important that team members felt that they had to establish the context in which implementation took place. The excellent scope of work prepared by USAID/Bissau was the key document in guiding the Evaluation Team Leader.

# CHAPTER FIVE

# BACKGROUND

## ECONOMIC SETTING

### Economic Background

The macroeconomic environment for project implementation in Guinea-Bissau is in flux. Recent actions by the GOGB indicate movement toward phasing in a comprehensive program of economic restructuring under the direction of the World Bank and the International Monetary Fund. The basic characteristics of this program include a decrease or elimination of controls on both input and producer prices, decreased government expenditures, a liberation of private trading, and realignment of the PG to accurately reflect its value in world currency markets. To understand the elements of this restructuring program, a brief historical background is helpful.

In 1974 Guinea-Bissau attained independence from the Portuguese after a protracted period of armed conflict. The consequences of this conflict have had considerable impact on the economic life of the country. At independence in 1974, approximately 70 percent of agricultural land had been abandoned, and one-fifth of the population had been displaced. Many irrigation structures necessary for the cultivation of rice, the country's principal cereal grain, had been destroyed or damaged. In addition, the transportation system had been poorly developed. After independence, the government instituted a policy designed to regulate most aspects of the economy, especially those relating to food and agricultural inputs. This policy was characterized by subsidization of both food prices for consumers and input prices for farmers. Government structures were instituted for the purchase of food products to regulate both the internal provision of food and the export of agricultural products. The exchange rate for the PG was maintained at a higher-than-market level to facilitate importation of commodities from abroad. As a way of collecting revenue, the state tried to control the import and export trade. These factors, coupled with mismanagement, led to the proliferation of a parallel foreign exchange market, a lack of consumer goods in the country, and an inability to provide the inputs necessary for agricultural development.

Sale prices of food and producer prices for agricultural commodities were maintained at low levels. This resulted in difficulties in providing goods by the state-run marketing organization. For example, the Food and Agriculture Organization (FAO) has estimated that in 1980 the quantity of rice purchased by the state trading agencies was no greater than 7 percent of production. The lack of investment in agriculture, as well as the dearth of both agricultural inputs and consumer items, led to a decline in agricultural productivity. Although Guinea-Bissau produced 174,571 tons of paddy rice in 1960, by 1982 production had dropped to 95,000 tons. Droughts in the late 1970s and early 1980s exacerbated the production problems. In addition to decreasing agricultural productivity, Guinean agricultural and macroeconomic policies resulted in large cross-border trade of agricultural commodities. Estimates of this trade range from 5-40 percent of total production among those rural zones where surpluses occur.

Prior to 1983 the government expanded the civil service, increased imports of food and consumer items, and invested in generally unproductive areas. One example of its investment in unproductive areas is the Cumere agro-industrial complex, which needed to process 50,000 tons of rice and 70,000 tons of groundnuts annually to be profitable. However, this state-inspired enterprise has never gone into operation. Because economic growth did not keep pace with public and private consumption, the import bill increased and was not offset by an increase in exports. Government policies eventually led to an increased dependence on foreign aid. The World Bank has estimated that external assistance was equal to approximately 50 percent of the gross domestic product from 1982 to 1985. By 1986 foreign sources accounted for over 90 percent of total GOGB investments.

**Economic Restructuring**

In 1983 the GOGB began an economic adjustment program that included the improvement of agricultural incentives. This strategy put greater emphasis on agricultural productivity and market mechanisms than had been the case in the past. Producer prices for various crops were increased by 53-92 percent in 1984. In 1985 increases were approximately 63-66 percent. Despite the large increases, however, the producer price for rice in 1985 was only 75 percent of the world market price.

With regard to investment, the government began increasing spending in the rural development and fishing sectors. In 1985 public investment in these areas was more than twice as large as in 1979. Concerning trade, the PG was devalued by approximately 50 percent, and weekly devaluations were introduced. An increasing inflation rate, however, kept the disparity between the parallel and official exchange rate at approximately three to one. In addition no real commitment was made toward decreasing the size of the civil service.

The effect of these adjustments, combined with recovery from the 1983 drought, contributed to improvements in agricultural output in general and for rice in particular. Between 1980 and 1981, the average production for all cereal grains was estimated at 93,500 tons with production of paddy rice at 61,000 tons. By 1985 total cereal production had almost doubled to 180,000 tons of which rice accounted for 115,000 tons.

Although some positive results came from the actions taken in between 1983 and 1985, their effects were mitigated by expansionary fiscal policy, lower-than-expected disbursement of foreign financing, decreased official exports, and growing interest payments on external debt. At the end of 1985, the economy was at a critical stage. Cost/price distortions still existed, substantial amounts of external arrears had accumulated, and large imbalances existed in the fiscal and external areas. At that time it was difficult for the GOGB to obtain financing even for essential imports.

**Recent Developments**

The GOGB is instituting a more far-ranging policy of economic restructuring. In late 1986 a major reform of the pricing and marketing system was announced. Most prices were allowed to be freely determined, and rice prices were allowed to increase. Impediments to participation by the private sector in trade were reduced.

Talks between the government and the World Bank relative to the country's first structural adjustment program loan have continued. The adjustment program to cover 1987-1988 is likely to address the following areas:

- Institution of a restrictive monetary policy designed to reduce inflation;
- Correction of the severe over-valuation of the PG to encourage exports and limit imports;
- Increased revenues through modifications in the taxation system;
- Decreased expenditures on the public sector to reduce the current deficit;
- Broadening and intensifying the incentive reforms initiated since 1983 by ensuring attractive prices to farmers;
- Elimination of price controls on all but the most basic consumer goods and elimination of the existing subsidies on fertilizer and insecticides;
- Encouragement of domestic investment through the adoption of positive real interest rates in the financial sector;
- Establishment of a conservative external borrowing policy; and
- Negotiation with creditors with the hope of reducing debt-servicing costs.

As of May 1987, approval for the structural adjustment program had not been given by the World Bank, but is expected. In the interim the GOGB has announced substantial changes in its economic policies. On May 3 the PG was devalued to its parallel market rate, approximately 650 to the U.S. dollar. This 145 percent devaluation was the largest to date, and the World Bank has recommended frequent future adjustments in the exchange rate. In addition to the PG devaluation, prices of gasoline and diesel fuel increased by approximately three times while electricity prices went up four times. These measures are aimed at encouraging austerity, stabilizing prices, and controlling the smuggling of fuel out of the country.

With regard to the fiscal side, new taxes and duties have been imposed on gasoline, beer, and liquor amounting to 10, 85, and 40 percent, respectively. In the area of trade, a 50 percent export tax has been placed on cashew exports to earn revenues. Export rules on other products have been abolished.

With regard to the civil service, the policies announced on May 3 included setting the retirement age at 60 with the possibility of retirement at age 50 or after 15 years of service. Salaries were also raised for government workers with those at the lowest end of the salary scale receiving a 32 percent increase. Those workers at the highest end of the salary scale received a 15 percent increase.

**Summary**

The economic setting in Guinea-Bissau is changing. The government is attempting to introduce wide-ranging modifications in economic policy in an effort to correct distortions and redirect the terms of trade to emphasize agricultural production. Some results in increased cereals production have already been obtained. Increased supplies of agricultural commodities and consumer goods have begun to appear on the market. It is hoped that the far-reaching changes being negotiated will have an even greater effect. There is reason for cautious optimism concerning the economic setting for project implementation.

## AGRICULTURAL SETTING

### General Agricultural Situation

Guinea-Bissau has a climate that varies from a Guinean-maritime type in the coastal area to a Sudanese type in the interior. The average yearly rainfall ranges from over 2,600 mm in the south to 1,200 mm in the north with 70 percent of total rainfall occurring between July and September. Most soils in Guinea-Bissau are ferro-soils, sandy-clay in texture, and sufficiently deep to allow the cultivation of annual and perennial crops. From the viewpoint of land capability, about 30 percent of the total area, or 990,000 hectares, is suitable for rainfed or irrigated agriculture without crop limitations; parts of the mangrove area, approximately 175,000 hectares, are suitable only for rice cultivation.

According to a 1976 survey, about 445,000 hectares were under cultivation or fallow. Additionally, there were some 80,000 hectares of thin forest mixed with oil palms in which some shifting cultivation took place. It is estimated that of those 525,000 hectares, about 300,000 hectares were actually under cultivation in 1976. There were about 2.3 million hectares under forest of which 1.3 million hectares were second growth forests. Some 200,000 hectares were estimated to be under natural oil palms, and about 380,000 hectares were estimated to be covered with mangroves in the coastal areas.

In 1976 the average farm size was approximately 3.1 hectares of arable land. About 42 percent of all farmers had less than 2 hectares of land at their disposal for cultivation. About 25 percent of the farm land was usually in fallow. The land is generally divided into various plots, following the country's complex cropping pattern, which is influenced by both ethnic tradition and the region's potential. In general farmers divide their activities among three of four crops planted in different areas around or near the village. Normally farmers have a plot of land (*bolanha*) to plant flooded brackish or fresh water rice; another *bolanha* for rotated rainfed crops including groundnuts, rice, sorghum, and millet; and a field immediately adjacent to the house to grow complementary foodstuffs such as manioc and maize. The farmer may also have a piece of land under natural oil palm to produce palm wine and oil.

With the exception of some farmers in the northwestern part of the country who use bullock-drawn plows for land preparation of groundnut and cotton fields, most farmers carry out their agricultural activities with traditional hand tools. Farmers normally use their own seed and, with very few exceptions, no inorganic fertilizers.

Between 1976 and 1980 agricultural production declined by about 60 percent, largely as a result of drought conditions in 1977 and 1979. Thereafter, improved weather conditions and price incentives contributed to increased production, and by 1985, 180,000 tons of cereals were produced. Rice production also rose from its 1980 level of 42,000 tons and reached 115,000 tons in 1985. As a result of these production increases, the GOGB estimated that in 1985 the country was 87 percent self-sufficient in food grains. Recent macroeconomic policy changes hold promise for an even more improved food self-sufficiency picture.

Table 1
Cereal Production and Self-Sufficiency

(000 tons)

| Production | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 |
|---|---|---|---|---|---|---|
| Rice | 42 | 80 | 95 | 85 | 105 | 115 |
| Other Cereals | 25 | 40 | 46 | 47 | 60 | 65 |
| Total | 67 | 120 | 141 | 132 | 165 | 180 |

## Soils

In Guinea-Bissau, soils are generally poor in some major elements needed to grow crops. Phosphorus is very deficient in these soils, especially for all non-paddy crops. Only the soils in the Geba and Jabicunda sites in the project area seemed adequate for rice as well as for other less demanding, low-yield crops. Phosphorus fertilization on a regular basis is an essential part of annual soils management practices. Paddy rice may respond to phosphorus fertilization to a smaller extent than other crops as phosphate is not soluble in water-logged conditions. In these soils additional nitrogen is needed for all crops. Most of the soils in Guinea-Bissau will probably release only 35-55 kg of nitrogen per crop season. Most crops need two to three times that amount. Corn needs even more. Large losses by denitrification will occur with paddy rice. Potassium is deficient.

## Rainfall

Since the majority of crops in Guinea-Bissau are grown under rainfed conditions, it is vital that every effort be made to determine rainfall probabilities. In the project area only three years of rainfall data are available (see Table 2, Rainfall Patterns for Contuboel, 1984-1986), and no definitive statements can be made. However, looking at the rainfall pattern, it is evident that the rain does not start or end at the same time every year. Also, the ending of the rain is abrupt and can result in crop losses. Farmers know the unpredictability of rain and the severe consequences when rains are less than normal. Every effort should be made to eliminate the risk involved in rainfed agriculture by introducing water control and conservation measures. Farmers in Africa usually attempt to reduce this risk by using several small plots that are planted at different times. This has its disadvantages, but in most years it will avert a catastrophe.

Table 2
Rainfall Patterns for Contuboel, 1984-1986

| | 1984 | 1985 | 1986 | Three-Year Average |
|---|---|---|---|---|
| April | 0.0 | 0.0 | 0.5 | 0.2 |
| May | 75.9 | 0.0 | 98.4 | 58.1 |
| June | 251.5 | 151.8 | 146.2 | 183.2 |
| July | 324.1 | 172.4 | 221.0 | 239.2 |
| August | 313.9 | 375.8 | 322.0 | 337.2 |
| September | 318.5 | 471.6 | 381.6 | 390.6 |
| October | 137.9 | 4.0 | 167.8 | 103.2 |
| November | 19.4 | 0.0 | 0.0 | 6.5 |
| Total | 1,441.2 | 1,175.6 | 1,337.5 | 1,318.1 |

**Summary**

The Evaluation Team agrees with the statement in the 1984 REDSO/WCA Evaluation that says:

> . . . Land, water and climate at the project site are amenable to rice production and villagers were producing rice at the site in rainfed operations. Yields can be greatly increased with applications of relatively inexpensive technology; improved seeds, fertilizers, herbicides and terracing for water control. The level of skills can be gradually and effectively improved by training and demonstration.

The main constraints in agricultural sector that also exist in the project as identified by the Ministry of Planning are:

- Disorganization in the national economic sector. The lack of a viable economic framework favorable to the distribution of the products wanted, or needed, retards production. The lack of infrastructure and reasonable farm-gate prices is the most obvious disincentive;
- The low level of inputs available to agricultural developments. The system of production is based essentially on human inputs, and the lack of specific agricultural implements limits area expansion as well as outputs;
- The lack of animal traction and measures to control and/or improve soil fertility;
- The irregularity of rains, which seems to have increased in recent times;

- The degradation of natural resources;
- The permanent and seasonal emigration flow to neighboring countries especially of the younger generation; and
- The need for more basic education to develop the human resource base.

## INSTITUTIONAL SETTING: GOVERNMENT OF GUINEA-BISSAU IN THE RURAL SECTOR

Two socio-historical characteristics have been determinant in the institutional setting of the Guinea-Bissau Rice Production Project. One is that, at the initiation of the independence struggle in 1963, Guinea-Bissau was 99 percent illiterate and had only 14 people who had received university training. Despite post-independence efforts to improve national educational facilities, the illiteracy rate remains over 95 percent.

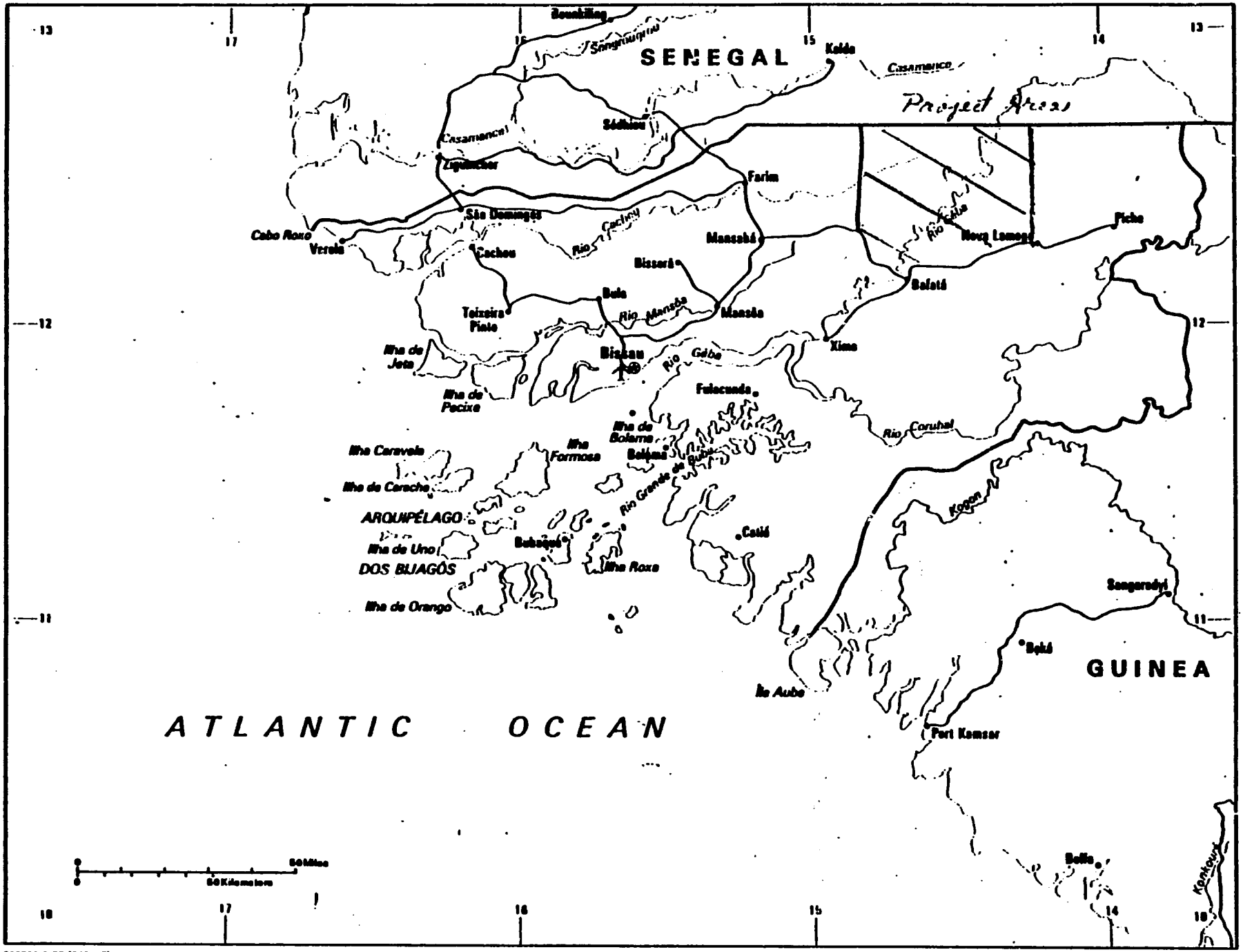
A second characteristic is that most government personnel who have received education are drawn from a Creole elite who descend from unions between Portuguese, or Cape Verdean, traders and administrators and local women from over a dozen Guinean ethnic groups. From the beginning of Portugal's contact with its colony, these racially mixed middlemen directed and dominated relations between the ethnic inhabitants of Guinea-Bissau and foreign powers. Today, as urban-based government employees, the Creole elite continue to serve as official spokesmen for Guinean interests and as intermediaries between nationals and foreign governments and donors.

These human resource problems are reflected in the strikingly low educational level of GOGB personnel at Contuboel, a situation that reflects the poor standards and limited number of educational facilities. High school graduates must receive scholarships and be sent abroad to receive university education. Good grades and government contacts are the two main criteria for selection. The exceptionally high illiteracy rate may be attributed in part to the fact that almost 90 percent of Guinea-Bissau's population are farmers and the agricultural calendar conflicts with traditional academic schedules. Therefore, it is not surprising that there are few university-trained staff at Contuboel. Given that many project personnel are taken from the city, GOGB staff who come from outside this region have much to learn regarding the priorities and complexities of village life.

Within this institutional context, DEPA was the major GOGB institution responsible for contributing the human resources necessary to manage and implement the Rice Production Project. DEPA is responsible for coordinating inputs and personnel for research and experimentation projects in Zone II (see Map 1, Guinea-Bissau, and Map 2, Detail of Project Area). DEPA works in conjunction with other rural development offices including the Department of Agricultural Hydrology and Soils, the Department of Plant Protection, and the Department of Agricultural Mechanics and Equipment. Because of DEPA's role as coordinator of research and experimentation in several zones, it considers projects at the Contuboel Center to be national rather than regional projects and, therefore, foreign project inputs to be subordinate to national needs. This perspective allows, as the Director sees fit, a certain amount of shifting of personnel and material inputs to other DEPA projects. In keeping with this concern for national development, DEPA has focused on projects concerned with food crops having national significance such as rice rather than seeking to fortify the diverse alimentary bases present in the various regions.

The Contuboel Center is staffed by DEPA personnel, and the technical assistance provided by AID for its low land (*bas-fond*) Rice Production Project works through the Extension Division, which comprises the Extension, Credit, and Hydrology Units. The Contuboel Center also receives assistance from the FAO for its Seed Multiplication and Research Divisions. In addition the Center participates in training programs and receives assistance from national and regional organizations such as the West Africa Rice Development Agency (WARDA) in Liberia; the International Institute of Tropical Agriculture (IITA) in Ibadan, Nigeria; the International Crops Research Institute for Semi-Arid Tropics (ICRISAT) in Hydrabad, India; the International Maize and Wheat Improvement Center (CIMMYT) in Mexico; the International Rice Research Institute (IRRI) in the Philippines; and Semi-Arid Food Grains Research and Development (SAFGRAD).

