

PJ BAC 864

658-0001

SAO TOME

Crop Production +
Diversification

Project EVALUATION

FY 79

Evaluation of Agricultural Diversification

Project #658-0001-6-6177820

During the period September 17 to October 4, progress under AID Project 658-0001-6-6177820 (hereafter referred to as the project) was evaluated. The period occurred between cropping seasons so, except for small areas of onions and sweet potatoes, none of the crops supported by the project were seen in the field. Therefore, the bases for judgements made during this evaluation were a study of available data, discussions with technical staff associated with the project, and visits to field staff.

I. Background

In 1975, the Democratic Republic of Sao Tome and Principe (STP) gained its independence from Portugal. In 1977, a grant of \$300,000 was made to the GOSTP for partial support of a food-crop diversification program. Historically, the agriculture of STP has been dominated by the production of export oriented plantation crops, most recently cacao, coffee, coconuts, and oil palm. Production of food crops was suppressed in order to maximize the availability of valuable land and cheap labor. Thus, with the possible exception of breadfruit, bananas, and some vegetables, production of food crops was less than required to meet the nutritional needs of the country's population and food importation was routinely required.

At the time of initiation of the current project, a three phased program was being developed by the GOSTP to meet the needs of the country's agricultural sector. Specific objectives^{1/} of the program were:

1. To increase the yield of cocoa, copra, coffee, and palm kernels in order to assure employment of rural people and improve their standard of living, and to concurrently earn the foreign exchange needed for assorted food imports and other priority imports essential for the country's economic development;
2. To diversify crop production on the nationalized plantations into other export crops in order to make the economy less dependent on cocoa with its fluctuating price and assure a more dependable and stable level of foreign exchange; and
3. To diversify crop production on the nationalized plantations into basic food commodities for domestic consump-

^{1/}As identified in the original project paper.

tion, in order to save scarce foreign exchange currently expended on imports of foodstuffs (especially rice, beans, corn, onions, potatoes, and sweet potatoes) and in order to improve the nutritional intake of the population.

The project grant was directed at the third objective of this program and proposed to finance (1) acquisition of equipment including tractors; (2) necessary seeds, fertilizer, and other materials; (3) limited technical assistance during critical project implementation periods; and (4) training to insure continuity of the project. The anticipated input of the GOSTP into the project was valued at \$593,000. In general, principal outputs were to be approximately 40 hectares of land directed to the production of import substitute and nontraditional export crops (beans, corn, onions, rice, and sweet potatoes) during each of the two planting seasons each year and intensive training of two technicians in the production of the target crops. The objective of this report is to evaluate progress towards achievement of these project outputs.

II. Persons Consulted

1. U.S. Embassy, Libreville, Gabon
 - Arthur T. Tienken, Ambassador
 - John M. Yates, Deputy Chief of Mission
2. Government of Sao Tomé & Príncipe
 - Ministry of Agriculture
 - Arlindo Gomes Braganca, Minister
 - Osvaldo Sena Martins, Director of Research
 - Maria Údete Costa, Head, Food Crops Research-Corn
 - Antonia Albertino Afonso Dias, Head, Section of Cooperation
 - Leonel S. Barros, Director, Logistical Support
 - Ministry of Foreign Affairs
 - Rafael Branco, Secretary General
 - Ovidio Barbosa, Coordinator, Cooperative Program
 - Leonel Aguiar
3. Dutch Technical Team
 - William Heemskerk, Agronomist
 - Harco Jellema, Soil Scientist
 - Reinoud Post, Animal Scientist

III. Progress Towards Objectives

1. Food crop diversification. Target crops identified for the project were corn, beans, rice, onions, and sweet potatoes. Each of these crops is an important constituent of the local diet, and all except the latter are imported in substantial quantities (Table 1). Available data on sweet potatoes/cassava do not indicate a deficiency. Production of corn during the period 1974-76 averaged approximately 500 tons/year while production of beans, rice, and onions was nil. Combined importation plus production placed annual availability during this interval at approximately 1600 tons corn, 700 tons beans, 1500 tons rice, 120 (?) tons onions, and 4000 tons sweet potatoes/cassava. An FAO report covering the year 1971-1972 indicated higher consumption of both corn (2085 tons) and beans (800 tons) during that period suggesting that availability of these products has decreased. This observation is supportive of statements by technicians that supplies of these imported food products are generally inadequate to satisfy the demand.