# Guinea-Bissau

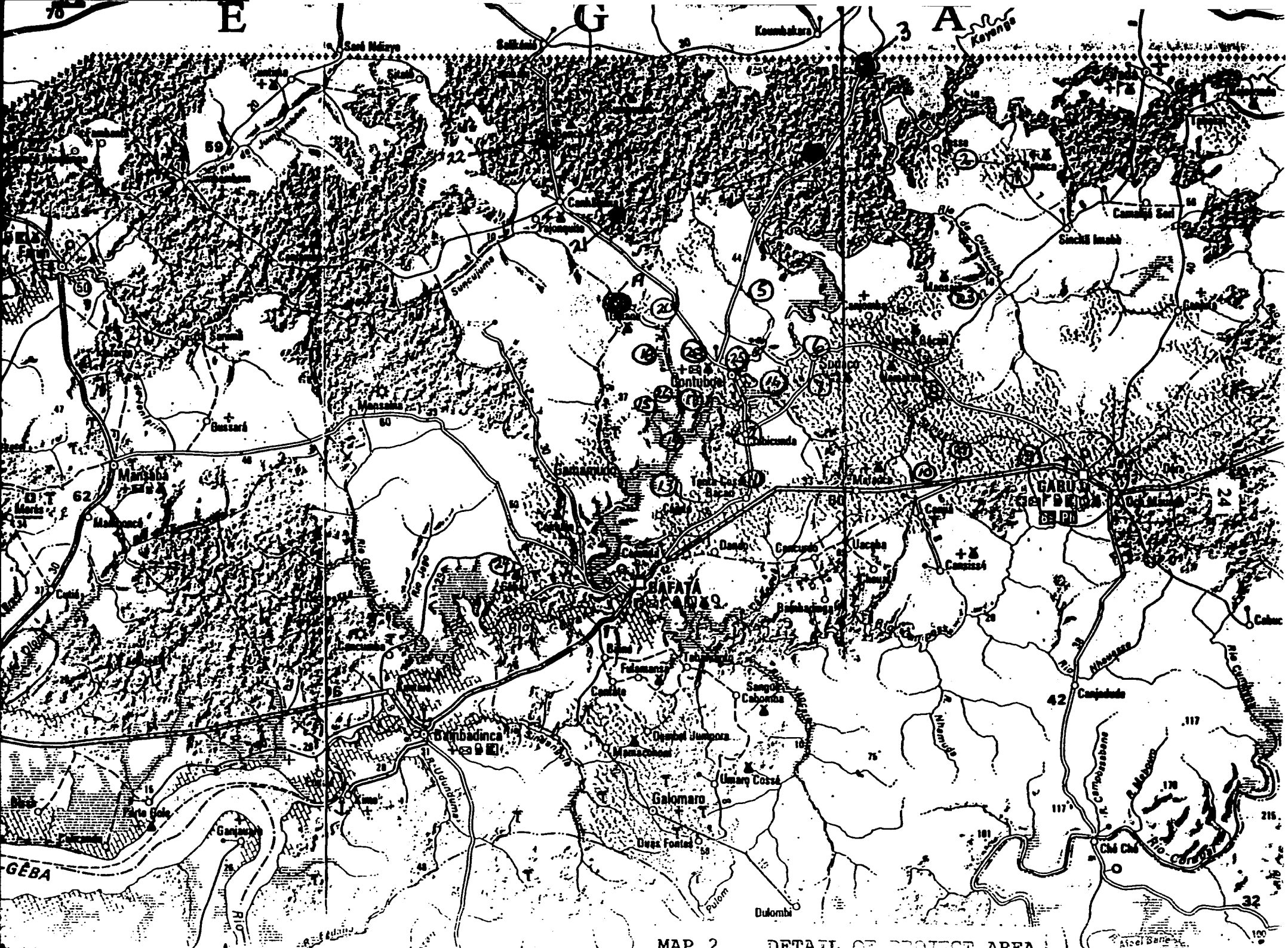



502728 9-77 (542147)
Lambert Conformal Projection
Standard parallels 8° and 32°
Scale 1:2,100,000

Railroad
Road
Airport

GUINEA-BISSAU

MAP 1




MAP 2 DETAIL OF PROJECT AREA

## LIST OF BOLANHA LOCATIONS

1. Paunea (non-project)
2. Paiana (non-project)
3. Sare Bacar
4. Badjingara
5. Canquenhi (DEPA-F,S,Ex) (non-project)
6. Sonaco (DEPA-F,S,Ex) (non-project)
7. Cutame
8. Velingata
9. Cataba Alfa
10. Dembel Uri
11. Tanta Cosse
12. Djabicunda (non-project)
13. Santanto
14. Sare Djaiba
15. Medina Ioba
16. Saucunda (I and II)
17. Waquilare
18. Sare Biro
19. Ginane
20. Madina Sare
21. Lenqueto
22. Bonco
23. Mansadjam (non-profit)
24. Geba (non-profit)
25. Contuboel (non-profit)
26. Canjai
27. Sintaka Boria
28. Sare Dabel
29. Cansanti

# THE SAHELIAN FARMER IN ZONE II

## Social Setting

The Rice Production Project area is situated in the eastern Sahelian Zone II of Guinea-Bissau. The ethnic composition is Fulani (70 percent), Mandinga (28 percent), and Balanta (2 percent).

Both Fulani and Mandinga are Islamicized, patrilineal, highly stratified societies, with a complex system of occupational castes. The residential unit is a household consisting of a man and/or his wives and children within a larger compound formed around an elderly male, his brothers, and their wives and children. Compounds may range from 20 to 60 people depending on the number of households. Within the compound, cereals are stored in community-owned silos to which each wife has access on the day she is the cook. The consumption unit is composed of all members of a compound organized around various women responsible for cooking meals at a single hearth.

## The Agricultural Cycle

The principal agricultural activity in the project area is the growing of millet, sorghum, and maize. The production unit for these subsistance crops is a man and his sons. Fields are planted for three years successively and then left to fallow for a period of 10-15 years. A rough approximation of yields for these crops is 400 kg per hectare. Although Fulani are generally classified as pastoralists, in this area they do not recall any period when they did not practice agriculture or when they did not have a fixed residence to which they returned after seasonal migrations.

In the Contuboel area, rice is a secondary staple and is traditionally cultivated in the *bas-fond* by a woman and her daughters. In 1953 only 14 percent of the crop area was dedicated to *bas-fond* rice production. Among the Fulani and the Mandinga, yields averaged 400 kg per hectare. For many years immigrating families could easily request land from earlier inhabitants who could not cultivate all their territory. Immigrants would receive free land loans for as long as the lender saw fit, and in cases of low population pressure, these loans became permanent. As population increased over the years, these land grants became more difficult to obtain, and in many areas there are immigrants without rice lands.

Among the Fulani, a distinction is made between rice production for household consumption and that which is reserved for individuals. The individual female producers later are located at the perimeter of the *bolanha*, and the rice production from this land can be kept or sold by the women as they see fit.

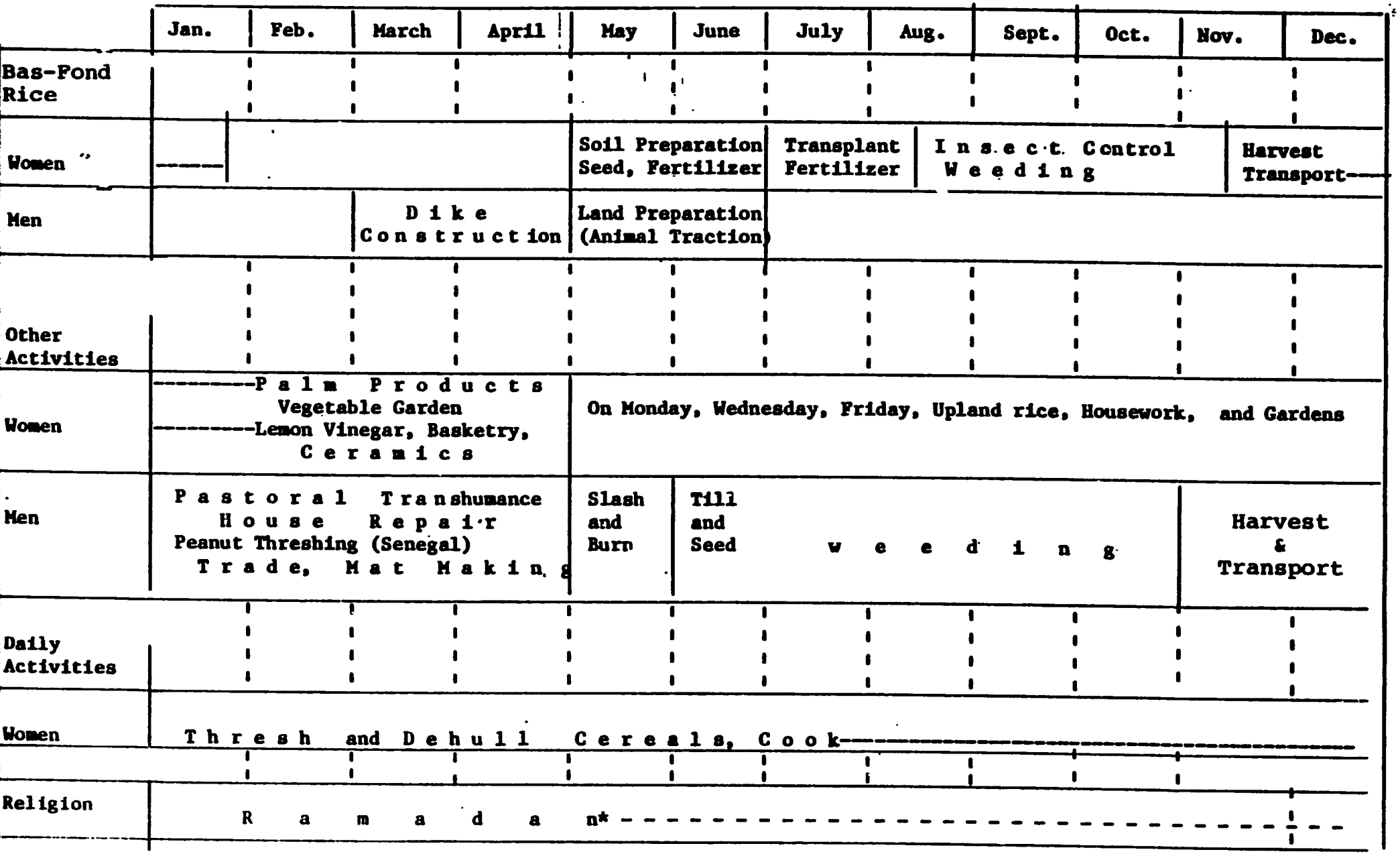
Rice is a secondary staple that usually only lasts until April or May. Sorghum, millet, and maize are primary staples consumed throughout the year. Many villagers prefer rice because of its flavor and ease in preparation. Others prefer sorghum, claiming that it can be prepared in a greater number of ways. These villagers assert that no matter how much rice is produced it will never become a substitute for sorghum, millet, or maize.

Depending on the task, rice-related labor may be carried out either by an individual woman or by a group of women. A women and/or her daughters generally perform less intensive activities such as seeding and transplanting. For more laborious activities, such as weeding, co-wives or women of a compound unite into mutual assistance groups and together complete the task consecutively in each of the participating women's fields. Traditionally, men play no role in *bas-fond* rice cultivation although, with the introduction of water control structures, men were to be responsible for dike construction and maintenance and for soil preparation when animal traction was utilized. Men also play a role in the transportation of harvested rice.

As the agricultural calendar indicates, women are principally occupied with *bas-fond* rice cultivation between May and January (see Figure 1, Agricultural Calendar). However, it is important to emphasize that in many areas women leave the rice fields every Monday, Wednesday, and Friday to dedicate themselves to household activities, private gardens, and upland rice cultivation. The last activity occupies less than 1 percent of all cultivated areas. In the dry season women spend their time on the income-producing activities, such as the preparation and sale of palm nut products, lemon vinegar, baskets, ceramics, and vegetables. Throughout the year women are further responsible for threshing, dehulling, and cooking all the cereals to be consumed. Of all labor activities, it appears that women consider threshing and dehulling to be the most tiring, closely followed by weeding.

## FIGURE 1

## AGRICULTURAL CALENDAR




* Ramadan is a lunar month of fasting, occurring on the lunar Islamic calendar.

Men's contribution to *bas-fond* rice cultivation began with the introduction by the Rice Production Project of contour dikes. Dike construction and field preparation take place prior to or at the onset of the rains from March through May. These tasks, which are vital for *bas-fond* rice production, compete with other male activities. At the same time that men should be constructing dikes, they may be also involved in transhumance or seasonal migrations to Senegal for groundnut threshing. *Bas-fond* land preparation by animal traction also competes with demands of slashing and burning shrubs, seeding, and soil preparation for the production of sorghum, millet, and maize to which most cultivated lands are dedicated. Of all their activities, males claim that dike construction and slashing and burning are the most difficult, although the latter requires only sporadic involvement.

Both male and female farmers have long been familiar with methods for seed selection and crop protection. Traditionally, farmers have selected short cycle crops and those that produce the best yields. These seeds are dried and stored on the panicle, a technique that is said to prolong germination capacity. By way of crop protection, farmers generally burn the husks and stalks of millet near insect-infested fields. The smoke deters many of the pests and eggs, and larvae in the residues are destroyed.

## HISTORY OF THE RICE PRODUCTION PROJECT

### 1976-1979: Project Antecedents

To combat the problems associated with imported rice and to diversify sources of rice, the GOGB, with the assistance of FAO, created in 1976 the Contuboel Center. At the same time the United States, through the U.S. Embassy in Bissau, approved funding for a small self-help project in the amount of $6,000 in the same location. This effort started in January 1977. The objective was to introduce dry season rice production. Initially, only 12 families showed an interest in that self-help effort. Each family was given approximately 0.5 hectare, but they worked collectively in preparing and maintaining the fields, dikes, and canals. Once the local farm community had witnessed the harvest in May 1977, over 300 farmers applied for entry into the pilot project. Further assistance was sought from USAID/Bissau. With the cooperation of the FAO technician assigned to the Contuboel Center, the self-help effort was expanded into an AID Accelerated Impact Project (AIP) of $275,000.

**1980-1984: The Rice Production Project**

On August 28, 1980 the current project was authorized for a life-of-project expenditure of $4.5 million. The GOGB and FAO were to make contributions to the project, and the implementation period was to be four years from the date of the execution of the Project Agreement. The purpose, as stated in the project paper, was "to increase food production and farm income of at least 1,200 farm families (7,650 people) in Guinea-Bissau's Geba River Basin area." The purpose was to be accomplished through the development of land for rice production and the creation of an institutional capacity in the form of a government-run extension service. A contract for technical assistance was signed with Aurora Associates, Inc. on April 15, 1982, to provide long- and short-term technical assistance to the GOGB.

**The 1984 Evaluation and the 1985 Project Supplement**

An informal evaluation was conducted in January 1983 by REDSO/WCA. It recommended reorientation of the project from an irrigated effort using pumps to rainfed *bas-fond* rice production. In October and November 1984, REDSO/WCA again evaluated the project and made the following observations:

1. Project implementation had been allowed to stray far off course.
2. A major impediment to project progress was the lack of a full complement of appropriately skilled technical assistance.
3. DEPA and AID supported continuation of the project in a somewhat modified form.
4. The technical assistance team had been expending efforts at the level of mechanized land development and planning major earthworks, neither of which was sustainable or compatible with increased village participation.
5. Significant increases in yields could be expected with the successful introduction of simple water control structures and improved agronomic practices.
6. Economic incentives did not exist to produce surpluses.
7. Pump irrigation activities discontinued under the earlier evaluation were not economically viable.
8. Significant contributions remained to be made in the areas of commodity procurement and long- and short-term training.

The Evaluation Team recommended redirection of the project to follow more closely the original intent of DEPA; that is, to attend to the needs of the farmers with technology they can implement themselves, and to provide training and commodity support, and institutional strengthening to DEPA's center (REDSO/WCA Evaluation, Guinea-Bissau Rice Production, December 19, 1984, p. 1).

USAID/Bissau accepted the findings of the evaluation, and the Guinea-Bissau Rice Production Project Paper Supplement was approved in early 1985. It outlined a course of action to be pursued by the project through the end of the project in 1987. In summary, the paper stated:

> . . . The Project must address the agronomic issues of rice production through improved water management practices, and intensive community development efforts designed to work with the most innovative farmers in the bas-fonds. . .
>
> The Project must make sincere efforts to be responsive to the priorities of the farmers in improving their total cropping systems, and not solely rice production. The Extension Trainer/Agronomist can offer technical assistance in other food crops cultivated in the region.
>
> The bas-fonds development should be accomplished without machinery, and should be initiated on a scale that does not place an unrealistic burden on village labor. Criteria for site selection should be a demonstrated village leadership interest, agronomic potential (rice being cultivated presently), and the appropriateness of the terrain for simple water control structures. (Project Paper Supplement, Guinea-Bissau Rice Production, p. 17).

# CHAPTER SIX

# THE RICE PRODUCTION PROJECT

## PROJECT DESCRIPTION

The Rice Production Project was designed to contribute to the stated GOGB aim of food self-sufficiency by increasing "food production and farm income of about 1,200 small farm families in the Geba River Basin area of Guinea-Bissau" and by developing "the institutional experience and information bases which may enable the farming systems developed in the project to spread beyond the immediate beneficiary universe and be replicated elsewhere." To accomplish this, the project focused on increasing *bas-fond* rice production in Zone II and the institutional capacity of DEPA at the Contuboel Center. Project organization is illustrated in Figure 2, The Project Mechanism.

USAID/Bissau's provision of technical assistance, training, and commodity inputs to the Contuboel Center was implemented in the following manner:

1. Technical assistants, including a Chief of Party/Credit Advisor, Extension Specialist/Agronomist, and a Rice Production Specialist, were provided through an AID contract with Aurora Associates, Inc. and resided at Contuboel during the project life.

2. USAID/Bissau provided training for short- and long-term participants selected at Contuboel Center and administered through USAID/Bissau.

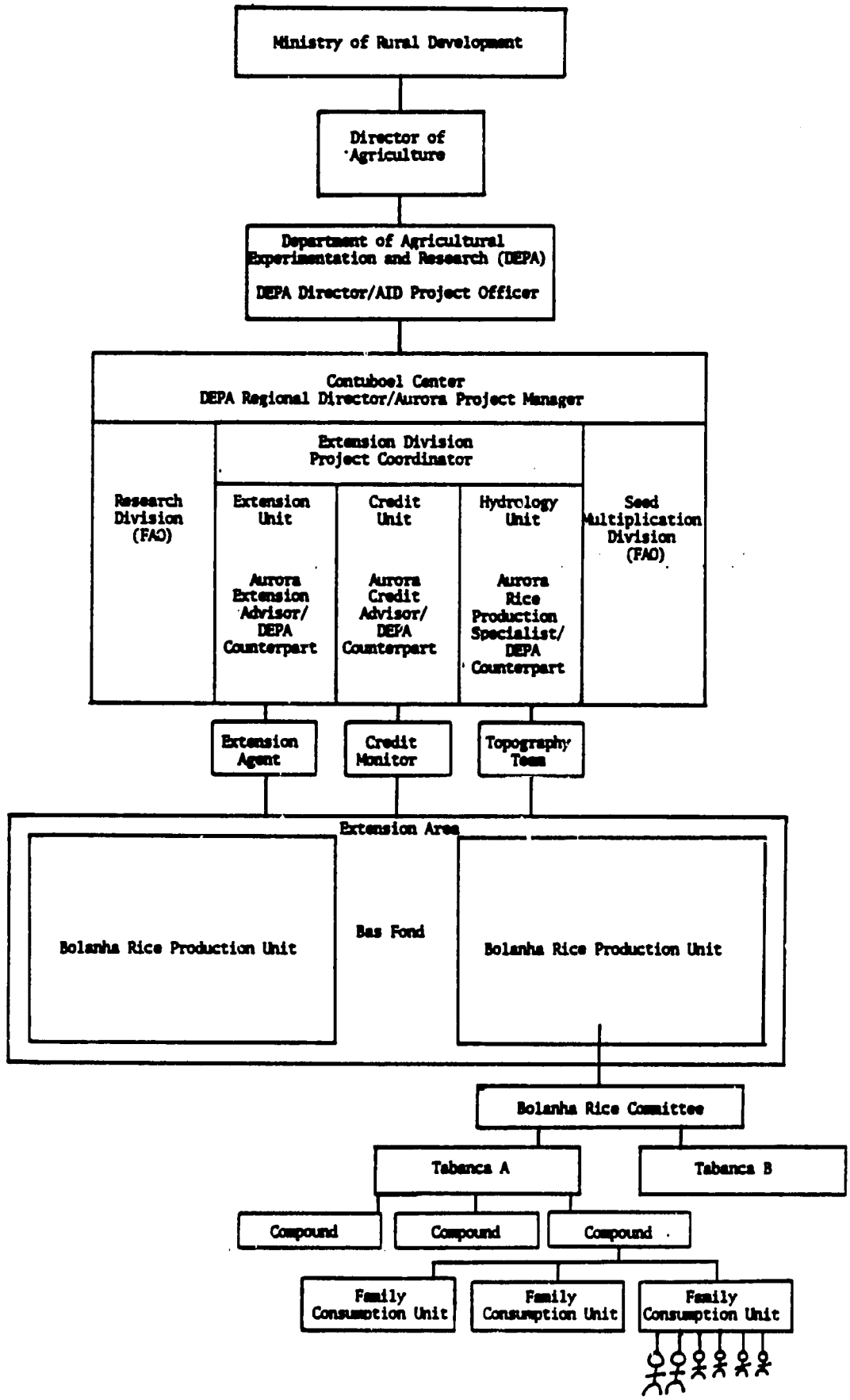
3. Commodities, including vehicles, office equipment and supplies, agricultural inputs such as fertilizer, hand tools, and animal traction equipment, were ordered by USAID/Bissau on recommendations made by the Aurora Team and DEPA.

DEPA was to provide inputs in the form of local staff and salaries, spare parts, and fuel.

DEPA and AID inputs were to be provided to the Contuboel Center and then, by way of the project-created Extension Division -- comprising the Extension, Credit and Hydrology Units -- to be channeled to *Bolanha* Rice Committees and eventually to the farmers. Each Aurora Team member had a DEPA counterpart and designed training sessions for the staff within its unit. The principal role of the Aurora

FIGURE 2

THE PROJECT MECHANISM



Team was to strengthen a system for providing farmers with project inputs and to facilitate farmer adoption of and participation in an improved water management techniques and agronomic technological package. Each unit had local personnel who served as intermediaries between the Contuboel Center and the farmer: extension agents in the Extension Unit, credit monitors in the Credit Unit, and a topography/survey team for the Hydrology Unit.

These intermediaries provided services to farmers by way of a *Bolanha* Rice Committee composed of representatives from all villages within an extension area. It was to these committees that the extension agents were assigned and to which agricultural inputs were directed. Decisions about extent and type of water control inputs were also made by these committees. Farmers desiring project assistance would contact their compound head who would in turn communicate their interest through *tabanca* leaders and finally to the *Bolanha* Rice Committee. Thus, the *Bolanha* Rice Committee served as a village-based intermediary with the Contuboel Center. The committee was responsible for assisting with project land allocations, distributing project inputs (fertilizer, seeds, farm implements, etc.), administering credit, and communicating to the Contuboel Center any problems involving farmer participation or the extension agent.

When farmers desire project assistance, they must choose a *bolanha* representative who is sent to the Contuboel Center to make the request. Project assistance necessarily implies water control structures and consequently the consent of all villagers who farm within a *bolanha* where contour dikes are to be constructed. Once the Contuboel Center has selected the site based on village interest, agronomic potential, and feasibility of water techniques, the village meets with other *bolanha* villages to inform them of the planned changes. In this way the requesting village becomes the new extension area after which the *bolanha* is named and in which the *Bolanha* Rice Committee is situated. Thereafter, all other villages that farm within the same *bolanha* channel communications and requests for inputs through the first village.