The current food diversification project envisioned the introduction and/or increased local production of food crops now imported. Adaptability of corn and sweet potatoes was known on the basis of previous experience. Corn yields, however, were low (700-800 kg/ha) so a substantial margin for improvement in productivity appeared possible. Information on the adaptability of beans, rice, and onions to the ecological conditions of STP was limited. Much of the technical assistance provided under the project has been directed towards assessing the production potential of corn, beans, and rice. Progress to date is reviewed on the following page, by crop.

Table 1. Quantities^{1/} of corn, beans, rice, onions, and sweet potatoes imported by Sao Tome-Principe, 1974-1976.

Product	Importation (Tons)		
	1974	1975	1976
Corn (grain.)	1087	835	300
Corn (flour)	378	539	225
Beans	704	620	760
Rice	1316	1453	1677
Onions	----- (120-1700) ^{2/} -----		

^{1/} Planning section,

^{2/} An import figure of 120 tons was suggested by Bredero, et al. (cited below) and 1700 tons by Osvaldo Martins, Director of Research, STP, during our visit. However, it seems unlikely that the GOSTP would put as much or more resources into import of onions at a stated value of nearly \$1.00/kg as in the more basic food crops, rice and beans. Therefore, in the absence of data, it is suggested that the actual quantity of onions imported is at the lower end of the range.

Bredero, J. Th., W. Heemskerk, and H. Toxopeus. 1977. Agriculture and livestock production in Sao Tome and Principe (West Africa). Wageningen, Foundation for Agricultural Plant Breeding. 35 p.

Corn: During 1978, replicated variety tests were established in both Sao Tome and Principe. Each test included 20 entries selected to represent a wide range of materials, both in terms of adaptation and resistance to diseases. Detailed observations were made only at locations in Sao Tome.

Incidence of virus diseases (streak, strips, and mottle), blight, and rust were observed to be high in Sao Tome and severely reduced the yields of all nonresistant material. This factor permitted the rapid detection of material markedly superior to the disease susceptible local varieties. Based on 1978 data, the best materials yield as much as three times more than local entries. Two varieties, both developed at IITA in Nigeria and carriers of multi-disease resistance, were selected and multiplied during the past season. The 500 kg of seed produced will be used to plant approximately 20 ha during the next month. Anticipated yield from this area is 2000 kg/ha, although yields as high as 9000 kg/ha have been recorded in experimental plots at one

location. While individual estimates varied, as much as 100 additional hectares of corn may also be planted on Government farms during the coming season. Seeds of selected varieties are not available for this additional area.

Beans: Trials with beans (Phaseolus vulgaris) were not initiated until early 1979 when a collection of 25 varieties was received from CIAT in Columbia. Then, low seed viability resulted in irregular stands and prevented a valid comparison of varieties or an estimate of yield potential of the crop. A sufficient number of plants was obtained, however, to produce seed for new tests and to alert researchers to management requirements of the crop. Specifically, most varieties flowered early with the result that plant growth was limited. High plant populations may be required to compensate for the limited yield potential of each individual plant. Effects of the many insect and disease pests which affect beans under tropical conditions may also be accentuated by the limited capacity of most of the varieties to compensate for adverse conditions. Therefore, careful attention to pest control will be required.

Visual quality of the seeds produced was good. However, few of the introduced varieties have the light seedcoat color preferred in STP. Additional introductions would therefore be desirable at this point in the evaluation effort.

Insufficient information is currently available to support a conclusive recommendation relative to the potential for bean (Phaseolus vulgaris) production in STP.

Cowpeas (Vigna unguiculata) have also been evaluated as a potential food diversification crop. Ten introductions from IITA formed the basis of initial trials. Growth was satisfactory under conditions on Sao Tome and results available thus far indicated that yields of 1.5-2.0 tons/ha can be obtained with proper management. At present, timely control of insects appears to be the critical step in successful cultivation of the crop.