This project mechanism was to achieve the following outputs:

1. The successful introduction of improved water management techniques and improved agronomic practices;

2. Improved management capacity of DEPA in providing services to farmers, including an extension system and a rural engineering staff in place;

3. Experimental farmer associations operating and supervised by DEPA technical personnel; and

4. Development of a Geba River Valley Plan.

The inputs mobilized by the project and the progress made toward achieving the outputs described immediately above are discussed in the forthcoming sections.

## GOAL

The goal of the Rice Production Project, as originally set forth in the project paper, was "to contribute to the stated Government of Guinea-Bissau aim of food self-sufficiency." The GOGB defines food self-sufficiency in terms of rice production. However, within the project area rice is a secondary staple and daily consumption patterns are based on a wide variety of cereals. Thus, if self-sufficiency is indicated only by the amount of rice produced, the project will not be successful in achieving the goal for a long time.

It is possible to interpret the goal in a number of ways. The project could contribute to food self-sufficiency by increasing the rice production of farm families within the client group. Given the assumption that these families were not self-sufficient in grains, production increase in rice would make available food that then would not need to enter the system from outside. The goal might also imply an attempt to increase rice production by farmers in the Contuboel area in the hope that basic subsistence needs would be met and a net outflow would result from the region.

In the Project Paper Supplement, reference is made to the technical package and the economic incentives for production. Because it was not clear if an economic incentive existed that would encourage farmers to produce rice beyond that necessary

to meet their own needs, the Project Paper Supplement states that the "project is intended to address regional subsistence in rice production, rather than exportable surpluses." The definition of regional subsistence, however, is left unclear. Contuboel is located in Zone II, so a possible interpretation could be that the project would attempt to encourage the production of marketed surplus within individual rice production units. This marketed surplus would then be available to help meet Zone II food requirements.

Contuboel's mandate does not include the entire Zone II area. Leaving aside the question of economic incentives for surplus production, it was probably unreasonable to expect the project to do much toward attaining regional self-sufficiency given the limited number of producers with which it was working. It appears, therefore, that the project was not intended to encourage the commercialization of a marketed surplus by farmers but to bring their production up to some given level necessary to provide for their own subsistence needs.

A lack of data on household grain consumption requirements, as well as a dearth of information on production, including a breakdown by crop, makes evaluation of the food status of the client group difficult. Without such data, it is impossible to state clearly whether the client population was food self-sufficient. Given the implicit assumption that it was not, efforts to increase rice production seem justifiable.

## PURPOSE

### Discussion

The Project Paper Supplement states the project purpose as follows:

> . . . to increase food production and farm income of about 1,200 small farm families in the Geba River Basin area of Guinea-Bissau, and to develop the institutional experience and information bases which may enable the farming systems developed in the project to spread beyond the immediate beneficiary universe and be replicated elsewhere.

The project purpose breaks up logically into two areas. One is the quantitative objective of increasing food production and farm income of 1,200 small farm families.

Apart from the issue of defining a small farm family and showing how increased production is linked to increased farm income, this aspect of the purpose is fairly straightforward.

The second part of the purpose refers to an institutionalization of capability within DEPA to expand its services to farmers beyond the target group of 1,200 small farm families. The emphasis placed on developing experience that may enable a spread of relevant technology beyond the immediate beneficiaries speaks mainly to an increased capability within DEPA, mostly in the area of outreach to farmers. Although the Project Paper Supplement does not address the question of research, institutionalization of a research component could also have been envisioned to ensure the ability of DEPA to evaluate the appropriateness of a given technology. The development of information bases also implies a research component. In addition, for an outreach component to be effective, it must also include a strong research-extension link.

The major comment regarding the appropriateness of the project purpose concerns the time frame for implementation. Twenty-seven months for institutionalization of a farmer outreach mechanism is at best overly optimistic. Another difficulty with the purpose involves the implicit link between increased food production and farm income. In a subsistence agricultural setting, especially one characterized by the absence of producer prices that cover a farm family's cost of production, it is not clear that increases in production will be translated into an improved income situation, especially if the increase in production requires an increase in expenditure.

**Conclusion**

There is adequate evidence to suggest that approximately 1,115 farm families were reached by the project in terms of providing them with agricultural inputs; that is, seeds, fertilizer, hand implements, water management techniques, etc. This resulted in increased food production, particularly of rice. However, the job of institutionalizing the outreach capability of DEPA has just begun. The Extension, Hydrology, and Credit Units are operating, but they are at an embryonic stage. With the departure of the Aurora Technical Assistance Team, there could be some real losses in terms of the status of these fledgling institutions.

# TECHNICAL ASSISTANCE

## Background

The 1984 Evaluation was critical of the performance of the Aurora Team that had worked on the project until the time of the evaluation. The Evaluation mentioned:

1. Excessive numbers of technicians (DEPA could not make counterparts available for them);
2. Improper programming (team members arrived without a logical sequence in relation to the work needed to be done);
3. Frequent absences from the Contuboel site; and
4. Excessively high cost of technical assistance (40 percent of the project budget).

These deficiencies are being addressed although some problems are sure to continue given the circumstances under which the team has had to work. However, it is the opinion of this Evaluation Team that the Aurora Team members are attending to their duties, have developed their individual programs, and have made reasonable progress under very difficult circumstances.

Two major factors mitigate against the Aurora Team successfully achieving the tasks assigned them. These factors are: (1) the unrealistically defined outputs to be achieved in a 27-month time frame, particularly those related to institutionalizing the work of the Extension, Hydrology, and Credit Units; and (2) the weak support that they have received from USAID/Bissau.

## Chief of Party/Credit Advisory

The Chief of Party of the Aurora Team, who arrived in January 1985, had, besides her role of Team Leader, the additional responsibility of developing, institutionalizing, and managing the Credit Unit. Management of the team has been a difficult and onerous task given the remote location and the living conditions at the project site. Logistical support problems, noted in the 1984 Evaluation, had to be constantly attended to by the Chief of Party, and continued to plague the project. Management under the conditions faced by the Chief of Party has few easy solutions.

The ability of the Chief of Party is not questioned. She is very competent and cooperative. Her understanding of the objectives of the Aurora Team's technical assistance mission is amply documented in the excellent series of monthly, quarterly, and annual reports that assess progress, identify problems, and recommend courses of action. That she has been persistent in following up on details is also well-documented in her reports. Her reports represent the only adequate historical record of the Rice Production Project. However, it is evident that not all decisions made were by consensus nor that decisions made were observed by all parties.

It can be argued that the human resource base necessary for a credit program did not exist at Contuboel. There were no trained indigenous people to staff the Credit Unit; DEPA had little interest in the program when it was initiated; there is some question about whether the farmers needed the credit in the first place; and, finally, and perhaps most significantly, no satisfactory package of technology was available to give the farmers, so the possibility of payback was questionable.

In this environment the Credit Advisor was responsible for building a credit and agricultural input distribution program from scratch. She directed the establishment of a record file, the creation of a requisition system, the setting up of a series of warehouses through which commodities were distributed in a systematic and controlled fashion, the organizing of a credit department, the development of a credit program for the Extension Unit, and the establishment of a record system at the village level.

At the time of the current evaluation, 40 percent of the Credit Advisor's time is spent just reviewing the accounts of the two bookkeepers and credit monitors. The payback is low, and as of April 1987, over 2 million PG remain uncollected of 4.5 million PG borrowed. Some extension agents in the villages have collected farmers' payments but have not returned them to the Credit Unit for accounting. Pay for DEPA personnel has not been forthcoming on several occasions. Under these circumstances it would require a very strong person to manage the program. The Credit Advisor has skillfully filled the role although the institutional gains are slim.

**Rice Production Specialist**

The Aurora Team's Rice Production Specialist arrived in April 1983. His principal tasks have been to train the personnel of the Hydrology Unit and lead that unit in developing water management techniques that will increase rice production in the *bas-fond* setting. Details regarding these two tasks are found in Chapter 7 "Achievement of Outputs." The Rice Production Specialist's most important contribution has been the training of the Hydrology Unit personnel to execute contour dikes and catchments successfully and to make road improvements. This unit has achieved a high degree of competency and will probably be able to perform satisfactorily after the Rice Production Specialist's departure.

Unfortunately, little progress has been made regarding the development of water management technologies that are replicable or sustainable. Various types of water control structures were installed without systematic testing, particularly from a sociological and economic point of view.

**The Extension Specialist/Agronomist**

The Extension Specialist/Agronomist arrived in May 1985 and faced the formidable task of developing an extension capability that would be an integral component of the Rice Production Project. His major task was to reorganize the Extension Unit and establish a chain of command. In addition, he established an evaluation process for selecting new recruits.

A training program was developed for his tenure, and a training coordinator was hired to manage the programming and logistics requirements of the courses. Extension agents have received formal and informal training in demonstration field techniques, data collection, field trials, improved agronomic techniques, land development, and extension methodology. The Extension Specialist/Agronomist has proposed study trips to USAID/Bissau for agents and farmers. However, no trips have taken place to date because of logistical problems.

The Extension Specialist/Agronomist has a reasonable sense of where he is going in his institutional-building task. However, two years is a short period of time for such a major undertaking, and the gains to which this advisor has contributed could well be lost if there is not follow-up activity to support the Extension Unit.

### Short-Term Technical Assistance

A gross deficiency in the technical assistance component has been the almost complete lack of short-term technical assistance to supplement the efforts of the Aurora Team. USAID/Bissau, the Aurora Team, and DEPA were never able to achieve a consensus on the type of short-term assistance to be provided. Funds were to have been used to mobilize social and agricultural scientists to assist at critical junctures of project implementation. When these inputs never materialized, deficiencies emerged that had a negative impact on project implementation. An anthropologist examining the problems of land tenure and farmer's attitudes regarding new technology could have assisted the Aurora Team in developing appropriate agricultural innovations to promote increases in rice production. The lack of an agricultural economist to assist the team in developing the data base to measure the agronomic and water management interventions from a cost-effective standpoint has resulted in a serious shortcoming in the project. Short-term agricultural scientists could have contributed to developing an appropriate technological package. This oversight by the Aurora Team, USAID/Bissau, or DEPA seriously diminished the effectiveness of the project.

### Conclusion

The Aurora Team performed in a highly satisfactory fashion. However, its effectiveness was severely constrained by the difficult working environment and the short time horizon in which it was directed to achieve heroic institutional objectives. The lack of short-term technical resources to support the project is regrettable.

## PARTICIPANTS

The Project has provided training at the Bachelor of Science (B.S.) level in the United States for two long-term participants in the fields of Agronomy and Hydrology. One returned to Contuboel only two months before project termination;

the other will return only after the technical assistance team has left. The total AID cost for these two trainees was $310,871.

There have also been 12 short-term traineeships during the project, at a total cost of $51,265. Training was provided in English and French on a wide range of agricultural topics relating directly to the Rice Production Project. At project termination only one of these will not yet have returned.

In addition two long-term participants received funding under an African Graduate Fellowship and the Development Education Program, both administered for Portuguese-speaking Africans in the United States through the American African Institute. One will receive a B.S. in Agronomy, and the other a B.S. in Agricultural Economics. One participant will return in 1988, and the other in 1990, well after project termination.

DEPA management selected the four long-term participants on the basis of high school grades, period of time affiliated with the project, and likelihood of their return to Contuboel after training was completed. DEPA's criteria for selecting short-term participants included junior high or high school grades and appropriateness of the training program to the participant's duties at DEPA. Short-term training was concentrated on middle- to upper-level DEPA functionaires, including the DEPA Director from Bissau, DEPA counterparts in the Extension and Hydrology Units, and extension supervisors. All participants were male. All participants appear to be very satisfied with the appropriateness of the training received. Upon return to the Contuboel Center, short-term participants are required to submit a report to the DEPA project manager on what was learned. Each participant is required to give a class on the subject he studied during the extension training seminar that takes place annually in the dry season.

Given the limited availability of trained staff in Guinea-Bissau, these programs are a small step toward creating the institutional base necessary for sound DEPA project management. Training received from other institutions, such as WARDA which provided 18 traineeships to the Contuboel Center between 1978 and 1986, also helped remedy this situation.

The number of long- and short-term trained personnel in areas such as water management, topography, mechanics, heavy machines, soil fertility, plant protection, accounting, and, especially, management and administration is still inadequate. There were no farmer and extension agent visits to neighboring countries, although two are being planned to Burkina Faso and one to Senegal. These would be an important way for farmers and extension agents to observe techniques employed elsewhere.

Most important is the need for local training. What is required for DEPA staff are basic daily courses in reading, writing, and arithmetic. Given the need of the Contuboel Center staff for such basic training, it would appear almost as easy to train farmers as extensionists and credit monitors. If training were properly designed for farmers, the project could take advantage of this most stable, locally adapted, and agriculturally experienced human resource.

## COMMODITIES

### Vehicles

#### Introduction

The entire range of means of transportation, from project vehicles to motorcycles and bicycles to support the Rice Production Project that have been ordered since the Project Paper Supplement, has failed to reach the project site in a timely fashion to promote the institutional objectives of strengthening the Credit, Hydrology, and Extension Units. A major impediment has been the lack of a procurement plan on the part of USAID/Bissau to serve as a guideline. Additionally, the lack of timely action by USAID/Bissau on the recommendations made by the Aurora Team contributed to these transportation commodities arriving at the project site out of phase.

#### Project Vehicles

A second set of project vehicles was requested by Aurora in September 1985 . and ordered by USAID/Bissau in August 1986 to support the Aurora Team that came out in 1985. These items arrived on site in the spring 1987.

**Mercedes Truck to Haul Agricultural Inputs**

This truck was requested by Aurora in September 1985 and ordered in August 1986. It arrived at the project site in April 1987.

**Motorcycles**

Eight motorcycles for supervisory personnel in the Credit, Hydrology, and Extension Units were requested by Aurora in September 1985 and ordered in August 1986. They arrived at the project site in May 1987.

**Toyota Mini-Bus**

A mini-bus, which arrived in November 1986, was not recommended for the project by the Aurora Team. It has been used to transport farmers to project sites and demonstration trials.

**Tractors**

Tractors were ordered in 1985 to support contour diking and arrived in 1986.

**Bicycles**

Fifteen bicycles were ordered and delivered to the project in 1985. These bicycles were sold to extension agents at a subsidized price. Most of the bicycles are not working. The owners do not appear to know how to maintain their bicycles. Spare parts were provided by the project, but classes in maintenance and repair have not been given by DEPA. Most of the extension agents sold their bicycles, and some are asking for new ones. Bicycle procurement was declared by the Aurora Team to be a disaster. Fifteen new bicycles have arrived in the country and are to be assigned to extension agents.

**Office Equipment and Supplies**

Approximately $50,000 worth of training materials and office supplies and equipment were ordered for the Credit, Hydrology, and Extension Units. These materials are important to achieving the institutional objective of strengthening these units. Although the process for ordering these materials started in 1985, these commodities have yet to reach the project site.

**Agricultural Inputs**

**Agricultural Inputs and the Credit Unit**

Prior to 1985, Contuboel had been operating an input distribution program utilizing donor-supplied commodities. This system lacked reasonable controls. Deliveries of commodities occurred on a random basis and generally without notice. After delivery no system existed to ensure accountability. Inputs received by farmers were often free or greatly subsidized.

USAID/Bissau was asked by DEPA to provide inputs to the Contuboel Center. USAID/Bissau conditioned its provision of inputs on the creation of a control mechanism. In 1985 Contuboel and the Aurora Team decided to institute a credit program based on the assumption that farmers could not pay cash for agricultural inputs. One objective for providing agricultural inputs was to encourage participation in the Rice Production Project. At the request of DEPA/Bissau, the credit system was expanded to include inputs provided to Contuboel by all donors. The creation of a system for the agricultural control of donor-provided materials caused considerable strain between the Aurora Team Leader, who was chosen to implement the system, and the Contuboel staff.

An agreement between the GOGB and USAID/Bissau defining the function of the credit program for AID-financed agricultural inputs and specifying management guidelines was not produced until July 1986, 16 months after the credit and sales program began. Although prohibited by the agreement, project-financed inputs were utilized in non-project areas, mainly as a result of poor warehouse facilities that made it impossible to keep AID-purchased inputs separate from those provided by other donors.

In 1985 all commodities were available for purchase on both a credit and a cash basis. Prices were set by the government, and the project was obliged to abide by them. It was impossible to reflect the real cost of the inputs or pass on the transportation costs to the purchaser. In addition to the large subsidies on inputs, a highly negative interest rate of 5 percent (inflation in 1986 was estimated by the World Bank at 35 percent) was initially charged by the Credit Unit (see Table 3, Subsidies on Agricultural Inputs Provided by Rice Production Project, 1985, and Table 4, Subsidies on Agricultural Inputs Provided by Rice Production Project, 1986). Farmers had one year to pay back their loans, and a down-payment of one-third was required.

DEPA is involved with three agricultural campaigns per year. These are the rice production, horticultural, and dry season campaigns. The Credit Unit provided agricultural inputs for each of these campaigns. The result was that the Credit Unit evolved into an entity with a significant management requirement.

Prices on some agricultural inputs were raised by the GOGB in 1986, and these were passed on to the farmer although, even with the increased prices, the subsidies remained extremely high. In 1986 the credit system was modified, mainly due to poor payback, and the program increased reliance on cash sales. Only animal traction implements and carts were then available for purchase on credit. In addition no credit was given to those villages that had not repaid their previous loans, and only fertilizer and hand tools were available for cash purchase. Commodities were still available for purchase during each of the three agricultural campaigns. By 1987, as administrative and repayment problems continued, the credit and sales program was consolidated. Orders for inputs are now accepted once a year rather than during three campaigns, and outstanding balances have been combined into one lump sum. Interest rates have been raised to 15 percent, and a 50 percent down payment is required. Pay back is still required within one year. Repayment continues to be a problem. As of April 31, 1987, only 56 percent of the amount loaned had been paid back.

It is difficult to estimate the effect of moving from a mainly credit-based to a cash-based system on the demand for agricultural inputs. No data are available from 1985 and 1986 on the proportions of cash to credit sales. The strong demand for fertilizer and hand tools in Bonco, one village where the project began work in 1986,

Table 3

Subsidies on Agricultural Inputs Provided by
Rice Production Project, 1985

| Item | Project Purchase Price CFA | Project Purchase Price PG /1 | Price To Farmer | Subsidy PG | Subsidy % /2 |
|---|---|---|---|---|---|
| NPK (kg) | 203 | 284 | 9 | 275 | 97 |
| Urea (kg) | 145 | 203 | 13 | 191 | 94 |
| Machete | 3,950 | 5,530 | 545 | 4,985 | 90 |
| Rake | 1,070 | 1,498 | 220 | 1,278 | 85 |
| Hoe | 4,960 | 6,944 | 700 | 6,244 | 90 |
| Shovel/3 | 2,240 | 3,136 | 700 | 2,436 | 78 |
| Weeder/3 | 1,900 | 2,660 | 390 | 2,270 | 85 |
| Sickle | 2,710 | 3,794 | 425 | 3,369 | 89 |
| Seeder/3 | 42,315 | 59,241 | 6,500 | 52,741 | 89 |
| Donkey Cart | 73,500 | 102,900 | 14,650 | 88,250 | 86 |
| Bullock Cart/3 | 150,000 | 210,000 | 15,100 | 194,900 | 93 |
| Donkey Plow | 41,740 | 58.436 | 6,500 | 51,936 | 89 |
| Bullock Plow/3 | 85,950 | 120,330 | 15,300 | 105,030 | 87 |

NOTES:

Transportation costs have not been factored in. Subsidy would be higher with transportation costs included.

1/ Calculation based on parallel market exchange rate of 1.4 CFA/PG.

2/ Amount of subsidy divided by purchase price.

3/ Not purchased in 1986. Purchase price for 1985 used. Sales price for 1986 used.

4/ Available in 1986 only and used for donkey carts.

Table 4

Subsidies on Agricultural Inputs
Provided by Rice Production Project, 1986

| Item | Project Purchase Price CFA | Project Purchase Price in PG /1 | Price To Farmer | Subsidy PG | Subsidy % /2 |
|---|---|---|---|---|---|
| NPK (kg) | 155 | 310 | 47 | 263 | 85 |
| Urea (kg) | 140 | 280 | 49 | 231 | 83 |
| Machete | 805 | 1,610 | 530 | 1,080 | 67 |
| Rake | 1,000 | 2,000 | 550 | 1,450 | 73 |
| Hoe | 1,330 | 2,660 | 700 | 1,960 | 74 |
| Shovel /3 | 2,240 | 4,480 | 700 | 3,780 | 84 |
| Weeder /3 | 1,900 | 3,800 | 390 | 3,410 | 90 |
| Sickle | 560 | 1,120 | 425 | 695 | 62 |
| Seeder /3 | 42,315 | 84,630 | 24,950 | 59,680 | 71 |
| Donkey Cart | 77,000 | 154,000 | 42,350 | 111,650 | 73 |
| Bullock Cart / | 150,000 | 300,000 | 38,650 | 261,350 | 87 |
| Donkey Plow | 46,240 | 92,480 | 21,350 | 71,130 | 77 |
| Bullock Plow / | 85,950 | 171,900 | 56,700 | 115,200 | 67 |
| Tires /4 | n/a | | 3,800 | | |
| Tubes /4 | n/a | | 900 | | |
| Tire pump | n/a | | 3,500 | | |

NOTES:

n/a = Data not available
Transportation costs have not been factored in. Subsidy would be higher with transportation costs included.

1/ Calculation based on parallel market exchange rate of 2 CFA/PG.
2/ Amount of subsidy divided by purchase price.
3/ Not purchased in 1986. Purchase price for 1985 used. Sales price for 1986 used.
4/ Available in 1986 only and used for donkey carts.

indicates that cash is available for the purchase of agricultural inputs at least in some villages. Interestingly, Bonco is located approximately 5 kilometers from the Senegalese border. The availability of cash in other villages is indicated by the strong demand for donkey cart tires and tubes in 1986. The total spent on these items in all villages in 1986 would have purchased 21 tons of urea fertilizer, enough to generate significant increases in yields in over 100 hectares of land.

**The Administrative Structure**

At the village level the agricultural inputs sales program is administered through the *Bolanha* Rice Committee, which is held responsible for the debts incurred by its constituency. Orders are processed with the help of the extension agents from the Rice Committee to Contuboel. Deliveries of agricultural inputs are made to the Rice Committees in each village which are then responsible for distribution to individual farmers.

The Credit Unit at Contuboel consists of a chief and an assistant accountant, and two credit monitors. Their work is supervised by the Aurora Team Leader. With her departure, responsibility for the Credit Unit will probably fall to the chief accountant. It is doubtful that his position within the DEPA hierarchy is sufficiently strong to enable him to maintain control over the Credit Unit.

The operation of the Credit Unit has been severely hampered by the modest skill level of the DEPA employees. Late arrival of motorcycles has prevented the credit monitors from making frequent visits to the credit committees and farmers. Extension agents have been relied on in some cases to collect payments, sometimes resulting in mismanagement of funds. It should be noted that the credit monitors themselves have not been immune to this problem.

The agricultural input sales program has been operating for two years. Given the large amount of training necessary for the DEPA/Contuboel staff, it is unrealistic to think that such a program could be institutionalized within this short period. It is doubtful whether the program will continue functioning after the departure of the Aurora Team in July 1987. For this reason the institutional objective of establishing a viable sales agricultural inputs program administered by the Credit Unit will not have been achieved.

**Procurement Issues**

A global list of commodity needs for a two-year period was submitted to USAID/Bissau by the Aurora Team. USAID/Bissau managed the procurement process. Commodities were procured in Senegal or other countries. The lengthy procurement process resulted in late delivery of commodities. In 1985 agricultural inputs arrived one month after the beginning of the rice production season, and in 1986 they arrived four to five months late.

**Fertilizer**

Inorganic fertilizers were provided through the Rice Production Project. Fertilizer needs were estimated by extension agents based on the recommended dose and the total size of the *bolanha.* This estimate was communicated to the Extension Unit, which approved the quantities and then transmitted the order to the Credit Unit for delivery. The majority of the fertilizer purchased by USAID/Bissau was distributed to farmers participating in the Rice Production Project, but some was sold to farmers outside of the project area. Lack of separate warehousing facilities made it impossible to separate AID-purchased fertilizer from that supplied by other donors.

The Aurora Team identified problems with the fertilizer program including:

1. Lack of soil analysis or testing of fertilizers to determine proper dosage, application rates, and/or time of applications;
2. Inconsistencies in formulation of procured fertilizers;
3. Extension recommendations based on amount of fertilizer and not on available nutrients; and
4. Problems with timely delivery.

In 1985 fertilizers were available for purchase on credit. Total fertilizer sales decreased in 1986 (from 81 tons in 1985 to 15 tons in 1986) with the introduction of a policy of cash sales only (Table 5, Total Fertilizer and Animal Traction Implement Sales (Cash and Credit), 1985, and Table 6, Total Fertilizer and Animal Traction Implement Sales (Credit and Cash), 1986). The late arrival of fertilizers also contributed to a decrease in sales.

Table 5

Total Fertilizer and Animal Traction Implement Sales
(Credit and Cash), 1985

| Extension Areas | NPK | Urea | Carts | | Plows | | |
|---|---|---|---|---|---|---|---|
| | kg | | Donkey | Bullock | Donkey | Bullock | Seeder |
| | | | number | | | | |
| Project | | | | | | | |
| Bonco | | | | | | | |
| Cansanti | 50 | | | | | | |
| Cataba Alfa | 3,000 | 2,350 | | | | 3 | |
| Contuboel | 1,016 | 1,150 | | 1 | 2 | | |
| Cutame | 2,650 | | 7 | | 8 | 2 | 7 |
| Dembel Uri | 4,850 | 2,500 | 8 | | 8 | 15 | 10 |
| Ginane | 2,400 | 2,200 | 9 | 2 | 1 | 2 | 7 |
| Madina Ioba | 1,650 | 450 | | | | 2 | |
| Madina Sare | 1,800 | 1,800 | 6 | 4 | 2 | 11 | 17 |
| Santanto | 2,350 | 1,400 | 5 | | 2 | 2 | 3 |
| Sare Biro | 950 | 200 | 2 | 1 | | 7 | 5 |
| Sare Djaiba | 1,850 | 800 | 13 | | 5 | 5 | 7 |
| Saucunda | 8,700 | 3,250 | 8 | 1 | 3 | 7 | 3 |
| Tantacosse | 2,000 | 2,000 | 7 | | 8 | 4 | 10 |
| Velingara | 2,000 | 1,000 | 7 | | | 3 | 9 |
| Waquilar | 2,250 | 2,250 | 3 | | 1 | 11 | 10 |
| Total Project | 37,516 | 21,350 | 75 | 9 | 40 | 74 | 88 |
| Non-project | | | | | | | |
| Canquenhi | 1,950 | 650 | | | | | |
| Djabicunda | 7,100 | 2,950 | | 1 | | 3 | |
| Fulamori | 1,300 | 500 | | | | 2 | |
| Geba | | | | | | | |
| Mansadjam | 1,000 | 500 | | | | | |
| Paiana | 1,400 | 150 | | | | | |
| Sonaco | 3,900 | | | | | 4 | |
| Sotocai | 50 | 450 | | | | | |
| Tindinto | 300 | 400 | | | | | |
| Exten. Ag. | | | | | | | |
| Others | | | | | | | |
| Total Non-project | 17,000 | 5,600 | 0 | 1 | 0 | 9 | 0 |
| Total | 54,516 | 26,950 | 75 | 10 | 40 | 83 | 88 |

Table 6

Total Fertilizer and Animal Traction Implement Sales
(Credit and Cash), 1986

| Extension Areas | NPK | Urea | Carts | | Plows | | |
|---|---|---|---|---|---|---|---|
| | | | Donkey | Bullock | Donkey | Bullock | Seeder |
| | kg | | number | | | | |
| **Project** | | | | | | | |
| Borco | 3,000 | 3,000 | 14 | 2 | 3 | 3 | 3 |
| Cansanti | | | | | | | |
| Cataba Alfa | | | | | | | |
| Caucunda | | | | | | | |
| Contuboel | | 500 | | | | | |
| Cutame | | | | | | | |
| Dembel Uri | | | | | | | |
| Ginance | | 1,000 | | | | | |
| Madina Ioba | | 1,000 | | | | | |
| Madina Sare | 500 | 500 | | | | | |
| Santanto | | 750 | | | | | |
| Sare Biro | 250 | 500 | | | | | |
| Sare Djaiba | | 500 | | | | | |
| Tantacosse | | 1,000 | | | | | |
| Velingara | | | | | | | |
| Waquilar | 250 | 2,000 | | | | | |
| Total Project | 4,000 | 10,750 | 14 | 2 | 3 | 3 | 3 |
| **Non-project** | | | | | | | |
| Canquenhi | | | | | | | |
| Djabicunda | 1,000 | 2,000 | | | | | |
| Fulamori | | | | | | | |
| Geba | | | | | | | |
| Mansadjam | | | | | | | |
| Paiana | | 50 | | | | | |
| Sonaco | | | | | | | |
| Sotocai | | | | | | | |
| Tindinto | | | | | | | |
| Exten. Ag. | 300 | 200 | | | | | |
| Others | 125 | 507 | | | | | |
| Total Non-project | 1,425 | 2,757 | 0 | 0 | 0 | 0 | 0 |
| Total | 5,425 | 13,507 | 14 | 2 | 3 | 3 | 3 |

Given the complexity involved in procurement of large amounts of fertilizer for delivery to Guinea-Bissau, it is not surprising that problems of late delivery would have developed. Although it would have been possible to vary extension recommendations based on fertilizer formulation, this would probably have led to confusion about applications rates on the part of both farmers and extension agents. More attempt should have been made by USAID/Bissau in the procurement of fertilizers to ensure consistency of formulation.

**Hand Tools**

In 1985 and 1986 hand tools were purchased by the project and made available to farmers both inside and outside the project zone (see Table 7, Total Hand Tool Sales (Credit and Cash), 1985, and Table 8, Total Hand Tool Sales (Credit and Cash), 1986). In 1985 subsidies on hand tools were high, ranging from 78 percent on shovels to 90 percent on machetes (see Table 3 and Table 4). In 1985, 716,000 PG in hand tools were purchased, compared with only 297,000 PG in 1986 (using 1986 prices to put hand tool sales on a common basis). Since hand tools should be expected to last for more than one season, decreased sales do not necessarily indicate decreased demand.

Data on sex role differentiation and agronomic practices indicate that mainly men use the machete and weeder (see Table 9, Sale of Hand Tools and Use By Men and Women, 1985-1986). Although women are responsible for weeding, they generally do not plant in lines and so cannot benefit from the weeder. Because of its heavy weight, men are more likely then women to use the short-handled hoe (*daba*). Men and women appear to use the rake and shovel in about equal proportions. In terms of hand tools, greater numbers of those types that appeal to men appear to have been sold.

**Animal Traction**

Donkey carts were strong sellers. In the rural areas they provide a practical means of transportation of goods, people, and produce (see Table 5 and Table 6). It is interesting to note that donkey cart tires and tubes elicited a strong demand from villagers in 1986, even though these items were available for cash sales only (see Table 7 and Table 8). During the 1986 campaign, 207 tires and 264 tubes were sold.

Table 7

Total Hand Tool Sales
(Credit and Cash), 1985

| Extension Areas | Machete | Hoe | Weeder | Sickle | Rake | Shovel | Tire Pump |
|---|---|---|---|---|---|---|---|
| | number | | | | | | |
| Project | | | | | | | |
| Bonco | | | | | | | |
| Cansanti | | | | | | | |
| Cataba Alfa | 20 | | | | | | |
| Contuboel | | | | | | | |
| Cutame | 10 | | | | | | |
| Dembel Uri | 106 | 27 | 35 | | 11 | 13 | |
| Ginane | 50 | 25 | | 1 | 40 | | |
| Madina Ioba | 22 | 11 | | | | | |
| Madina Sare | 34 | | 50 | 40 | 40 | | |
| Santanto | 42 | 26 | 6 | | 12 | | |
| Sare Biro | 23 | 3 | 13 | | 20 | | |
| Sare Djaiba | 55 | 5 | 4 | 1 | 41 | | |
| Saucunda | 36 | | | 1 | 1 | | |
| Tantacosse | 30 | 20 | 24 | 16 | 30 | 18 | |
| Velingara | 35 | 1 | | 7 | 22 | | |
| Waquilar | 18 | 3 | 5 | | 20 | | |
| Total Project | 481 | 121 | 137 | 66 | 237 | 31 | 0 |
| Non-project | | | | | | | |
| Canquenhi | 19 | 14 | | | | | |
| Djabicunda | 20 | | | | | | |
| Fulamori | | | | | | | |
| Geba | 25 | 40 | | | | | |
| Mansadjam | | | | | | | |
| Paiana | | | | | | | |
| Sonaco | | | | | | | |
| Sotocai | 6 | | | | | | |
| Tindinto | 4 | | | | | | |
| Exten. Ag. | 2 | 4 | | | | | |
| Others | 50 | 50 | | | | | |
| Total Non-project | 126 | 108 | 0 | 0 | 0 | 0 | 0 |
| Total | 607 | 229 | 137 | 66 | 237 | 31 | 0 |

Table 8

Total Hand Tool Sales
(Credit and Cash), 1986

| Extension Areas | Machete | Hoe | Weeder | Sickle | Rake | Shovel | Tire Pump |
|---|---|---|---|---|---|---|---|
| | | | | number | | | |
| Project | | | | | | | |
| Bonco | 64 | 179 | | 40 | 39 | | 7 |
| Cansanti | | | | | | | |
| Cataba Alfa | | | | 40 | | | |
| Contuboel | | | | 6 | | | |
| Cutame | | | | | | | |
| Dembel Uri | | | | 40 | | | |
| Ginane | | | | | | | |
| Madina Ioba | | | | | | | |
| Madina Sare | | | | | | | |
| Santanto | | | | | | | |
| Sare Biro | | | | | | | |
| Sare Djaiba | | | | | | | |
| Saucunda | | | | | | | |
| Tantacosse | | | | | | | |
| Velingara | | | | | | | |
| Waquilar | | | | | | | |
| Total Project | 64 | 179 | 0 | 126 | 39 | 0 | 7 |
| Non-project | | | | | | | |
| Canquenhi | | | | | | | |
| Djabicunda | | | | | | | |
| Fulamori | | | | | | | |
| Geba | | | | | | | |
| Mansadjam | | | | | | | |
| Paiana | | 15 | | | | | |
| Sonaco | | | | | | | |
| Sotocai | | | | | | | |
| Tindinto | | | | | | | |
| Exten. Ag. | | 6 | | | | | |
| Others | | 45 | 6 | 18 | 9 | 2 | |
| Total Non-project | 0 | 66 | 6 | 18 | 9 | 2 | 0 |
| Total | 64 | 245 | 6 | 144 | 48 | 2 | 7 |

Table 9

Sale of Hand Tools and Use By Men and Women, 1985-1986

| Used By | Type of Tool | Number 1985 | Sold 1986 | 1986 Cash Price[1] | Total Value |
|---|---|---|---|---|---|
| | | | | ----------PG---------- | |
| Men | Machette | 607 | 64 | 500 | 355,630 |
| | Weeder | 137 | 6 | 390 | 55,770 |
| | Sub-Total | | | | 411,400 |
| Mainly Men | Hoe | 229 | 245[2] | 700 | 331,800 |
| | Sub-Total | | | | 331,800 |
| Women | Sickle | 66 | 144 | 425 | 89,250 |
| | Sub-Total | | | | 89,250 |
| Men and Women | Rake | 237 | 48 | 550 | 156,750 |
| | Shovel | 31 | 2 | 700 | 23,100 |
| | Sub-Total | | | | 179,850 |

1 Used 1986 cash price for both 1985 and 1986 purchase.

2 About 15 small hoes for use by women were purchased in 1986.

These data indicate either a large demand from outside the project population or excessive wear, considering that a total of only 89 two-wheeled donkey carts were sold over the two-year period. Animal traction is the purview of men, so the carts, tires, and tubes mainly benefit them, although women may have access to the use of donkey carts for transportation of produce, albeit sometimes at a fee.

The utility of donkey carts in improving the productivity of rural labor is not in dispute. A more crucial question is whether project resources should have been used to subsidize the purchase of inputs that do not directly increase the productivity of women's labor in rice cultivation. Many types of mechanized agricultural equipment for rice producers exist, but these were not offered for sale. Resources from either input supply system could have been used to support local production of these items.

Although significant numbers of animal traction implements were provided by the project, including carts and plows, little attempt appears to have been made to encourage construction of contour or parcel dikes with animal traction (see Table 5 and Table 6). The Aurora Team stated that limited access to animal traction equipment by farm families was a problem. It would be difficult to build dikes with animal traction before the first rain, but waiting until that time would likely result in conflicts with work in non-rice fields. The recommendation of the Extension Unit was to use animal traction in land preparation. From an administrative and cost standpoint, animal traction equipment had the highest procurement price; it would have been wise to eliminate the animal traction equipment from the agricultural input sales program, especially given the relative lack of emphasis accorded the use of animal traction in rice production by the Aurora Team.

### Seed

Improved seed was one item that was to be provided to farmers as part of the project's agronomic package. The FAO is responsible for a seed production unit at Contuboel. This unit provides three-improved varieties of rice seed (BG 90-2, I Kong Pau and ROK-5). There appear to be no problems with the taste of the improved varieties.

Seed is provided to farmers for only one year. At the end of the growing season, they are required to reimburse 110 percent of the seed that they were originally given. The Aurora Team noted problems with the seed multiplication program, including a degeneration of the BDG 90-2 variety resulting in an increased susceptibility to blast and insect pests and low germination rates. There are also problems with seed supplies, resulting in farmers not having enough of the improved variety to plant the entire rice area. The Aurora Team also felt that farmers should be provided with seed over a longer period of time, to maintain the purity of the strain.

### Macroeconomic Policies and the Agricultural Input Program

In 1985 and 1986 the GOGB determined sale prices on agricultural inputs that did not accurately reflect the actual costs of the items or the transportation cost. This resulted in an extremely large level of subsidization (see Table 3 and Table 4). In addition to controlling sales prices, the GOGB also limited the interest rates for credit sales.

Credit systems are meant to revolve. Unfortunately, because of the subsidization, the low interest rate charged, and the low repayment rates, it was difficult, if not impossible, to revolve funds in the project's credit program. Because of the unavailability of agricultural inputs for sale in Guinea-Bissau, purchase of these materials had to be done outside the country with hard currency. Unless recent macroeconomic policy changes result in increased hard currency reserves and/or increased availability of agricultural inputs, it is difficult to imagine that the input sales program as it currently exists can be sustained without considerable outside donor support.

### Conclusions

Agricultural credit and sales programs generally limit themselves to provision of materials necessary for adoption of the improved technology. This reduces the management requirements of the system and provides stricter accountability of project funds. Limited resources are also utilized in a more productive fashion. The credit and sales program as implemented by the project invested considerable effort in the provision of equipment that did not increase the productivity of labor in rice production.

Given the unavailability of goods in Guinea-Bissau, the fact that sale prices did not accurately reflect the actual cost of materials, and the possibilities of cross-border trade, the real possibility exists that farmers were participating in the Rice Production Project only to gain access to agricultural inputs. Although it would have been impossible to restrict the use of project-provided inputs to rice cultivation, concentrating on those inputs that increase the productivity of labor could have resulted in less demands on project resources and DEPA management. To the extent the purchased inputs were used, however, they did contribute to increased rural productivity.

Current Guinea-Bissau macroeconomic policies make implementation of an agricultural input provision program virtually impossible. The Aurora Team was justified in moving the project's agricultural input supply system away from credit and toward a reliance on cash sales. Until the GOGB eliminates or drastically reduces the subsidies on agricultural inputs, it will be difficult if not impossible to institutionalize a self-sustaining input supply system on either a credit or a cash basis.

## GOVERNMENT OF GUINEA-BISSAU INPUTS

As part of the original agreement between the Government of the United States and the GOGB, the GOGB's contribution was to have been the gas and oil necessary to run project transportation items. It appears that the DEPA was unable to provide sufficient quantities, and invariably gas and oil for the project were paid for out of the petty cash fund that the Aurora Team managed. The salaries of certain DEPA project personnel, which were originally planned as a GOGB input, were paid with cash grants generated from the sale of P.L. 480 commodities and/or food commodities from the World Food Program.

# CHAPTER SEVEN

# ACHIEVEMENT OF OUTPUTS

## INTRODUCTION

This chapter presents the status of achievement of the outputs of the RFP:

1. The successful introduction of improved water management techniques and agronomic packages;
2. Improved management capacity of DEPA in providing services to farmers including an extension and rural engineering staff in place;
3. Experimental farmer associations operating and supervised by DEPA technical personnel; and
4. Development of a Geba River Valley Plan.

## OUTPUT: THE SUCCESSFUL INTRODUCTION OF IMPROVED WATER MANAGEMENT TECHNIQUES AND AGRONOMIC PACKAGES

### Background -- Water Management Activities

In the Project Paper Supplement, it was emphasized that the simplest, most effective and appropriate technology for water management in the *bas-fonds* is to level terraces and build dikes in the upper reaches and level terraces with a drainage canal and water control structures in lower reaches where storm runoff is excessive. The design, layout, and construction of contour dikes and terraces was seen as an approach that was "elegantly simple."

Contour dikes are designed to impound rainwater on gradually sloping lands as the rainwater drains from higher to lower elevations. This method of water management is used to grow rice throughout the world. However, in the past it has not been used on a large scale in this part of Africa. It was anticipated that the construction of terraces separated by dikes would be made by using animal traction and/or manual labor.

In Guinea-Bissau about 125,000 hectares of *bas-fonds* are suitable for rice cultivation. Traditionally, there has been no method for holding water on the land in the *bas-fonds*. A major output of the project was to identify and test water management structures to be employed by the farmers that would contribute to increasing rice production. It was the contour-diking technique in the *bolanha* production unit within the *bas-fond* that was the major technique tested.

**Tractors for Making Contour Dikes**

Although it was anticipated that animal traction and/or manual labor would be used to make contour dikes, almost immediately this approach was abandoned in favor of using a tractor for this activity. The construction of partial contour dikes began in 1985 using a tractor loaned by the FAO. Partial contour dikes are defined as dikes constructed by the use of tractor-pulled disc plows but not yet completed manually. By 1986 with the delivery of two AID-funded tractors, the rate of dike construction began to increase greatly. In 1986 approximately 262 hectares were under partial or completed contour dikes, and by April 1987 this area had increased to 416 hectares (see Table 10, Description of Project Bolanhas, 1985-1987). In the last two years there has been a total rejection of manual work for the construction of new contour dikes.

The rationale given by the Rice Production Specialist for tractor use was that it marked the survey lines and created a base for the dike. In addition it provided loose soil for the farmer and facilitated manual completion. A tractor can do 10 meters of dikes in nine seconds. It is estimated that it takes a person one whole day to complete the same task. Tractor dike construction is possible only during the dry season because soil moisture is too high at other times. Although there are other demands on labor time to perform dry-season tasks such as cultivation of irrigated crops, trading, and transhumance, during this season men generally have more spare time than during other seasons.