In contrast to common beans, cowpeas are not currently widely accepted as a food in STP. Only one segment of the population--immigrants from Cape Verde--eat cowpeas as a part of their traditional diet. Seed produced last season will be used to plant approximately 10 ha in the coming season and it is presumed that production of cowpeas will be expanded if they are accepted as a food.

Rice: Upland rice varieties have been tested over a period of three seasons. Two varieties were selected and multiplied last season and ten entries are being continued in variety evaluations. In the most recent trials in northern Sao Tome, entries were reported to be disease free, probably because of successful selection for disease resistance in previous tests. Early maturing materials (<120 days) appear to be best adapted to this short growing season area. Yields

as high as 4500 kg/ha were recorded in experimental plots at one location and 2000 kg/ha is estimated to be an achievable yield level on larger areas. At two locations in southern Sao Tome where rainfall is 3000-4000 mm/year, satisfactory yields were recorded for several varieties although production problems, particularly those related to soil fertility and diseases, appear to be greater in the south than in the north.

Evaluation of rice under this project has been limited to upland conditions. The Peoples Republic of China provided a team of ten specialists for three years to assist with the development of paddy rice cultivation. The infrastructure developed under the project appears to be only partially utilized and no expansion is evident.

Discussions with the Minister of Agriculture revealed two features of paddy rice cultivation, as introduced, which are considered unsatisfactory in STP:

1. The production techniques are extremely labor intensive, thus not attractive within the agricultural system in STP. The need for a more modern technology was expressed.
2. Agricultural laborers in STP have no tradition of working in the mud and do not willingly work in paddy rice.

Upland rice production would suffer from neither of the above objections, but problems relating to fertility requirements and disease, insect, and bird control (see Bredero, et al., previously cited) are not unique to paddy rice production and would require solution before upland rice production can be entirely successful.

Onions: No data on onions were available but one planting of four varieties was observed at Ferreira Governo in northern Sao Tome. Development of the bulbs was good. Previous experiences in Sao Tome suggested that onions could be successfully grown during the dry season (June-September). In most countries where onions are produced, planting is timed so that bulbing takes place during the season of longest days. STP is so near the equator that variation in daylength will be minimal and not a critical factor in determining planting dates. Yet, it may be necessary to restrict planting to time intervals which will permit harvest and curing during a rain-free period. Until further experience is gained, it is suggested that transplants be grown and planted during the March-May rainy season so that harvest will take place during the dry season.

Production of onions in STP will require a different set of inputs than the other target crops of this project. First, seeds are imported since onions do not normally flower and produce seed unless the tubers are exposed to a period of low temperature. The low temperature requirement can be met during storage; methodology for doing this was discussed. Second, during the dry season, successful production of onions will require supplemental irrigation. Irrigation water was

available at several sites visited. Quantities appeared to be limited, but the possibility of readily increasing flow was indicated. Third, onions require conditioned storage for prolonged preservation under tropical conditions; availability of conditioned storage is very limited in the country. Thus, a set of inputs not considered in the original project may be required if the year-round demand for onions on STP is to be met. However, the currently high local-market price (approximately \$1.00/kg) would appear to justify the necessary inputs.

Sweet potatoes: Work with sweet potatoes was not being actively pursued by the food-diversification staff. A desire to concentrate on corn, rice, beans, and onions was cited as the reason. A contributing factor probably relates to the reasonably adequate supply of this crop (when considered with taro and cassava) from locally grown sources. Still, observations of a sweet potato harvest revealed a level of productivity markedly below the potential of the crop. It could not be ascertained whether the deficiency was the result of poor management or use of a low yielding variety, but both reasons are suspected.

Summary: The rather modest goal of establishing production of import substitute and nontraditional export crops on 40 ha during each of the two planting seasons each year will easily be met by the end of the project, although the distribution of hectares among crops will not correspond to that described in the project document. In fact, at this time, it is not even certain whether or not all the target crops can be successfully grown on STP. Additional work needs to be done with beans, particularly, to determine its adaptability to the islands. All crops will benefit from research to identify optimum production practices.

Screening for varieties is but a first step in development of a farming system. Planting dates; plant spacing; fertility practices; weed, insect, and disease control methods; harvest techniques; and storage requirements are all components of the package needed to optimize returns from a crop production effort.