Table 10

Description of Project Bolanhas, 1985-1987

| Bolanha | Year Work Started | Land Type /1 | Families/2 | Area Under Contour Dikes /3 Area of Project Effort/3 1985 | 1986 | 1987 | Area With Dikes Completed To Project Standard 1986 /4 | 4/31/87 | Rice Yield /6 1985 | 1986 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | ha | | | | | ton/ha | |
| Saucunda I | 85 | B | 160 | 28.5 | 28.5 | 28.5 | 3.4/5 | 3.4 /4 | 1.5 | 2.0 |
| Madina Sare | 85 | B | 172 | 12.0 | 12.0 | 12.0 | 6.0/5 | 6.0 /4 | 4.8 | 3.0 |
| Cutame | 85 | B | 73 | 7.0 | 7.0 | 7.0 | 1.3 | 1.3 | 1.9 | 1.4 |
| Ginane | 85 | B | 54 | 18.6 | 18.6 | 18.6 | 6.8 | 6.8 | 2.8 | 1.7 |
| Velingara | 85 | B | 75 | 6.0 | 6.0 | 6.0 | 3.4 | 3.4 | 3.5 | 3.0 |
| Tanta Cosse | 85 | B | 96 | 6.3 | 14.1 | 29.1 | 4.6 | 4.6 | 2.5 | 2.2 |
| Dembel Uri | 85 | B | 118 | 10.0 | 16.9 | 16.9 | 8.3/5 | 8.3 /4 | 2.9 | 2.0 |
| Sare Biro | 85 | B | 45 | 10.0 | 10.0 | 18.0 | 3.9 | 3.9 | 2.4 | 2.1 |
| Santanto | 85 | R | 67 | 32.7 | 32.7 | 32.7 | 8.3 | 8.8 | 3.3 | 2.7 |
| Madina Icoba/7 | n/a | R | 60 | n/a | n/a | n/a | 0.0 | 0.0 | 2.0 | 2.2 |
| Sare Djaiba | 85 | R | 65 | 17.5 | 20.8 | 20.8 | 11.4 | 11.4 | — | 2.7 |
| Waquilare | 85 | R | 30 | 5.9 | 5.9 | 5.9 | 1.3 | 1.3 | 3.5 | 1.8 |
| Sari Dabal | 85 | R | 65 | 16.8 | 16.8 | 16.8 | 15.8 | 16.8 | — | — |
| Bonco | 86 | B | 97 | 47.8 | 47.8 | 31.0 | 31.0 | | 2.2 | |
| Saucunda II | 86 | R | — | 25.3 | 25.3 | 0.0 | 0.0 | | — | |
| Canjai | 87 | B | — | | 15.0 | n/a | 0.0 | | | |
| Sare Bacar | 87 | B | 30 | | 37.6 | n/a | 0.0 | | | |
| Badjingara | 87 | B | 20 | | 12.2 | n/a | 0.0 /4 | | | |
| Cansanti | 87 | B | — | | 10.0/5 | n/a | 0.0 | | | |
| Lenqueto | 87 | B | 33 | | 26.6 | n/a | 0.0 | | | |
| Cataba Alfa | 87 | B | 50 | | 13.9 | n/a | 0.0 | | | |
| Sintcha Boria | 87 | B | — | | 15.5 | n/a | 0.0 | | | |
| Total (Area and Families) | | | 1,310 | 171.3 | 262.4 | 416.2 | 106.5 | 107.0 | | |
| Average (Yield) | | | | | | | | | 2.8 | 2.2 |

NOTES:

1/ Bas fond (B) or riverside (R).
2/ The number of familes for each bolanha.
3/ Partial contour dikes the latter are defined as dikes which were initially contstructed by tractor (or other means) and need to be completed manually. This includes areas where surveying was done and no dikes are constructed.
4/ Completed as of December 31, 1986.
5/ An undetermined area has been completed as of April 31, 1987.
6/ Yield measured on area for which dikes were completed to project standard.
7/ Water control structures existed prior to the project.

The Aurora Team ordered tractors of the same type and model as those of the FAO (Massey Ferguson Model 290, 75 hp). This allowed for interchange of spare parts and plows. Given the difficulties with spare parts and maintenance in Guinea-Bissau, it made good sense to invest in tractors compatible with those already in use at Contuboel.

### Costs and Returns of Tractor Use

By 1987 the survey and tractor crew were able to construct the necessary dikes for 3 hectares of rice land per day. This included approximately 630 linear meters of dikes. Each dike is approximately 1 meter wide. No reliable cost data are available for the construction of dikes and drainage structures. This, coupled with the lack of yield data on the effects of partially constructed dikes, makes assessment of the costs and returns for tractor use impossible. Since construction of partial contour dikes by tractor was a major technological innovation, it is unfortunate that no systems were established to evaluate the economic aspects of this question.

### Sustainability of Tractors for Contour Diking

It is estimated that the tractors should be able to operate for at least five years without major overhaul. With weekly preventative maintenance, it has been possible to keep the tractors running about 90 percent of the time.

In addition to the calculations of the economic return to the use of tractors, their sustainability involves two questions: 1) the ability of DEPA to keep the tractors maintained; and 2) the availability of spare parts. Some training of mechanics has been provided by the Rice Production Project, and the FAO at Contuboel has qualified mechanics. This should take care of the problem of tractor maintenance. Procurement of spare parts without donor assistance is more problematic. Although it is not unreasonable to expect the GOGB to provide tractor services to farmers, the DEPA should begin passing more of the cost of the service to farmers. The revenue generated will help to finance tractor repair and maintenance. Farmers' willingness to bear a larger share of the real cost of the tractor program should be a reliable indicator of their desire to complete dike construction.

**Land Tenure and Land Management Innovation**

The Rice Production Project was directed toward increasing yields on previously cultivated lands through the introduction of improved water management techniques rather than toward increasing hectarage under cultivation. The central element of the project's technological package, contour dikes, required group acceptance of the new structures. Almost inevitably these new structures resulted in a complete redistribution of *bas-fond* lands. Given the complexity of this issue, project management resolved to place the problem of land distribution in the purview of newly created *Bolanha* Rice Committees, which were to serve as intermediaries between project personnel and farmers.

*Bas-fond* lands were redistributed somewhat arbitrarily in accordance with the lists of "farmers" whose names were compiled by the Rice Committee. Technically the land was to be distributed to active adults who had previously been farmers of *bas-fond* lands. In practice the land was distributed to those adult villagers who were present to sign the list. Even though it is primarily women who farm *bas-fond* lands, in some areas men (husbands) received equal parcels of land, which were to be farmed by their wives. In other areas people who had no lands previously, either as a result of land unavailability or of low priority of rice cultivation in relation to other crops, received *bas-fond* lands in the new distribution. Conversely, many who had extensive rice lands prior to project intervention received relatively smaller plots in keeping with the predetermined plot sizes. Those who were absent from villages when the lists were made received no land. While project management claims that project lands were distributed according to how villages wanted it, in fact redistribution followed *the Bolanha* Rice Committee lists that were prepared with varying criteria for eligibility.

*Bolanha* parcel shapes vary considerably by area. Some areas have asymmetrical plots in keeping with traditional land divisions. More commonly, *bolanhas* are divided into identically geometrical parcels regardless of location at upper or lower levels of *bas-fond* slopes. A third system consists of individually owned strips that completely traverse the *bas-fond* and in which upper and lower areas as well as bits of contour and parcel dikes are included.

Regardless of land divisions, women continue to cultivate their private, income-earning plots at the upper levels of the slopes beyond the outer perimeter of the project *bolanha*. These higher areas are seeded as nurseries at the beginning of the rainy season. The rice plants that remain in the nurseries after transplanting is completed are considered the private property of these women. Thus, the introduction of improved water management techniques holds an unexpected benefit for these non-project lands.

Divisions that were marked only by stakes at the beginning of the project later became marked by small dikes. This alteration occurred when project personnel realized that, without elevated divisions, water that was well controlled within a properly maintained segment of the dike would be drained through a neighbor's plot if the latter had neglected to maintain her part of the dike.

**Farmer Participation in Innovation**

To evaluate whether a water management or agronomic innovation has been successfully introduced, farmer priorities, interests, acceptance, and participation must be considered. On-site interviews with farmers and observations revealed that farmers generally had two basic motives for requesting project assistance. One was to maintain food self-sufficiency. The term "maintain" is used because it appears that, except for years of severe ecological stress, farmers in the Contuboel area have achieved self-sufficiency for several years now. In Zone II self-sufficiency cannot be measured in terms of rice, since rice is a secondary staple in a larger farming system in which, as in many other Sahelian cultures, sorghum, millet, and maize play a much greater role. Estimates on self-sufficiency in a region must be calculated as a function of the entire farming system, not in terms of a single cereal of preference on a national scale. As one farmer put it, "Rice is nice, but millet makes the house stand." Furthermore, concentration on a single crop, even if it is preferred for various reasons, is a high-risk strategy in a fragile agroclimatic zone.

A second motive for farmer requests for project assistance is related to reduced labor requirements. Farmers are interested in technology such as carts and tools that will ease their daily workload. This implies that the introduction of any new

technological package in rice requires some consideration of constraints it would create for labor in other agricultural activity. As a result of the Rice Production Project, two new activities were introduced: contour diking and land preparation by animal traction. Because of the heavy physical labor this requires, male participation was imperative. However, these new activities conflicted with the slash-and-burn phase and land preparation phase of the more essential shifting cultivation. The project provided animal traction implements and hand tools, but many of these did not decrease womens' labor requirements in rice production. No animal traction implements to assist in dike construction were made available. Thus, even if it were clear that farmers understood and wished to participate in the construction of contour dikes, this activity conflicts with other labor requirements and works against the farmer's desire for reduced labor.

**Farmer Perceptions of Water Control Structures**

It is far from evident whether most farmers understand the function of water control inputs. Rather, many farmers perceive contour dikes as a pre-requisite for access to other project benefits such as the agricultural input sales program. In economic terms villagers interested in having tractor work done on their *bolanhas* contacted DEPA at Contuboel and agreed to purchase the fuel that was necessary for the tractor work. This was the first measure of farmer interest.

The second measure was whether farmers completed the dikes manually. Less than 41 percent of dikes were finished to project standards. It is thus unclear whether payment of highly subsidized fuel was a valid indicator of farmer willingness to complete contour dikes and participate in improved rice production, or if the desire of farmers for access to the agricultural input supply system was in fact their main motivation for joining the project. When some farmers were asked about the function of a drainage canal, they responded, "How should we know, but we can't say 'no' to people who are helping us."

The *Bolanha* Rice Committee and some farmers recognized that contour dikes prevented water and fertilizer from sliding down the *bas-fond* with the rains. These said at first they thought dikes were DEPA's way of stealing their land. This claim may refer either to DEPA's redistribution of *bas-fond* lands or to a confusion about

contour dikes serving as new parcel "divisions." Even now some farmers believe that, as has been done in the past, the tractor will come back year after year to trace the dikes and that no input need be made by villagers in dike completion. In some areas plot size is so small that tractor-traced dikes and plot divisions seem to occupy a considerable part of cultivable surface area. In any case, some farmers felt that, after dikes were traced, their role was to remove some of the loosened soil from the traced contour to decrease its size. There was no need to compact the dike since the tractor would return the following year. These opinions about the function of contour dikes and the farmers' role in their completion are significant, given that manual completion of dikes was the main measure used by the project to assess farmer participation.

However, the impact of water management technology on farmers' yields is best seen over a period of several years. The fact that most of these structures were put in place within the last two years does not provide the necessary time frame to see the effects of the new technology. While low farmer participation in dike completion and poor understanding of water control functions may indicate that the technological package is neither sustainable nor replicable in the short term, it is highly probable that over a period of several years, farmer participation in dike construction will increase as the effects of the new technology on yields and total production become apparent.

**Farmer Perceptions of Other Innovations**

Farmer acceptance of other improved techniques was variable. Farmers appear to be unfamiliar with the need for leveling between contours. Instead, they treat lower pockets within their fields as a source of drinking water if it tastes good; if not, they disperse the water by hand or dig small canals around the hole to drain the water into other areas of the plot.

While line transplanting has been adopted on a small scale, farmers prefer broadcasting seeds and random transplanting, claiming that it is far less labor intensive and that there are fewer weeds.

Farmers seem to understand the function of fertilizer, improved seed, and pesticide technologies better than other technologies. This may be due in part to the fact that fertilizer is used traditionally in many aspects of agriculture including in the *bas-fond*. Farmers also have long had a method for seed selection of short cycle crops and superior strains, and techniques of repelling pests. A greater knowledge of these traditions on the part of the extensionist could greatly facilitate the extensionist's task of explaining new techniques.

**Farmer Preferences in Implements and Equipment**

The *Bolanha* Rice Committees expressed great satisfaction with the equipment that the project provided. Among the items that these committees preferred were machetes, weeders, bullock plows, and donkey carts. In interviews with rice farmers, it appeared that much of this equipment was not limited to use in rice cultivation but used extensively, or principally, in shifting cultivation. Male representatives of the *Bolanha* Rice Committee play a very small role in rice cultivation, but a large role in the choice and distribution of agricultural inputs.

**Summary: Water Management Techniques**

The Evaluation Team strongly supports the validity of contour diking by tractor as a technology that can have immediate and obvious impact on increasing rice production in *bas-fonds*. However, insufficient data are available to determine whether contour diking is sustainable and replicable in Zone II both from economic and sociological perspectives.

Other water management techniques, such as animal traction to create contour dikes, labor-intensive contour diking, construction of catchments, and use of low-lift pumps utilizing surface water for rice production were not sufficiently tested. Therefore, the implications of using these techniques cannot be determined.

**Lack of Scientifically Based Agronomic Recommendations**

Little agronomic research was observed at the Contuboel Center by the Evaluation Team. Currently there is no written recommended package of technology for distribution by extension agents to farmers. This is unfortunate because without a proven package of superior technology, farmers may easily lose confidence in the advice they receive from DEPA. Extension fields are used to evaluate the rice technology, but the results obtained from these fields, as explained by the Extension Specialist/Agronomist, are inconclusive. It is essential to remember, however, that a 27-month time horizon is too short a period to develop and test a technological package that would be suitable for *bas-fond* rice production.

The project provided fertilizer to increase rice yields in the *bas-fond* setting. This fertilizer contributed to increased rice yields although it is impossible to evaluate the extent of its impact.

## OUTPUT: IMPROVED MANAGEMENT CAPACITY OF DEPA IN PROVIDING SERVICES TO FARMERS INCLUDING AN EXTENSION AND RURAL ENGINEERING STAFF IN PLACE

**Background**

During the 27-month period, the following services were developed to improve the management capacity at the Contuboel Center and in turn provide services to the farmers in the project area:

1. A Credit Unit composed of one accountant, one bookkeeper, two credit monitors, and one central and six zone warehouses (Figure 3, Credit Unit Organizational Chart);

2. A Hydrology Unit, consisting of three topography teams and two designers/drafters (Figure 4, Hydrology Unit Organizational Chart); and

3. An Extension Unit of 24 extension agents, three supervisors, and two coordinators (see Figure 5, Extension Unit Organizational Chart).

FIGURE 3

CREDIT UNIT ORGANIZATIONAL CHART

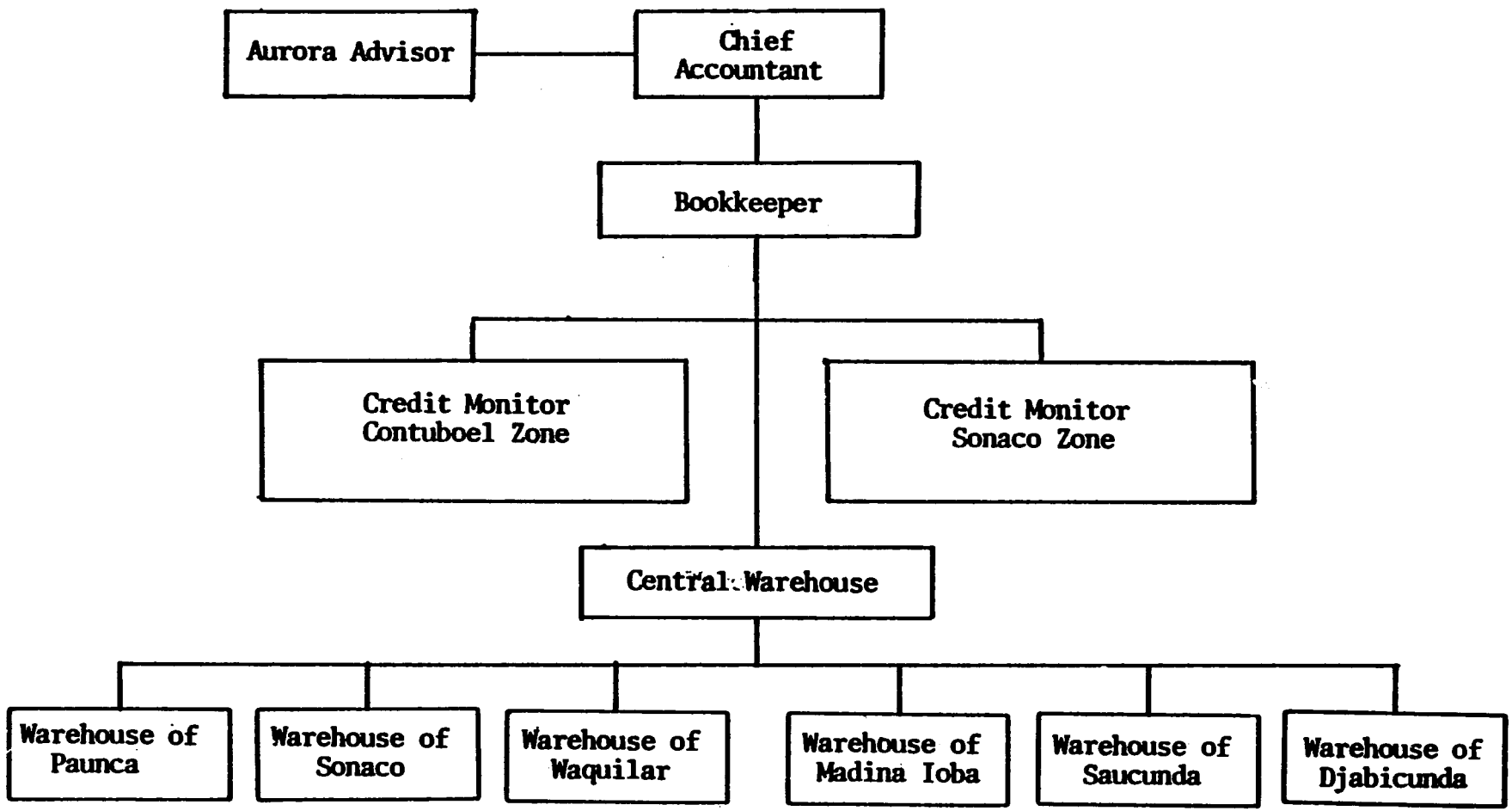


FIGURE 4

HYDROLOGY UNIT ORGANIZATIONAL CHART

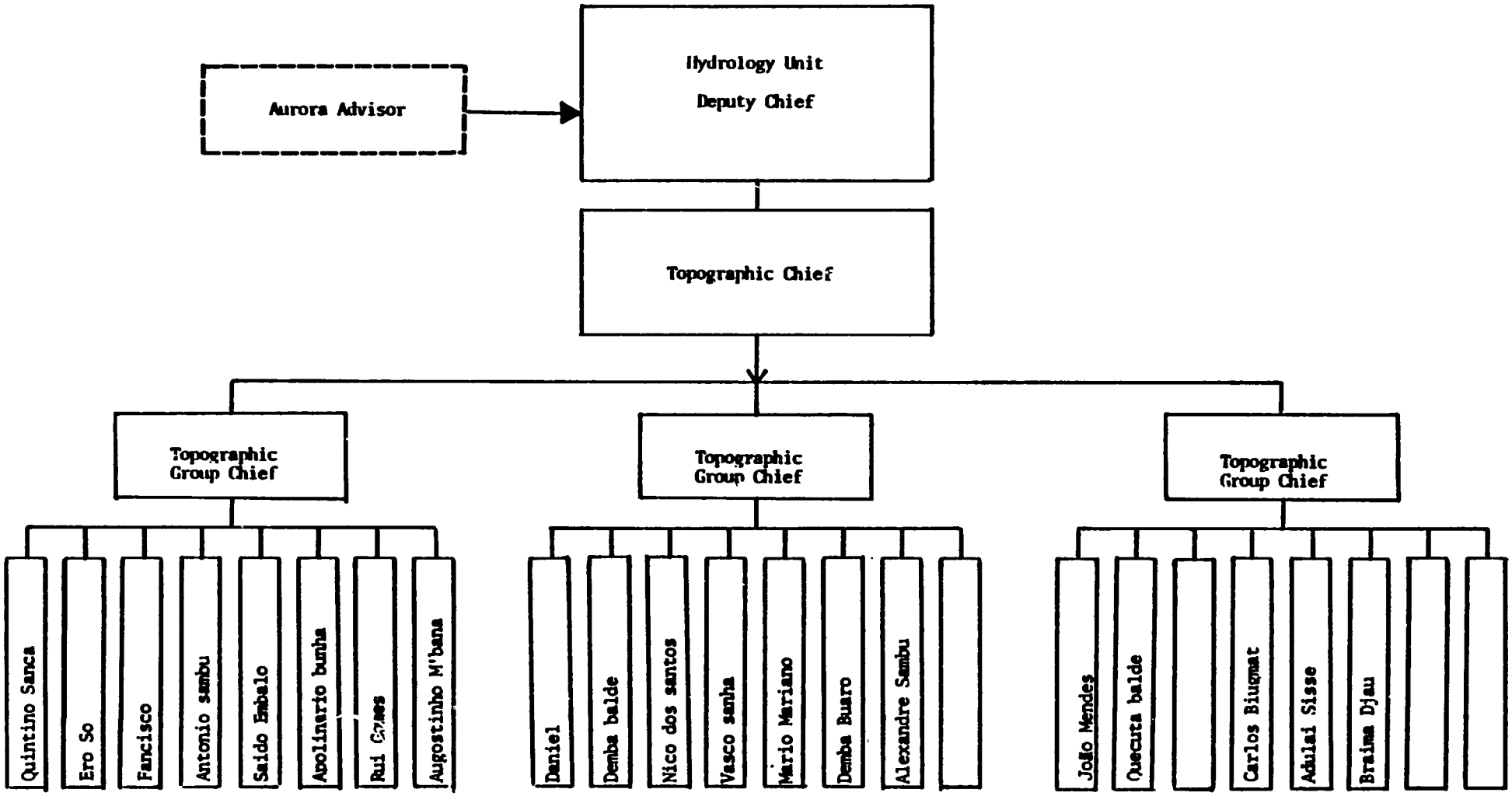
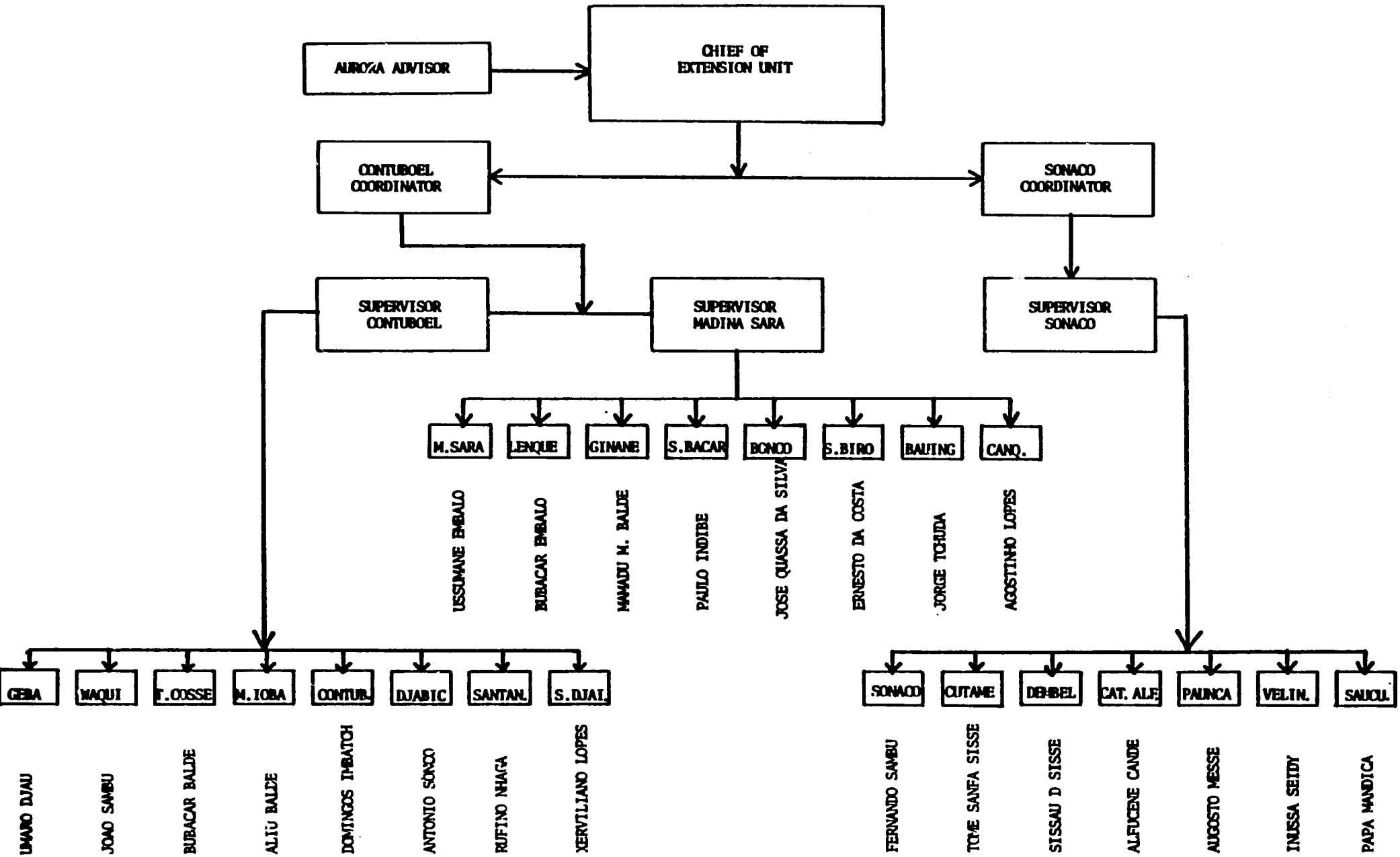


FIGURE 5

EXTENSION UNIT ORGANIZATION CHART



Each unit received technical assistance from the Aurora Team that worked directly with DEPA counterparts. In all units training programs were developed and a formal hierarchy with clear roles and responsibilities was established.