To date, there has been little risk in the effort undertaken, but export crops (cacao, oil palm, or coconut) must be replaced if the area in food crop production is to expand. Suggestions throughout technical reports indicate a series of problems that require attention in order to assure realization of anticipated yields on a consistent basis. The 'thin' technical staff in STP has done an admirable job of crop variety evaluation but will need increased support to develop the complementary package of production technology. It is my recommendation that any follow-up on the project include a relatively steady stream of specialists to assist with problems as they arise. Initially, these will be related to basic machinery use and maintenance and the adoption of modern production technology (fertilizers, herbicides, etc.). Later, attention to seed processing and produce storage will be required. Throughout a follow-up project, the GOSTP should be encouraged to identify and

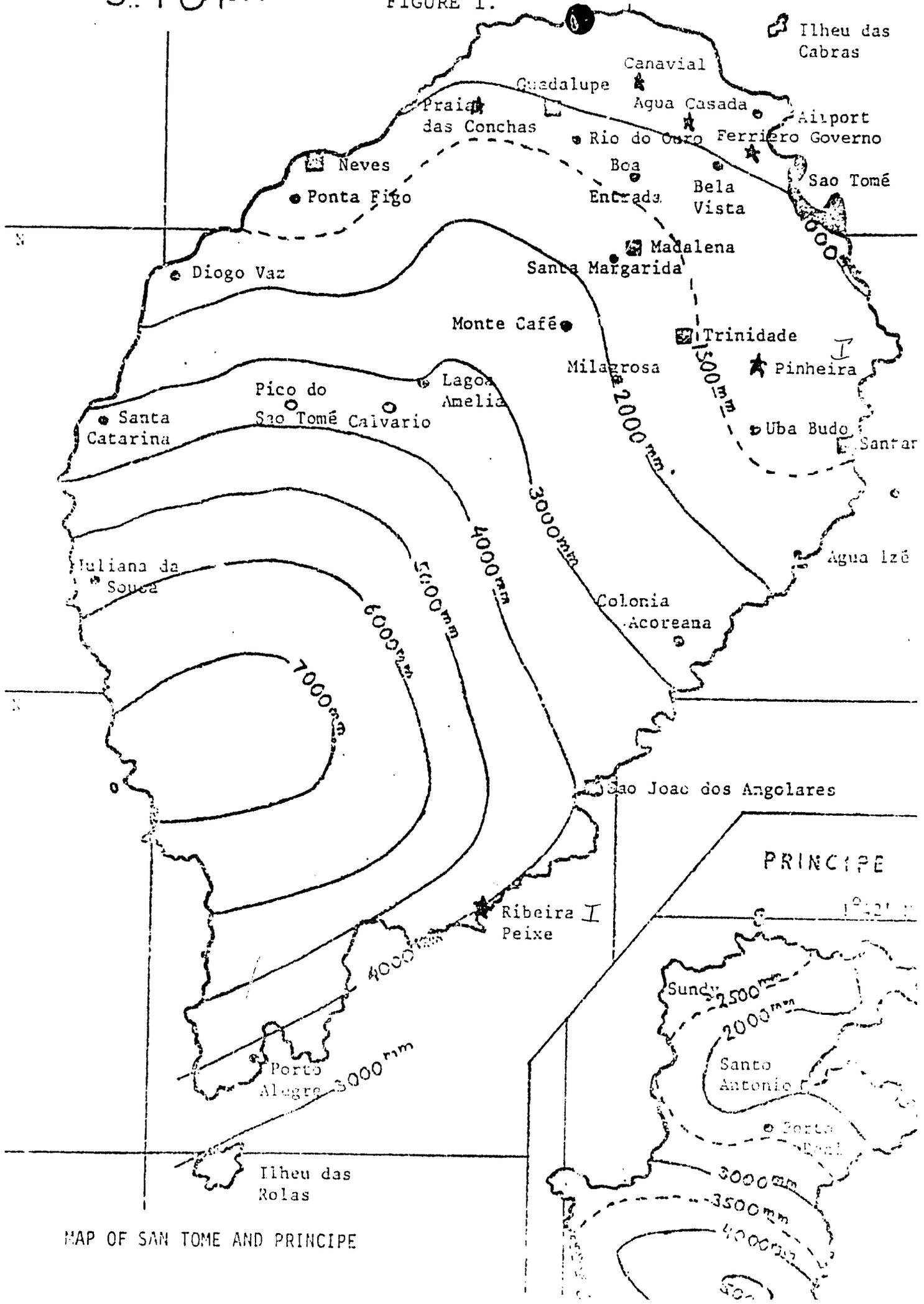
allocate people for training abroad so that, eventually, the technological know-how to manage the systems will be available locally.

2. Selected production sites. The initial project identified three locations (Canavial, Bela Vista, and Ribeira Peixe) to start the crop diversification program. Sites visited during this evaluation are described below. Their approximate locations are shown in Figure 1, along with average yearly rainfall isohets. Appropriateness of each area for the purpose of mechanized food crop production is indicated.

- Ribeira Peixe: a low elevation (50-70 m), high rainfall (4100 mm) location of nearly flat topography. Some large, loose stones were present but not so many that they couldn't be easily cleared to permit mechanization. The land area currently cleared is approximately 60 ha. Further expansion of area would apparently require removal of cacao which appeared to be somewhat marginal under the high rainfall conditions. Nutrient deficiency symptoms had been observed on experimental plots of corn and rice by previous technical teams. Soil tests just completed indicated a pH of 4.5-5.0 and low levels of P and K. Bananas interplanted with taro had been established on 3 ha of the cleared land. Availability of land for project target crops at Ribeira Peixe within current Government plans was uncertain.
- Pinheira: a gentle to steeply (5-10% slope) rolling area at from 70-110 m altitude with an annual rainfall of 1280 mm. Approximately 8 hectares were available for food crops. The surrounding were all planted to cacao which was said to be marginal because of the low rainfall. Considerable area could be cleared for row crops but erosion control measures would be necessary. Trees should be left along waterways and on steeper slopes. Contour planting and, possibly, terraces would be desirable. In general, however, the site appears suitable for mechanized production of upland rice, corn, and beans.
- Monte Cafe Saudade: an upland (700 m), high rainfall (2300 mm) site in an area generally characterized by steep (>10%) slopes. The small area cleared was largely in vegetable production. Possibilities for extensive mechanization appear limited and, in fact, should be discouraged because of the high erosion hazard. Rational use of the area would include continued production of plantation crops (coffee) and production of high value horticultural crops on selected flat areas. The choice of economic crops will be conditioned by the high labor requirement for all cultural operations.
- Ferreira Governo and Canavial: neighboring sites in a low rainfall (900-925 mm) area. The elevation of Ferreira Governo is approximately 10-30 m and that of Canavial, 60-70 m. Slopes at both sites are slight to moderate (5-10%)

S. TOMÉ

FIGURE 1.



MAP OF SAN TOMÉ AND PRÍNCIPE

with no obvious impediments to large-scale mechanization. Soils are fertile, deep, and well drained. Water is available via gravity flow for irrigation, but the quantity was not determined. Surface structures were present for conducting irrigation water at both locations.

Land cleared at each location was 10 ha. Plantation crops with which food crops would have to compete are cacao and/or oil palm. Cacao in the area was stated to yield approximately 300 kg/ha. The highest yield of corn and rice so far recorded in STP (9000 kg/ha and 4500 kg/ha, respectively) were produced at these locations.

--Agua Casada and Praia das Conchas: low elevation (0-80 m), low rainfall (750-925 mm) sites having considerable flat, but quite rocky area. Cleared land at Praia das Conchas is approximately 30 ha; at Agua Casada the cleared land is considerably more extensive because of recent tree removal to increase the Airport's runway visibility. At both sites however, the great number of small to large rocks present will impede utilization of the land, at least by mechanized means. Development for mechanized use will entail considerable cost; however, a high initial cost may more than offset the future recurring costs of hand labor to manually conduct cultural operations in food production.

Summary: Of the northern sites visited, those at Pinheira, Ferreiro Governo, and Canavial can be most easily put into food crop production. Planting dates and cropping systems outlined in the original project analysis are appropriate with the exception of onions as noted above. Further, with normal management, these locations should support continuous production without undue hazards of erosion.