### Credit Unit

The development of the Credit Unit has been a major area of project effort. The Credit Unit provides agricultural inputs on a cash or credit basis. Inappropriate macroeconomic policies, lack of training and management skills, and poor transport and warehousing facilities have significantly limited the effectiveness of the Credit Unit. (For a more complete description and analysis of the Credit Unit refer to Chapter 6, "The Rice Production Project.") There is serious doubt about the sustainability of this effort with the departure of the Aurora Team.

### Hydrology Unit

The need for trained topographers to form the core of the Hydrology Unit was indicated in the original Project Paper. In 1983 a Senegalese surveyor was contracted to train topographers to survey the irrigated rice lands then being developed. He started a training program by teaching basic courses in mathematics and survey methods. This training, along with the practical field work, was the basis for the development of the current group of topographers at Contuboel. With the new direction of the program toward water control in the *bas-fonds*, the need for topographers continued and recommendations were made for a program to train three two-man teams in topography and survey methods. A contract was made with a second surveyor to start this topographer's training program.

The new surveyor arrived in country in April 1985, and with the help of his DEPA hydrology counterpart established a formal training program for four DEPA topographers that began by teaching basic mathematics (addition, subtraction, multiplication, and division) and survey techniques. DEPA selected 12 additional people in 1985 to create two more topographic teams. The new teams rotated with the established group in survey work and would work in the *bolanhas* one week and then two weeks at the Contuboel Center. They helped to lay out roads, trees, housing areas, and recreation facilities.

A third contract for a surveyor training program was made for an eight-month period. The trainer arrived in Guinea-Bissau in December 1986. He was hired under a Personal Services Contract with USAID/Bissau and was furnished a house at the Contuboel Center without furniture or other services such as electricity and water. He returned home after only two weeks.

A recent Guinean graduate from Texas A&M University, with a degree in hydrology, supervises the Hydrology Unit. The Hydrology Unit has three assistant topographers each heading a group of seven people (one topographer, five helpers, and one tractor driver). The topographers are permanent members of the DEPA staff, but the topographic crew are hired on a temporary basis and are replaced as needed. These people are not salaried but given food for their services. The three teams are capable of working alone without assistance from the Aurora Team.

The Hydrology Unit has helped improve water management in 22 *bolanhas*, on 417 hectares within the project area. Beyond this, the Hydrology Unit was also responsible for building and maintaining small water reservoirs.

**Summary**

The Hydrology Unit is well established, and if adequate financial support is forthcoming from the GOGB for operational costs, this unit can continue to function beyond the departure of the Aurora Team, particularly given the presence of Duarte Louis Sá, the recently returned AID participant. The topography teams are sufficiently proficient to implement the engineering dimensions of a contour-diking program using a tractor in the *bas-fond* setting.

**Extension Unit**

Extension agents are the main vehicles for achieving the project purpose: the transfer of a technological package to farmers that allows them to increase farm income. The success of the project may be measured by the effectiveness of the extension agent who is the critical intermediary between the project and the farmer. At present there are 24 trained extension agents.

The extension agents' effectiveness depends on a selective recruitment process, adequate training and familiarity with agricultural research, appropriate wage incentives, frequent supervision, personal capacity to communicate with a large number of farmers, and the general logistical support provided by the Contuboel Center.

**Recruitment and Capacity to Communicate with Farmers**

In 1986 the project more than doubled its 12-person extension agent service by adding 14 new recruits. The project improved the recruitment procedure of extension agents with a written examination and an oral interview aimed at assessing the candidates' potential as good extensionists. The system selects recruits with the necessary minimal educational preparation and personal qualities for the job. It also makes some attempt to test the previous training, agricultural experience, and technical know-how of the recruits through specific questions and problems included in the written test. Preference is given to candidates speaking Fula. This in itself is a considerable improvement over the previous informal, virtually arbitrary recruitment process, which did not consider previous field experience or linguistic abilities.

Recruitment efforts have been hampered by the non-availability of qualified female candidates in the region with five years of high school and who are willing to live in somewhat difficult conditions. Female extensionists communicating directly to the female rice producer would allow for an easier flow of information. Also, the meager number of qualified senior candidates has hurt the project. Seniority signifies to many farmers in this patriarchal society experience, knowledge, and maturity.

At present all extensionists are male, about 60 percent speak Fula, and many originally come from rural areas although schooling was received in cities. Extension management recognizes the shortcomings in the system and has made a concerted effort to aim recruitment and/or on-the-job training in the direction of addressing the more obvious problems. The new, formalized recruitment procedure is sustainable by DEPA management after the departure of the Aurora Team.

**Training and Research**

Extensionists receive theoretical and practical training that generally take place during the dry season. In 1985 three one-day farmer training sessions were held in the form of field days. In 1986 three week-long courses were given: one in water management and two in rice production. In addition there were three one-day training sessions during the rainy season: one on improved farm management and two that examined model extensionists and farmers' plots to assess relative advantages of various techniques. In the off-season of 1987, a five-week training course was conducted in rice production and extension methodology.

These courses were designed by the Aurora Extension Advisor. In general he is responsible for preparing about 70 percent of the sessions and has recently completed a preliminary text on "Extension Methods and Rice Production Techniques" to be used in the training program. The remaining 30 percent of training sessions are given on selected topics by DEPA staff and long-term training returnees. About 35 percent of the training time is spent in practical field and laboratory work while the remaining 65 percent is spent in the classroom.

Extensionists receive practical training while cultivating and maintaining their own rice plots within the village *bolanha*. The land for extensionists' plots is granted by the villagers and is used to demonstrate traditional and improved agricultural practices as well as the effects of fertilizer application. These fields simultaneously serve as an important source of the extensionists' subsistence needs.

Within the last three years, the project has greatly expanded its training facilities both in theoretical and in practical aspects. Nonetheless, several areas might still be improved. First, even though DEPA staff participate in providing about 30 percent of training in the new sessions, there is no indication that this percentage is sufficient to make the sessions sustainable after the departure of the Aurora Team. More effort should have been made to transfer responsibility of training sessions to qualified DEPA personnel and to ensure the regular input of short-term trainees through lectures on subjects in which they were trained. Both practical and theoretical training might also have been extended to farmers on a

greater scale since they are potentially the greatest catalysts for change at the village level.

### Wages

Extension wages vary from 6,200 PG to 11,400 PG. Wage scales in 1985 appear to have been somewhat arbitrary given that extension supervisors receive lower wages than certain extension agents. In 1986 organizational shifts resulted in more balanced pay scales. New recruits were consistently paid 6,200 PG while old agents received the same salaries. In 1987 most of the personnel working in the Extension Unit received an increase making the new range 8,000 PG to 10,300 PG. Extensionists could choose to receive their salaries in PG or rice, oil, and sardines. The market value of these goods is equivalent to three times their salary. Because of very low wages, several extensionists left to pursue more lucrative professions. Others were relieved of their duties for various infractions of discipline including in some cases the misuse of project funds.

In 1986 and 1987 the project, rather than DEPA, paid the salaries of all new recruits. While this ensured the availability of extension agents necessary to the project, in the short run it has created a unsustainable situation. The GOGB has had, over several years, serious problems paying their employees, and it is questionable whether the 12 newly recruited extension agents and 12 existing agents may be able to be maintained by government funds.

### Supervision

The Aurora Team reorganized the Extension Unit to ensure regular contact with the farming community. Starting from the 1986 rainy season, each extension agent was supposed to make regular bi-weekly visits to all *tabancas*. Other extensionist activities, such as periodic field training, demonstration plot work, and record-keeping, were also programmed into the bi-weekly timetable.

In theory each extension supervisor was responsible for overseeing the activities of eight extension agents in the supervisor's assigned zone. In coordination with the extension agents' schedules to demonstrate new techniques or oversee farmers'

activities in various areas of the *bolanha*, supervisors were also to follow daily schedule of visits to project *tabancas* within the supervisor's zone. The objective of these visits is to assess extension agent skill in demonstrating the new technology, to verify that extensionists are on site and following the pre-planned schedule, and to hear any complaints or comments by farmers about extension agents' performance.

This system contains a number of serious problems. Although schedules allow for the coordination of activities between agents and supervisors, the proposed intensive rhythm of activities is not realistic. The inability of agents and advisors to follow schedules is mainly due to transport problems. Consequently, some extensionists visited distant *bolanhas* within their extension areas only once a year while supervisors performed less than one-third of their scheduled visits.

Although extensionists were originally provided with bicycles, and supervisors were to receive motorcycles, most bicycles are in disrepair and motorcycles only arrived in May 1987 and have not yet been distributed. DEPA was nominally responsible for vehicle maintenance, and particularly for the furnishing of spare parts, but this assistance has not been forthcoming. As a result supervisory functions overlapped considerably with coordinator functions, since the extension coordinator, who has access to project cars, has had more frequent contact with the supervisor's extension agents than the supervisor, himself. Until transport problems are resolved, schedules should be trimmed down, and the extension coordinator should attempt to support or substitute for supervisors in their proposed activities.

**Logistical Support**

A final area that detracts from extension effectiveness is the difficulty in receiving regular and timely logistical support from the Contuboel Center. Inputs such as fertilizer and seed often arrive long after they can be of any use to farmers. Insufficient transport facilities make field demonstrations, extensionist visits to other villages of the *bolanha*, and regular extension supervision and credit-monitoring difficult. In the farmers' eyes, many of these shortcomings may be perceived as a result of the disinterest or irresponsibility of the extension agent. This situation must be remedied if extension agents are to be looked to for any authority in rice farming.

**Conclusion**

Considerable progress has been made in creating an institutional capacity to deliver services to the rice-farming population in the project area. However, it is doubtful that the activities of the Extension and Credit Units can be sustained after the departure of the Aurora Team. The lack of the GOGB ability to mobilize resources to support this institutional effort and the extremely short period of 27 months to realize the objectives explicit in this output worked against the successful accomplishment of the stated output.

**Farmers as Extension Agents**

The extension system as currently structured is not working. Available resources are small, there are serious transport problems, and educated staff feel little incentive to live in the village and perform extension functions at such meager wages. How then might the project develop an outreach capability that is sustainable in the face of all these problems?

The answer may lie in the farmer and a complete restructuring of the extension program to meet local conditions. In Guinea-Bissau, farmers, who comprise 90 percent of the population, are natural extension agents. Not only are they the local resource with the most extensive agricultural knowledge and experience, but as part of the village social structure, they also could be the most effective diffusers of new ideas. They know how, and with whom, to communicate and are likely to be more reliable as a result of village social pressure to perform their tasks properly.

The farmers are a much more sustainable extension resource than are paid GOGB extension agents. Nonetheless, they would have to be given sufficient incentives to either leave their fields and families during the year or give up their money-making activities in the dry season. Given DEPA resources, wages could not be an incentive, but giving model farmers research or practice plots within the project permits experimenting with high-yielding project seeds or fertilizers. Training trips for selected farmers performing extension functions might also be offered as additional incentive. As insiders in the community, farmers would

undoubtedly be more effective at extending the project's technological package. This idea does not suggest the elimination of extension agents, but the tailoring of the extension system in keeping with local conditions and financial limitations. Extension agents would supervise a broader area while farmer extension agents would concentrate on the mastering of new techniques at the village level.

New training procedures would have to be designed for presumably illiterate students. Although some may claim that concepts such as photosynthesis can only be understood by people with a fifth grade education, there is no reason why people with a sound knowledge of rice cultivation cannot grasp the concept if it is explained to them in appropriate terms. Training would be conducted in Fula and would probably take longer than current training programs because of the illiteracy problem. Learning would have to be done by role playing and practice rather than by writing.

Clearly, for farmers to be extensionists, a new recruitment procedure must be carefully designed. It must try to select the farming innovators who are eager to receive training, who would be reliable and regularly attend training sessions, who have good village standing, and good communication capacity.

## OUTPUT: EXPERIMENTAL FARMER ASSOCIATIONS OPERATING AND SUPERVISED BY DEPA TECHNICAL PERSONNEL

Between 1985 and 1987 no experimental farmer associations were formed. DEPA asserts that, rather than imposing new structures on the farmers, it prefers to support a system that villagers suggest. This approach has resulted in the formation of *Bolanha* Rice Committees, the main intermediaries between DEPA and farmers, particularly with regard to making agricultural inputs available to the farmer. The Rice Committees are composed of one to three people, and they are responsible for distributing *bolanha* parcels, mobilizing and coordinating farmers in joint work activities, and ordering and distributing agricultural inputs. In DEPA's view, this is a type of farmers' association since *Bolanha* Rice Committee members are selected by the villagers.

Indeed, to date these *Bolanha* Rice Committees have been crucial to the functioning of the credit system, for it is to the *Bolanha* Rice Committee and not the farmer that the project directs its agricultural inputs. But little attention has been paid to the relationship between *Bolanha* Rice Committees and farmers. The evaluation team observed that what project staff describe as the *Bolanha* Rice Committee consists primarily of male representatives from the village that first requested project assistance and after which the *bolanha* and extension area are named. Although *Bolanha* Rice Subcommittees appear to exist in a number of secondary villages within the same extension area, these subcommittees must channel their communication with the project through the central *Bolanha* Rice Committee.

In terms of representation, the Committees appear to have two flaws:

1. They appear to represent the villages' male traditional political hierarchy, rather than the interest of *bas-fond* rice farmers who are women; and

2. They may be biased toward the interest of a single village that potentially holds a monopoly on village project relations rather than representing the interests of the farmers within a *bolanha.*

Female farmers' accounts suggest that men have priority in the use of credit materials such as donkey carts, animal traction, and large hoes. Only when men have finished using these materials in their fields are they transferred to the *bas-fond bolanhas* for which they were originally intended.

Not only might the distribution of materials be biased toward the central village of the extension area, but it also appears to favor wealthier farmers. A villager who can afford a donkey cart generally charges non-family members 10 percent of their rice harvest for its use in transporting produce from the fields to the compound. Some animal plow owners charge rice farmers as much as 1,000-1,500 PG plus animal feed for the use of their bullock plow for one-half a day.

Moreover, farmers who desire project inputs must make requests via male household heads who, in turn, contract the *Bolanha* Rice Committee. Women and subordinate villages rarely make requests directly to the extension agent or to the credit monitor. This complex communication network makes it difficult to ensure that

the ordering and distribution of project materials is in accordance with the real rice farmers' needs.

Although *Bolanha* Rice Committees may facilitate the distribution of certain services to certain sub-groups within certain villages, there is no guarantee that these services reach the rice farmer. *Bolanha* Rice Committees are no substitute for true farmers' associations that would select representatives directly from the farmers within the *bas-fond* to whom the project allegedly is extending, rather than from among the village political hierarchy. Given the readiness with which village leaders accepted female horticultural associations, there is no indication that rice associations would be any more difficult for village leaders to accept.

What are referred to as *Bolanha* Rice Committees might more effectively be called agricultural committees and, if properly organized, could potentially play a very important role in coordinating donor activities and mobilizing agricultural inputs among the diverse agricultural activities that characterize the complex farming systems of the area.

## OUTPUT: DEVELOPMENT OF A GEBA RIVER VALLEY PLAN

The Project Paper Supplement called for the drafting of a provisional plan for development of the Geba River Valley. This plan has not been drafted to date. The Aurora Team feels that two years was insufficient to assess the possibilities for the implementation of improved agricultural technologies in the Geba River Valley. As stated in its 1986 Annual Review (February 1987), the Aurora Team was "still unable to make a judgement on the progress of the present work in the *bolanhas*" and felt it would be untimely to attempt to draft a plan. According to the Aurora Team, no direction was given by USAID/Bissau about the requirements of such a plan. Considering the limited time available for technology generation, the Aurora Team was justified in its decision not to attempt a provisional development plan for the Geba River Valley.

In a meeting with the DEPA Director, several points were mentioned which might eventually be incorporated into a development plan. These points include intensification of rice production in *bas-fond* land; diversification of efforts into programs designed to increase production of sorghum, millet, maize, cowpea, and manioc; increased work with horticultural crops; and production of rice in the dry season using water from the Geba River.

# CHAPTER EIGHT

# THE ECONOMICS OF RICE PRODUCTION IN THE PROJECT AREAS

## PRODUCTION COSTS

Several types of technologies have been tested by the project during its two-year life. No provision was made during project implementation to obtain contributions from an agricultural economist. As a result, economic data on the technologies tested by the team were not collected in a systematic fashion. The data that are available on production costs come from a description of the improved technology contained in the Aurora Team's Fourth Quarter 1986 Project Progress Report and should be interpreted with caution. Unfortunately, no data are available on production costs of traditional technology.

The objective of the production cost analysis is to estimate the returns to labor (RTL) of the improved technology, assuming a free market environment. Inputs are costed at their parallel market price estimated by the Aurora Team at approximately 300 percent of the official price. Producer price is also calculated at the free market rate, approximately 350 PG per kg of milled rice. The data on labor inputs come from estimates made by the Aurora Team based on interviews with a small number of farmers who were not selected by random sampling methods. The analysis of production costs assumes that partial contour dikes are constructed by tractor and that dike and drainage work are completed by farmers. Farmers pay for tractor fuel, but the analysis assumes that tractor and survey services are provided at no cost. For the purposes of this analysis, transportation costs from field to village were not included. (These can range as high as 10 percent of harvest.)

The RTL of the improved rice technology are estimated at 195 PG per hour for farmers using manual tillage techniques (see Table 11, Production Costs Associated with Improved Rice Technology, Manual Soil Preparation). Bullock traction is the dominant form of animal traction in the project area, and the RTL increase to 229 PG per hour when bullock traction is used for land preparation (see Table 12, Production Costs Associated with Improved Rice Technology, Bullock Traction Soil Preparation).

Table 11

Production Costs Associated with Improved Rice Technology, Manual Soil Preparation

| | | | |
|---|---|---|---|
| | | | PG per ha |
| COSTS | | | |
| Fuel /1 | | | 1,800 |
| NPK /2 | | | 21,150 |
| Urea /3 | | | 22,050 |
| TOTAL COST | | | 45,000 |
| REVENUE | | | |
| Yield | ton/ha | 2.8 | |
| Milling Rate | % | 70 | |
| Rice price | PG/kg | 350 | |
| TOTAL REVENUE | | | 686,000 |
| REVENUE ABOVE VARIABLE COST | | | 641,000 |
| LABOR TIME | | | NUMBER OF HOURS PER HA |
| Dikes /4 | | | 887 |
| Soil Prep. | | | 280 |
| Planting | | | 537 |
| Fert. Applic. | | | 70 |
| Weeding | | | 933 |
| Harvest | | | 350 |
| Threshing | | | 233 |
| TOTAL LABOR | | | 3,290 |
| RETURNS TO LABOR | | | PG/hr. 195 |

Source: Fourth Quarter (October-December 1986, Project Progress Report, Aurora Associates, Inc. and interviews with the Aurora Team.

NOTES

Input costs and producer price are calculated at parallel market rates
Assumes partial construction of contour dikes by tractor.
Assumes hand tools and animal traction equipment are available.

1/ Estimated at 9 liter/ha. at 200 PG/liter.
2/ 150 kg/ha at a cost of 141 PG/kg.
3/ 150 kg/ha at a cost of 147 PG/kg.
4/ To finish work and dike and drainage canal construction where applicable.

Table 12

Production Costs Associated with Improved Rice Technology, Bullock Traction Soil Preparation

Soil preparation utilizing bullock traction.

| | | | PG per ha |
|---|---|---|---|
| COSTS | | | |
| Fuel /1 | | | 1,800 |
| NPK /2 | | | 21,150 |
| Urea /3 | | | 22,050 |
| TOTAL COST | | | 45,000 |
| REVENUE | | | |
| Yield | ton/ha | 2.8 | |
| Milling Rate | % | 70 | |
| Rice price | PG/kg | 350 | |
| TOTAL REVENUE | | | 686,000 |
| REVENUE ABOVE VARIABLE COST | PG | | 641,000 |
| LABOR | | | |
| Dikes /4 | | | 887 |
| Soil Prep. | | | 47 |
| Planting | | | 280 |
| Fert. Applic. | | | 70 |
| Weeding | | | 933 |
| Harvest | | | 350 |
| Threshing | | | 233 |
| TOTAL LABOR | | | 2,800 |
| RETURNS | | | PG/hr. |
| TO LABOR | GP/hr | | 229 |

Source: Fourth Quarter (October-December 1986, Project Progress Report, Aurora Associates, Inc. and interviews with the Aurora Team.

NOTES

Input costs and producer price are calculated at parallel market rates
Assumes partial construction of contour dikes by tractor.
Assumes hand tools and animal traction equipment are available.

1/ Estimated at 9 liter/ha. at 200 PG/liter.
2/ 150 kg/ha at a cost of 141 PG/kg.
3/ 150 kg/ha at a cost of 147 PG/kg.
4/ To finish work and dike and drainage canal construction where applica

The RTL would be higher in subsequent years as fuel costs would be eliminated and dike work reduced.

The increase in the RTL was due to a decrease in the labor time needed for soil preparation and weeding. No data were available on the yield increase associated with animal traction; this effect needs to be investigated further.

In the village setting, it is always difficult to determine an opportunity cost for labor. If no alternate occupations exist, the opportunity cost is effectively zero. In the rainy season, there are certainly alternate activities in which women (the dominate rice producers) could be engaged, and the opportunity costs of labor is therefore not zero.

A market does exist for women's labor, but costs are difficult to estimate. They vary depending on the season of the year, the type of work to be done, and the religion of the worker. The relationship between employer and employee is also important; family members or friends often accept only food for the labor they provide. The Aurora Team estimated the average cost of women's labor at 485 PG per day (69 PG per hour based on a seven-hour day), including food. The RTL of the improved technology compares well with this estimate. From information provided by the Evaluation Team's Social Scientist, it can be deduced that labor costs can be as high as 175 PG per hour. At this rate the improved technology is considerably less attractive.

The Aurora Team feels that men's participation is necessary for the successful completion of contour dikes. No data were available to estimate the opportunity cost of men's labor, especially as it relates to the production of sorghum, peanuts, cotton, or millet. It is not possible to make any definitive statements regarding the attractiveness of the technology to men. The reluctance observed on the part of men to participate in dike construction may be an indication that their opportunity cost at that time is greater than the RTL of the improved technology package.

## RISK

The risk involved in adopting a new technology is undoubtedly an important aspect of a farmer's adoption decision. Adoption of the project rice technology

requires farmers to increase their cash outlay. Given the average parcel size of 3,000m$^2$, and recommended fertilizer application rates, farmers incur a cash cost of 12,960 PG (exclusive of tractor fuel). At a parallel market price of 350 PG per kg of milled rice, this represents only about 6.3 percent of their potential milled production. In addition improved water management should also help to reduce the risk incurred by farmers. To have a more accurate idea of the risk involved in the improved technology, it would be useful to have data on the proportion of farmers who were not able to cover their cash cost. The preliminary data available indicate that the risk associated with adoption of the improved technology is minimal.

## POLICY DIALOGUE

Prior to late 1986, the GOGB was controlling producer prices. Prices on agricultural inputs were also controlled, and continue to be so at the Contuboel Center. The objective of this section is to examine the effect on the RTL of the improved rice technology under price control and input subsidy policies.

In the case of the improved rice technology, fertilizer is the only purchased agricultural input. Not surprisingly, when fertilizer prices are subsidized, the RTL of the new technology increase under both manual traction and bullock traction but only by about 9 PG per hour (see Table 13, Effect of Input Subsidies and Product Price Controls on Returns to Labor of Improved Technology). Because fertilizer costs are relatively low, in comparison with labor times, the effect of fertilizer subsidization on the RTL is small. This is an important point for technology development -- the greatest payoff is likely to result from reducing labor times.

The project operated during periods of controlled producer prices, and the RTL under this situation are presented. Even with fertilizer subsidized, the RTL are still relatively unattractive under controlled producer prices. This, again, is due to the fact that fertilizer costs are relatively low and any savings occasioned by a fertilizer subsidy are more than offset by the lower producer price. In conclusion, relatively high fertilizer subsidies have little effect on the RTL of the improved rice technology. Given the large expenditures required to provide fertilizer subsidies on a national basis, these preliminary results indicate that the GOGB might be wise to re-evaluate its fertilizer-pricing policies.

## Table 13

## Effect of Input Subsidies and Product Price Controls on Returns to Labor of Improved Technology

Manual soil preparation

| | | Input Price Subsidized[1/] | |
|---|---|---|---|
| | | Yes | No |
| | | RTL GP/hr. | |
| Product Price Controlled[2/] | Yes | 25 | 16 |
| | No | 204 | 195 |

Soil preparation utilizing bullock traction

| | | Input Price Subsidized | |
|---|---|---|---|
| | | Yes | No |
| | | RTL GP/hr. | |
| Product Price Controlled[2/] | Yes | 29 | 19 |
| | No | 239 | 229 |

1/ Subsidized Prices: NPK - 47 PG/Kg.
Urea - 49 PG/Kg.

Unsubsidized Prices: NPK - 141 PG/Kg.
Urea - 147 PG/Kg.

2/ Producer Prices Controlled at 50 PG/Kg.

Parallel Rate Estimated at 350 PG/Kg.

# CHAPTER NINE

# LESSONS LEARNED

## ECONOMIC LESSONS LEARNED

The major economic lessons learned during implementation of the Rice Production Project include:

- The GOGB appears to be committed to instituting policy reforms designed to increase the role of the free market in the national economy. For farmers, this should mean higher prices for their products. Farmers will not adopt new technologies if adequate product prices do not exist.

- One objective of the input supply system was to encourage farmers to participate in improved rice production. Inputs purchased by the project were sold at less than their purchase price because of price controls. In addition, transportation and administrative costs could not be covered. As a result, subsidies on some inputs were greater than 90 percent. Providing inputs to farmers at below market prices as a way of encouraging participation is costly, non-sustainable, and leads to problems of management and accountability. Past macroeconomic policies have made it extremely difficult to operate an input provision system on a sustained basis.

- The private sector is generally able to provide services in a more timely manner and in a more efficient way than is the government. Macroeconomic changes that favor the private sector will do much to encourage the provision of agricultural inputs. If farmers receive adequate prices for their production, they will be able to purchase agricultural inputs from the private sector.

- Farmer unwillingness to adopt new rice technology may indicate lack of appropriate economic incentives. It is therefore important to have accurate and reliable information on the cost and returns of any improved agricultural practice. As a project attempts to test and extend improved technology, provision should be made for collecting economic data.

## RURAL DEVELOPMENT LESSONS LEARNED

### Agricultural Interventions and Project Design

The original objective of promoting improved rice production by using low lift pumps to move river water onto rice fields was worth testing. However, this option was abandoned as a result of the 1984 Evaluation. The project was redesigned to promote agricultural production using the following guidelines:

1. The project should be responsive to the priorities of the farmers in improving their total cropping system.

2. Significant improvements in land and water management can be made using animal traction and/or manual labor and hand tools if the proper technical assistance, extension, motivation, and related incentives are present.

3. Use of heavy equipment in the cultivated areas to help farmers with land shaping and construction of dikes and channels will reduce incentives. This approach is not readily extendable or sustainable.

4. Areas currently in rice production can realize a several-fold increase in yield with rudimentary water and land management and improved inputs.

These guidelines were found to be unreasonable by the Aurora Team and, with the support of USAID/Bissau, tractor-constructed dikes became the principal development intervention in the Rice Production Project. As it turned out, a two and one-half year period was not sufficient to answer questions concerning the sustainability or replicability of contour diking. No economic analysis of the water management benefits of these interventions was performed.

Since the redesign, catchments to store water for agricultural purposes as well as animal traction and labor-intensive methods of dike construction have been tested. It is impossible to draw any valid lessons as to the appropriateness of these two approaches.

**Lessons Learned**

- Improved technology cannot be produced without allowing sufficient time for the research necessary to develop and evaluate a technical package.

- The project attempted to test too many different water management techniques. No one technique was tested long enough to prove its acceptability, sustainability, and replicability.

- The lack of monitoring by either USAID/Bissau or REDSO/WCA, which played the major role in the evaluation and redesign of the project, resulted in the Aurora Team drifting from the technical guidelines suggested by the Project Paper Supplement.

- A project that attempts to improve production capability must have baseline data against which to measure change. No such baseline data existed.

- A project that is to determine effectiveness and appropriateness of costs must collect data in a systematic way. Data gathering by the Aurora Team evolved over the course of its tenure. The need to have an agricultural economist to make periodic contributions to the technical assistance team is critical.

**Extension**

A major feature of this project was its support of the development of extension services. The technical assistance team pursued this purpose diligently. However, the project never produced a superior technological package that the extension agent could take to the farmer.

**Lesson Learned**

- Before introducing an extension program that is interacting with farmers who have evolved a complex survival strategy, it is imperative to offer a proven technology that will result in the improvement of their farming system. This implies a program of farming systems-type adaptive trials and demonstrations before and during extension efforts.

**Farmers as Extensionists**

Most available recruits to become extension agents have very modest educations and little agricultural knowledge before beginning work. The project paid or supplemented the salaries of 20 extension and credit agents. The GOGB and DEPA do not have the funds to continue support of these people. Many DEPA staff are often not provided with enough incentives to remain with the center. This also results in performance problems.

**Lesson Learned**

- When qualified extensionists are few and those that exist cannot be paid adequately, recruitment procedures and training programs should be directed to the most sustainable extensionists, those who are adapted to village conditions and the most effective diffusers of ideas -- the farmers.

### Role of the Social Scientist

The project was designed to promote an improvement in the agricultural production of Sahelian farmers in Zone II. No baseline study or agricultural census was conducted before or during project implementation. Without basic knowledge about the practices priorities and attitudes of the farm population, it is impossible to predict or even measure the effects of a new technology on land tenure labor constraints, traditional agronomic practices, diet, and social disparities. Over the last three years, there is no evidence that a social scientist participated in the technical assistance team's work or deliberations. Yet the team recognizes that a major impediment to acceptance of contour diking has been a people problem, not merely an agronomic or water management problem.

#### Lesson Learned

- A social scientist must be incorporated in a project that attempts to change social and cultural patterns and to have an impact upon the attitudes of the family farmer.

## INSTITUTION BUILDING LESSONS LEARNED

### Government of Guinea-Bissau Personnel

The GOGB technicians at the project site have made a concerted effort to make the Contuboel operation work. However, there is a very serious lack of management skills among the Contuboel leadership that influences every aspect of the operation. The staff cannot be faulted as they have not received training in management principles; yet they are called upon to administer and coordinate the numerous activities of the Contuboel station. Technicians in both the AID and the FAO projects have made significant steps in establishing management and control systems, but these will remain largely ineffectual until local technicians learn to implement and respect them.

**Lesson Learned**

- The lack of management skills must be addressed before DEPA will be able to provide sustainable services to farmers. USAID/Bissau must consider assisting the GOGB in building its own institutional capabilities. Of the highest priority is to provide basic management training for technicians in management positions.

**Basic Education**

A serious constraint of the staff at Contuboel below the supervisory level is their lack of basic education. This shortcoming has hindered their job performance.

**Lesson Learned**

- Technical assistance introduced into Contuboel should make allowances for this problem. A full-time basic education program, sponsored by AID or another donor, should be developed to upgrade the human resource capacity of all staff below the supervisory level.

**Government of Guinea-Bissau Contribution**

The project design assumed certain contributions by the GOGB. Among these obligations were salaries of DEPA employees and fuel and oil for project vehicles. It has become clear that the GOGB does not have the means to meet these obligations. In the last two years, USAID/Bissau has provided supplementary funds (P.L.480 reflows) for salaries of extension personnel and diesel fuel and gasoline to run the Contuboel Center. At one point, DEPA was several months in arrears on its utility bills and soiicited help from USAID/Bissau. Project petty cash funds controlled by the Aurora Team have been repeatedly used to purchase fuel and oil to run project vehicles. There are no indications that this situation will improve.

**Lesson Learned**

- If USAID/Bissau is determined to continue field projects, it should be understood that the GOGB does not have the means to contribute significantly to the operation. Budgets for the most basic expenses should be built into the project from the beginning. In this way, expectations will be more realistic and activities will not be jeopardized by the lack of necessary inputs.

## PROJECT PLANNING AND IMPLEMENTATION LESSONS LEARNED

### Project Management

One factor that hindered the progress of the Rice Production Project was the lack of satisfactory project monitoring on the part of USAID/Bissau. Its files for the Rice Production Project are sparse. The Aurora Team provided the Evaluation Team with the only complete documentation available. The Evaluation Team was not able to interview any USAID/Bissau official knowledgeable about the project. However, there are several clear indications of USAID/Bissau's approach. These include:

1. No workable implementation plan that could be used as a common road map by USAID/Bissau, the Aurora Team, and the GOGB;
2. No clear designation of responsibility for the Rice Production Project within USAID/Bissau;
3. No systematic and periodic reporting or field visits to the project site on the part of USAID/Bissau;
4. No commodity procurement plan;
5. No participant training plan; and,
6. Only two Project Implementation Letters exist to provide guidance to the GOGB regarding basic procedures to be followed.

### Lesson Learned

- Proper planning and monitoring can play a significant role in attaining project purpose. No such planning or monitoring on the part of USAID/Bissau are in evidence with regard to the Rice Production Project.

### Budgeting

USAID/Bissau was unable to provide the Evaluation Team with a clear picture or even an approximate idea of the budget and pipeline status for the Rice Production Project. As it turns out, the Aurora Team has had the same problem, making it extremely difficult for the Chief of Party to monitor the project budget.

As a result, there was insufficient information to plan procurement of commodities, study visits, participant training, and operational expenses.

**Lesson Learned**

- The USAID/Bissau Project Officer should set aside time when pipeline updates are received from REDSO/WAAC to meet with the Chief of Party so that budgeting might be more of a collaborative effort. This would also allow a technical assistance team to be made aware of project-related secondary activities initiated by organizations other than the contractor.

**Commodity Procurement**

The Aurora Team was able to identify all the equipment and supplies needed and make a global procurement request to USAID/Bissau through the GOGB in 1985. Although Contuboel agreed to the original request for materials, PIO/Cs were not generated until DEPA/Bissau and USAID/Bissau reviewed the requests. Lengthy delays were encountered at this point, and further delays resulted from the lack of appropriate catalogues with which to reference needed items for purchase agents. The longer the delays, the more changes that were made in the original request. In the end the Aurora Team was uncertain about what materials had actually been ordered. Some equipment trickled in during the later part of 1986, but the bulk of the commodities arrived in early 1987 or have yet to arrive.

**Lesson Learned**

- USAID/Bissau is not able to attend to the complexities involved in identifying, purchasing, and delivering commodities needed in the field. Perhaps this would be more appropriately handled through the contractor. The GOGB and the contract team should jointly generate commodities requests, and if, for any reason, there is a need to alter items, this should be done in collaboration with project personnel.

**Use and Control of Materials and Equipment**

Commodities purchased with project funds are routinely turned over to the GOGB with the expectation they will be used for project purposes. However, experience has demonstrated that DEPA tends to view its activities globally, and the

Rice Production Project's objective were not always a priority. For the Aurora Team, this has meant serious compromises in the program over the last two years.

**Lesson Learned**

- If project personnel do not have access to commodities necessary to the work for which they are held accountable, project objectives are compromised, the technical assistance team is over-extended, and undue strain is put on the technical team/host government relationship. There should be a clear and official policy regarding commodities purchased for a project included in the grant agreement signed by both governments. Equipment and supplies that are necessary for the realization of project outputs should be under the control of the technical assistance team until the end of the project at which time they could revert, as per AID policy, to the host government.

**Time Constraints**

The project was redirected in late 1984 following a REDSO evaluation. A new technical team was brought in and given the remaining two years in which to accomplish a great deal. In fact, technical assistance was extended an additional seven months to consolidate gains made as of the end of 1986. Most projects attempting any kind of significant change expect to invest at least five years of work to those ends, although 10 years has often proven more realistic.

**Lesson Learned**

- If there are only two to three years with which to work, it is inadvisable to attempt field activities in Guinea-Bissau.

**Support for a Technical Assistance Team**

It is not easy to support a technical assistance team in a country such as Guinea-Bissau. The Aurora Team did not have a consistent contact person at USAID/Bissau with whom to work. The roles of the USAID/Bissau staff connected with the project were fuzzy. This certainly contributed to a lack of follow-up.

USAID/Bissau accepted the responsibility of providing support services for the contract team. The record suggests that USAID/Bissau's performance in this area was unsatisfactory. Freezers in which to stock food, electricity to run freezers and pump water, and a plethora of related essentials were furnished and paid for by team members. Because the GOGB was reluctant to spend project funds on a generator for the Aurora Team, team members installed a generator at their own expense.

The project is located at an agricultural station where telephone communication, health facilities, and often food are non-existent. One works and lives with the same small group of people. Two of the members on the Aurora Team were allowed to bring families with infant children to this area. Yet the team was instructed to remain continuously on site, a restriction that was imposed only on AID contract technicians at this station. When it was necessary to leave the station for any reason, team members were charged $0.50 per mile -- thus a child's visit to the health unit in Bissau would cost a contractor $120; the nearest phone is $22 away. The technical team was thus made to feel that their physical and mental health were not a significant consideration of AID.

**Lessons Learned**

- Given the administrative capability at USAID/Bissau, the attempt to manage field projects is unrealistic. USAID/Bissau should consider contracting out management functions including general procurement. The technical assistance team would then be freed to provide its own support services through its home office or a locally developed capability.

- USAID/Bissau should designate a single Project Officer to handle any one project. This person should coordinate closely with the Chief of Party. Regular fixed meetings should be strictly respected.

- A technical assistance team must feel that it is working in collaboration with the USAID/Bissau and the GOGB for common goals. This will not happen if the team's welfare is sacrificed. The GOGB does not always understand expatriate needs; thus it is USAID/Bissau's duty to insist that certain conditions be met if technical assistance is to be provided. Given the management problems that exist in Guinea-Bissau, the technical team must be allowed to control resources needed for its own well-being (for example, fuel for generators). If families are permitted to accompany contractors, provisions must be made for their health and safety. Members of a technical assistance team should not be financially penalized for attending to health or survival needs in rural areas.

# CHAPTER TEN

# RECOMMENDED FUTURE COURSE OF ACTION

## RECOMMENDATIONS FOR A POLICY DIALOGUE AS IT WOULD RELATE TO RURAL DEVELOPMENT INTERVENTIONS IN ZONE II

One of the most critical factors influencing the implementation of the Rice Production Project has been the macroeconomic environment in Guinea-Bissau. Because the project was heavily involved in procurement and provision of agricultural inputs, issues such as currency over-valuation, lack of hard currency, and controls on input and prices had a heavy impact on the project but were considered to be outside the effective control of the project and its managers. These policies meant that the agricultural input supply operation needed constant infusions of outside funding to continue to operate.

Controls put in place by the GOGB on produce prices had an influence on farmer behavior. Because costs of purchased inputs were relatively small, compared with labor times, the most critical element in determining economic incentives for participation in the improved rice production technology is the price of rice.

Inappropriate monetary and agricultural policies contributed to a lack of hard currency, as did low world commodity prices. These problems resulted in difficulties with electricity and fuel on the national level and had severe impact on the effectiveness of the project.

Guinea-Bissau has taken steps toward economic restructuring that promise to create a more positive environment for agricultural production. The PG was devalued on the day of the Evaluation Team's arrival and is now in line with its real value. Negotiations with the World Bank on a comprehensive program of structural adjustments are proceeding. These developments need to be encouraged.

As the Guinean economy becomes more market oriented, it will be necessary to encourage the development of an equitable and efficient private marketing system. This may mean accepting variable producer and consumer prices on agricultural commodities that take real transportation costs into account. Until the economic

situation stabilizes, there is likely to be a feeling that private traders are charging unfair margins. Unless databases exist that enable evaluation of market structure, conduct, and performance, it will be difficult to make policy decisions about pricing and market access objectively. Policies need to be established that encourage the development of these databases.

Development activities in Zone II will need to reflect the changing economic realities. Input provision systems that operate at a loss will no longer be acceptable. As the private sector begins supplying inputs, the government will need to reduce its role.

In research and extension programs, more attention will have to be paid to understanding the economics of rice production and the marketing aspects related to it. Guinea-Bissau has great agricultural potential. Agricultural policy should encourage the development of this potential through appropriate research and outreach mechanisms. The Rice Production Project has made progress in this area, but the gains made at DEPA need to be reinforced. Policy will also have to take into account the diversity of agro-climatic conditions and socio-cultural practices present in Guinea-Bissau. This may mean a reduction in the emphasis placed on rice production.

## EXTENSION OF THE RICE PRODUCTION PROJECT

Several reasons argue for the extension of the technical assistance and participant training components of the Rice Production Project. They are:

1. Significant progress has been made in terms of institutionalizing the Credit, Hydrology, and Extension Units. However, these sections are still at an embryonic stage, and these modest institutional gains could be lost if there is not a sustained input of technical assistance.

2. DEPA feels that the Aurora Team has done a good job and, after two years of experience, has a good understanding of the problems inherent with encouraging development in Zone II. The Team can easily develop a full agenda aimed at sustaining the institutional process that it has initiated with DEPA.

3. There is a possibility that one or two members of the Aurora Team would stay on for a limited period of time beyond their current contractual arrangement if a decision is made shortly.

4. The first of two long-term participants has just returned from training. He needs considerable support from the Aurora Team as he is integrated back into the DEPA organization at Contuboel Credit Unit.

5. The existing input sales division is incapable of monitoring commodities that have recently arrived to the project site, or that have yet to arrive, without the assistance of the Aurora Team.

6. Both long- and short-term participant training should be sustained. A list has been prepared by DEPA and Aurora Team that can serve as the basis for a participant training program during this period. It is included at the end of this section.

7. The infrastructure to support the Aurora Team is in place at Contuboel. This has been a long and expensive process, and this infrastructure could easily vanish with the departure of the Aurora Team.

Depending on the availability of funds, this extension could be seen as a bridge to an agricultural project that could be developed over the next eight months and authorized, if all goes well, in the second quarter of FY 1988.

The focus of this interim activity should be to:

1. Strengthen the institutional base of the Hydrology and Extension Units;

2. Implement a short- and long-term participant training program;

3. Monitor the use of USAID/Bissau-provided commodities;

4. Analyze results of water management and agronomic activities undertaken by the project to date;

5. Begin the creation of baseline data on traditional agricultural practices, yields, household consumption, and labor force in villages within the project area; and

6. Monitor the use of any AID-provided agricultural inputs that have yet to be distributed.

This bridge activity should be undertaken only if the following conditions are met:

1. The GOGB indicates strong support for the activities described immediately above;

2. USAID/Bissau is staffed to support this effort in such a manner so as to be able to overcome the management difficulties pointed to in Chapter 9, "Lessons Learned"; and

3. That at least one of the three members of the Aurora Team would be able to stay on to provide continuity.

## RECOMMENDATIONS FOR TRAINING

Training, both long and short term, was planned for DEPA technicians during this last phase of the project that has not been executed. In addition, study visits planned for sites in Senegal and Burkina Faso could not get off the ground. It may be possible to implement the training programs discussed below with funds remaining in the Rice Production Project. The recommendations below are based on DEPA requests reviewed by the Aurora Team.

### Long-Term

1. Contuboel Director, Malam Sadjo, has requested training in water management/topography in the United States. As DEPA already has a technician with these skills, it might make more sense to broaden the director's knowledge of agronomy. He should also receive management training.

2. Extension Chief, Dona Quemabe, should receive training in agronomy and extension. Because he speaks only Portuguese, this training should be done in Portugal or Brazil, which is reputed to have the better extension service. This could be done at an agricultural technical high school, if possible, as Dona has little formal education. He should also receive basic management courses.

3. Chief Topographer, Armando Sambu, should receive training in elementary mathematics, design room skills, topography, and basic management. This should probably be done in Portugal at an appropriate technical school.

4. Other possibilities:

   a) The National Project Coordinator has also requested further education in hydrology and water management at Texas A&M University.

b) If DEPA decides to continue its credit program, a candidate should be sought for long-term training at a technical school in general bookkeeping principles and credit theory. A two- to three-year bookkeeping certificate would probably be possible. This candidate should have the equivalent of a junior high school education.

**Study Trips**

These trips were planned two years ago, but funds and preparations never arranged. They should be done as soon as possible:

1. Burkina Faso: to study dike systems used for holding rainwater. Participants: five best topographers; and

2. SAED in St. Louis, Senegal: Visits to farms to see improved hydraulic systems; exchange experiences with SAED technicians.

   Participants: Dona Quemabe, two extension supervisors, five best extension agents, five farmers, and two credit bookkeepers.

   This trip could be made in the new mini-bus.

**On-Site Training**

If DEPA decides to continue its credit program, technical assistance should be sought for the credit bookkeepers. It is pointless to send these people out for long-term training as they are in need of repeated practice in basic arithmetic and implementation of the credit system.

One option is to use the remaining project funds to create a viable training center at the Contuboel Center. There could be teachers for the different disciplines, including bookkeeping, topography, extension, and management.

## RECOMMENDATIONS FOR A NEW RURAL DEVELOPMENT PROJECT TO BE FUNDED BY USAID/BISSAU IN FY 1988

USAID/Bissau should support an agricultural project in Zone II in FY 1988 for the following reasons:

1. Current economic policy changes at the national level are likely to encourage rural and private sector development. These developments should be supported.

2. It makes sense to develop an agricultural project that can be viewed as a continuation of a sustained development effort.

3. The Evaluation Team agrees that the Rice Production Project was addressing a priority problem. In the process of its implementation, the project should look at the entire crop production system of the Sahelian farmer in Zone II. The GOGB, as well as the Evaluation Team, agrees on this point. A farming system research and extension project would be a logical continuation of the Rice Production Project both in institutional and in technological terms.

A farming system research and extension project in the Contuboel area should have the following characteristics:

1. The project should be modeled on the farming system mode concerned with the entire cropping pattern of the Sahelian farmer in Zone II;

2. The team should be led by an agricultural scientist with previous experience in farming system research;

3. The project should be designed to have an action orientation;

4. A focus of the project should be to link the Research and Seed Multiplication Divisions of DEPA with the Extension Division;

5. The project should last for at least five years with an option for an additional five years if adequate progress is being made;

6. The project should address the basic educational requirements of the DEPA regional staff at Contuboel;

7. Agricultural and cultural patterns of farm families in this part of the Sahel are complex. For this reason, a social scientist must play a major role in both project design and implementation; and

8. An agricultural economist will also have a significant role in such a project.

The purpose of such a project would be two-fold:

1. Develop appropriate technological packages for farmers in this agro-climatic region; and

2. Assist in developing a viable institutional capability within DEPA in farming systems research and extension methodology. These efforts should concentrate on the Seed Multiplication, Research, and Extension Divisions.

A condition to doing this project should be that USAID/Bissau is staffed with a Direct Hire agriculturalist who can play a meaningful role in the development of the Project Paper. To date, most agricultural activities have been designed by personnel that came in for short periods of time and do not have the type of detailed country specific knowledge that results in project designs that can be implemented.

# CHAPTER ELEVEN

# RICE PRODUCTION IN GUINEA-BISSAU -- SOME SUGGESTIONS

## INTRODUCTION

Much of the vegetation in Zone II is also found in south India, north Brazil, and the Philippines. This is not surprising because all are located at about 15 degrees north or south Latitude. Much of the technology developed at the International Rice Research Institute (IRRI) in the Philippines has been useful in those environments. For example, the IR 8 rice variety has produced eight tons/per hectare in each country mentioned. It appears that much of the research done at IRRI may be suitable for use in Guinea-Bissau with minimal additional adaptive work. Thus, closer ties must be established, especially between Guinea-Bissau and the IRRI centers concerned with rice technology, training, and manufacturing of appropriate hand tools and machines.

## CLIMATE

Average rice yields in rice-growing countries range from less than 1 ton to more than 6 tons per hectare Temperature, solar radiation, and rainfall influence rice yields directly by affecting the physiological processes involved in rice production and indirectly through disease and insect manifestations. When water is not limiting, rice yields are primarily determined by solar radiation. When properly managed, the dry season crop usually produces higher yields than the wet season crop because it receives more sunlight.

Little data are available on solar radiation levels in Guinea-Bissau, but they are probably similar to those in the Philippines where about 300 cal/cm$^2$/day are received in the wet season, compared with approximately 500 cal/cm$^2$/day during the dry season.

## TEMPERATURES

Critical low and high temperatures for rice production are 20°C and 30°C, respectively. Temperatures in Guinea-Bissau appear to be similar to those in the Philippines and so would allow year-round rice production resulting in maximum annual crop yields.

The "Rice Garden" concept takes advantage of a year-round growing season. With this concept 1 hectare of land was divided into 16 plots of 625 $m^2$ each. The varieties used matured in 16 weeks, allowing rice to be planted every Monday (52 times a year) and harvested every Friday (52 times a year). This technique resulted in a total yearly production of up to 31 tons per hectare. This technique could be practical in Guinea-Bissau if farmers can count on a stable water supply. It is a good production system and takes advantage of rainfall and solar radiation throughout the year. It produces the highest yields possible per unit of land and allows weekly rice harvests so storage is not a major problem and production gluts are eliminated. It also provides necessary seed when needed. Labor is spread over the year with reduced intensity during any one period.

## RAINFALL

Under rainfed rice culture, where temperatures are within the critical low and high ranges, rainfall is the most limiting factor in rice cultivation. Rainfed rice cultivation is generally confined to areas where the annual rainfall exceeds 1,000 mm.

Water is lost from rice fields during the crop season through transpiration, evaporation, and percolation. Water losses through percolation are the most variable. Total water loss ranges from 6 to 12 mm per day. Thus, on an average, about 180-300 mm of water per month are needed to produce a good crop of rice. About 1,250 mm per season is an average water requirement to achieve normal yields. The rain received in Zone II is adequate to grow a good crop of rice of 6 tons per hectare, and perhaps more (see Figure 1, Chapter 5). One factor that may limit production in newly cultivated areas is excessive water loss through percolation. In the project areas, fields do not appear to have established the plow-pan, which reduces

percolation. Without animal power for primary tillage, water loses may continue to be high.

### Soils

He Soils in the Geba River area are low in nitrogen, phosphorous, and potassium. The use of a complete fertilizer on a yearly basis is recommended. No analysis has been made of the soils in the rice project area. This should be done as soon as possible. Samples could be sent to laboratories in Senegal or in Europe to fill this important hole in the knowledge necessary to improve rice production in Guinea-Bissau.

## RICE PRODUCTION IN THE BAS-FOND AREAS

### Water

A discussion on the construction of the contour dikes was presented in Chapter 7. Yields obtained from extension agent plots in farmers' fields have reached up to 5.6 tons per hectare. Average yields on farmer fields have reached 2.8 tons per hectare. These yield levels may be the result of the water impounded at the critical period of reproduction.

Dikes help to impound water in a field and prevent water loss from run-off. Water stress at any growth stage, but especially at the time of reproduction, may reduce yields. The most common symptoms of water deficiency are leaf-rolling, leaf-scalding, impaired tillering, stunting, delayed flowering, spiklet sterility, and incomplete grain filling.

The rice plant is most sensitive to water deficit from the period of flowering to heading. Three days of drought at 11 and/or three days before heading reduces yield by 62 and 59 percent, respectively, by causing a high percentage of sterility.

Once water stress leads to sterility, there is no way for the plant to compensate. However, water deficits during the vegetative stage may reduce plant height, tiller number, and leaf area but not affect yields if water is supplied in sufficient time to permit recovery before flowering.

## OTHER AGRONOMIC FEATURES TO CONSIDER

### Varieties

One of the most important contributions to the world's rice production has been the introduction of high-yielding rice varieties of a short cycle duration (100-110 days). As a result it was possible in Asia to produce 10 tons or more in two crops during one wet season, as compared with 1-3 tons per hectare per rainy season. Utilization of this high-yielding, short-duration rice changed the face of rice production in Asia. If the work started by the Rice Production Project is to realize its full potential, it is important for research to select or develop a rice variety with a short cycle and high yields.

It is possible to produce a short cycle high-yielding variety that is resistant to insects and disease, especially blast. Blast disease is a problem in Guinea-Bissau. In Egypt IR 28 will produce over 9 tons per hectare and is completely resistant to most races of blast found in that country. Adaptive research in Guinea-Bissau should concentrate on this or a similar variety.

### Rice Ratooning

Rice ratooning has become a popular cropping system in some countries and appears to have potential in the *bolanhas* of the project area. In the mangrove swamps of Sierra Leone and Guinea, yields of 2.7 tons per hectare have been obtained from first crop rice (194 days) and an additional ratoon crop yields 1.7 tons per hectare (90 days). The per-day production is greater from the ratoon crop (18.9 kg per day) than from the main crop (13.9 kg per day). The main rice crop in Texas usually pays for production costs and profits come from the ratoon crop. Work on ratooning rice is also becoming a major research area at IRRI.

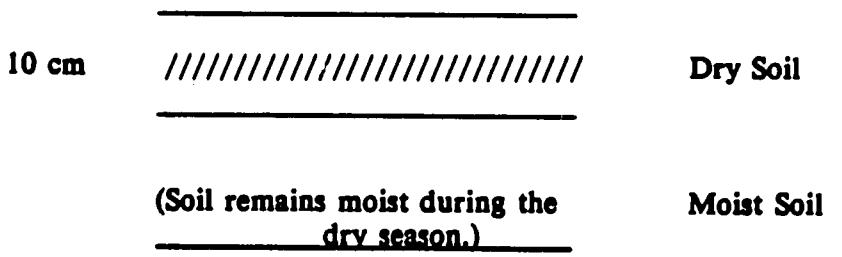
Moisture remaining after first crop rice should be sufficient for a ratoon rice crop in some areas of the *bolanhas*. This should be investigated thoroughly.

**Land Preparation After Rice Harvest**

One reason for planting rice so late after the rain has started is that enough water must accumulate in the paddy to soften the soil so that it can be puddled. This can take up to a month and 300 mm of water, thus effectively reducing the amount of rain that can be used for growing rice.

Experiments at IRRI have evaluated the effects of plowing at harvest time. Plowing is easy then because the soil is still moist. Plowing at this time allows a soil mulch to develop that dries and effectively prevents the loss of water from capillary action in the profile. During the following dry season, one or two passes with a harrow will keep the field almost free from weeds and weed seeds. With harrowing, seeding can take place in June and can be done in dry soil before the start of the rains. To establish a crop under this system, only enough rain is needed to wet the top 10 cm of dry soil.

The drawback of this system is that if crop residues must be used to feed cattle the need for planting rice early, to take full advantage of the rain, would have to be compared with the feed requirement for cattle. There are many possibilities for growing other forage crops to sustain cattle requirements.



### Dapag Seedling Production

It may be of interest to farmers of the project area to know how to grow rice seedlings under what is called the "Dapag System." With this system the seedlings are grown on a hard surface of plastic, cement, leaves, etc. The seeds are piled about one-half inch high with some border on the sides to keep the seeds confined. The seeds are watered several times a day to keep them very moist but not wet. They remain in this condition for about 14 days. The seedlings roots grow together, forming a matt. When the seedlings are taken to the field for transplanting, a 25-50 section of the matt is cut off and placed on the shoulder where seedlings can be taken off by hand, two seedlings at a time.

This method reduces the labor to prepare a soil-seed bed and saves water. However, the seedlings from the dapag matt must be planted in exactly two weeks; otherwise the roots break when taken from the matt and the seedlings are no good for transplanting.

## ALTERNATIVE CROPS

### Sorghum Ratoon

IRRI has also done a lot of work with ratooning sorghum and has had very good success. Farmers in the area of the Rice Production Project depend on sorghum as a food staple. At IRRI it has been possible to grow a main crop of sorghum and three ratoon crops. The ratoon crops mature in about one-half to two-thirds the time of the main crop and produce about one-half the yield. A main crop and a ratoon crop were a recommended technology in the Philippines. To grow more than one ratoon crop, at least one "soaking" irrigation and a fertilizer application were necessary. A ratoon crop should be tried in the upland areas of the project area.

### Sweet Sorghum

New sweet sorghum lines have been developed in the United States at Texas A&M University and have been tested in Africa. These lines have a high sugar content and could be used, if needed, to produce brown sugar in the villages in Guinea-Bissau.

### Azolla

Azolla has been tested in Guinea-Bissau, but results of these experiments were not available. A lot of work has been done with azolla at IRRI, and it has been found that azolla will not grow well in soils that have less than 30-50 ppm of phosphorus. IRRI has worked out a 14-day azolla test that can be completed with a minimum of time and effort. The process requires only a small container (a cup or glass) filled about three quarters from the top with soil. The remainder is then filled with water. An azolla frond is placed in the water for 14 days. At the end of that period, the number of new fronds is counted. If 10-15 new fronds are found, the soil contains approximately 50 ppm of phosphorous and should support the growth of azolla.

## AGRICULTURAL EQUIPMENT

Farmers in the Rice Production Project indicated the need for small hand-operated equipment to help in the management of their rice crop. A rotary weeder has been brought into the country, and farmer acceptance seems to be good. However, this weeder is not available locally. If someone could teach a local mechanic to make these weeders, it could create a small industry and provide additional employment for people in the villages.

IRRI is considering opening a regional office in Egypt. If this occurs, it should be able to help in the development of several small pieces of equipment that could be used such as a small foot-operated thresher, a five-row floating seeder for rice (used on puddled rice), and the rip planter for upland crops. IRRI also has some animal-drawn equipment that would fit into the program in Guinea-Bissau.

## TECHNOLOGY TRANSFER

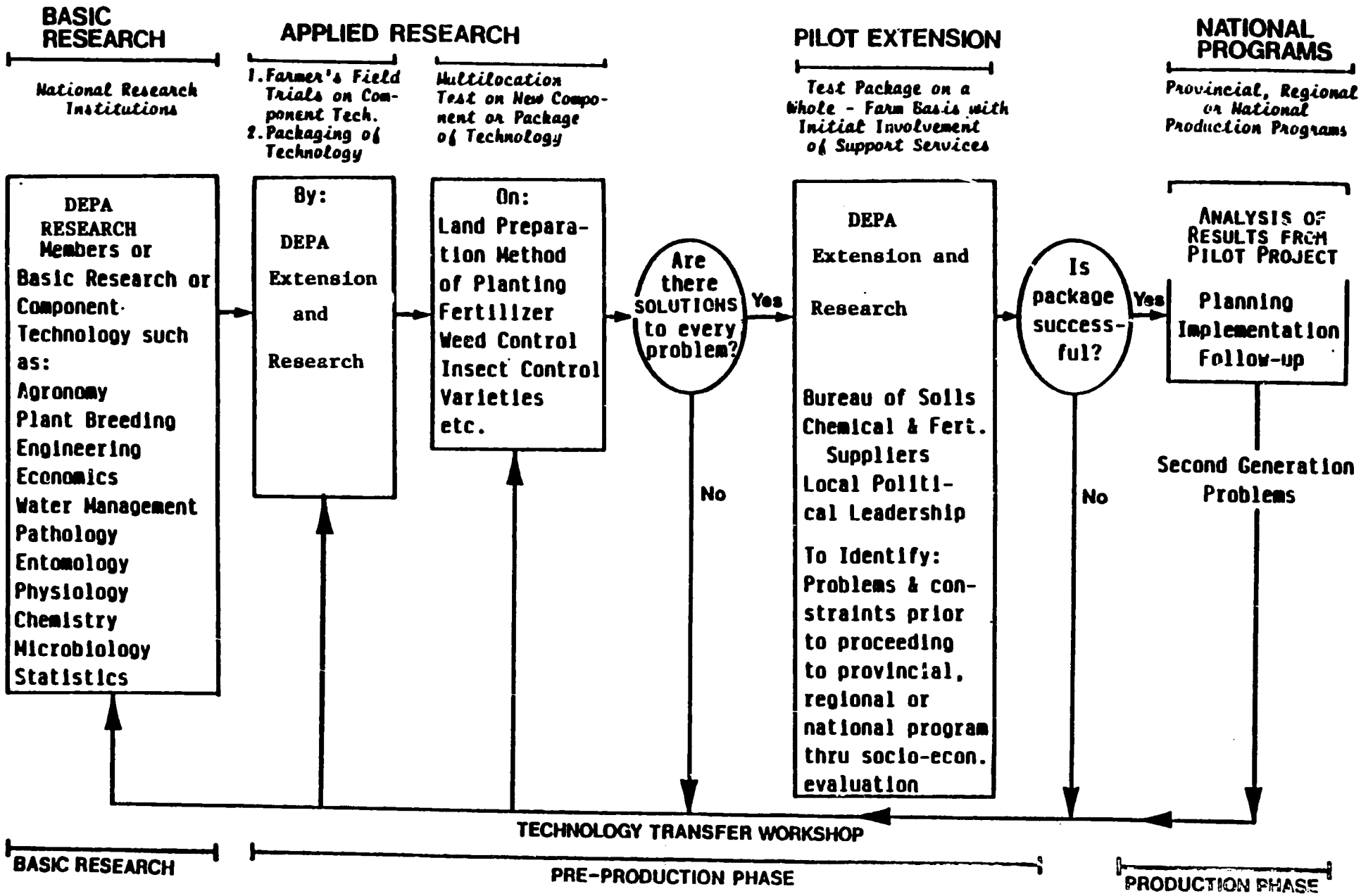
During the Rice Production Project, a major effort was made to train extension agents in rice production both in the classroom and the field. Much work has been done in Asia on the transfer of technology from research centers to farmers. A methodology has been developed that tries to bring research and extension together so there is a two-way passage of information, from extension to research and from research to extension (see Figure 6, A Concept in the Transfer of Agricultural Technology). Following the flow of information in Figure 6, new themes developed at a research station are passed on to extension counter-parts to evaluate in multiple locations in the project area. The technology is then evaluated, and a "yes" or "no" answer is given to determine if the technology will proceed to the next stage (pilot production) or if the technology will be returned to research for refinement. If the technology is allowed to advance to the pilot program, it is tested on an area large enough to encounter production or market problems that might be a constraint in a production phase which is the fourth step of the program.

## CONCLUSION

The Rice Production Project in Guinea-Bissau appears to have potential for producing rice yields similar to those produced in south India and the Philippines. Much of the work done to improve rice agriculture in those locations can be used here. As farmers get more exprience with the management of water in the bunded areas of the *bas-fond*, yields of rice will increase substantially.

FIGURE 6

# A CONCEPT IN THE TRANSFER OF AGRICULTURAL TECHNOLOGY



# ANNEX A

# PERSONS CONTACTED

# ANNEX A

## PERSONS CONTACTED

John D. Blacken, U.S. Ambassador, Bissau.

Cameron Pipitt, Acting AID Representative, USAID/Bissau

Patrick Gage, Program Officer, USAID/Bissau.

Vanita Sacardando, Training Officer, USAID/Bissau.

Linda Smith, Chief of Party, Credit Advisor, Rice Production Project, Aurora Associates, Inc., Contuboel.

Don Broussard, Rice Production Specialist, Rice Production Project, Aurora Associates, Inc., Contuboel.

Narina Varde, Extension Specialist/Agronomist, Rice Production Project, Aurora Associates, Inc., Contuboel.

Carlos Schwartz da Silva, Director, DEPA/Bissau.

Malam Sadjo, Director, DEPA/Contuboel.

Duarte Louis Sá, Extension Division Coordinator, DEPA/Contuboel.

Ernesto Mane, Head Accountant, Credit Unit, DEPA/Contuboel.

Amadu Diallo, Assistant Bookkeeper, Credit Unit, DEPA/Contuboel.

Romaldo Bubacar Cande, Extension Supervisor, DEPA/Contuboel.

Maria Saliu Balde, Extension Supervisor, DEPA/Contuboel.

Inussa Serdi, Extension Agent, DEPA/Bissau.

Titina, Extension Agent, DEPA/Bissau.

Topographers and Surveyors, Hydrology Unit, DEPA/Contuboel.

A series of interviews was conducted with approximately 45 villagers in the *bolanhas* of Demba Luri and Medina Sare. These included: village leaders, *Bolanha* Rice Committee members, old and young men and women farmers.

# ANNEX B

# BIBLIOGRAPHY

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# BIBLIOGRAPHY


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