Land currently cleared and available for food production is extremely small when compared to that which would be necessary to produce the quantities of food now imported. For example, production of 1600 tons of corn at 2 tons/ha would require 400 ha during each of two seasons. Essentially all relatively level land which is free of impediments to mechanization is now planted to export crops. Therefore, expansion of food production much beyond its current low level will require a careful analysis of land use alternatives and, as mentioned previously, will involve some risks.

IV. Technical Assistance and Training

Provisions for technical assistance and training in the project were modest. Assistance was provided only during critical project implementation periods such as at planting or during variety evaluation prior to harvest. Intensive training was provided for two technicians so as to insure continuity of the crop production effort after the end of the project. For meeting these objectives with rice, corn, and beans,

the International Institute of Tropical Agriculture (IITA) was contracted to provide intensive training to two persons and technical advice over a two-year period.

Discussions with Sao Tomean officials indicate that the technical support and training provided by IITA has been excellent. Field staff servicing the program were highly qualified and made significant contributions to the program. The rapid progress made in identification of improved corn and rice varieties attest to this. The less rapid progress with field beans (Phaseolus vulgaris) can be attributed to an unanticipated and lengthy acquisition period for a seed collection. To some extent, the delay with this crop has been overshadowed by the opportunity to closely evaluate cowpeas (Vigna unguiculata), for which no provisions had been made in the original project. Technical support for onion and sweet potato production were not part of the contract with IITA and were not provided from any other source. *

Two persons received two months of intensive training each at IITA in Nigeria. Maria Odete Costa, Head, Food Crop Research-Corn, received training in corn production and Agostinho Doria, Head, Food Crop Research-Rice, received training in rice production. Only Maria Odete Costa was available for interview during this project evaluation. The training was considered excellent; only language was somewhat of a barrier. Even though a translator was provided, the exchange was not considered as good as if the instruction had been offered in Portuguese.

V. Equipment Purchase

Equipment and supplies to support the project objectives were a considerable part (81%) of the grant budget. It was recognized at the initiation of the project that for full achievement of goals, inputs including equipment and materials must be provided in a timely manner. Yet, provision of equipment has been the least satisfactory component of the project, with more than one-third of the equipment still to be ordered at the time of this evaluation. The reasons for slow acquisition are diverse but relate mostly to the lack of an effective means of communication between the many parties involved. Occasional visits to the project site by the purchasing agency to assist with equipment selection, particularly when acquisition deviated from that specified in the original project, would have apparently resolved the problems observed.

Discussions held during this evaluation revealed the following to be an acceptable allocation of the equipment fund remaining in the project.

1. Exchange the MFD 400 tractor to be supplied out of Italy for an equivalent value in wheel tractors, model MF 245, plus implements. Implements should include a two-bottom disk plow and 8' disk harrow for each tractor. This exchange is desired because the MFD 400 is inadequate for the job (desflorestation) to be done. A Caterpillar D-6 is needed (see item 6, below).

③
3 Tractors

2. Acquire draw bars for each tractor.
3. Purchase additional spare parts for each MF 245 tractor acquired under the project. A list of specific requirements, as well as part numbers, was supplied.
4. Proceed with purchase of two corn shellers and two rice/bean threshers. This equipment should be tractor mounted.
5. Complete delivery on chain saws, hoes, and other hand tools) *received*
~~already purchased but not yet received.~~
6. Purchase a Caterpillar D-6 equipped with blades, etc. for deforestation.
7. Purchase herbicides for corn (atrazine and paraquat), beans (Prowl), and rice (Propanil) with any surplus funds.

VI. Conclusions

1. The project has significantly contributed to the rapid selection of improved corn and rice varieties adapted to STP. The area to be planted to these two crops during the next year will exceed the goal (40 ha/season/year) for increased area in production of diversified food crops. However, progress in the evaluation of new varieties of dry beans, onions, and sweet potatoes has been essentially nil. Evaluation of cowpeas, not originally envisioned in the project, was undertaken and the crop found to be promising in STP.
2. Land areas initially identified for diversified crop production have been found satisfactory for the crops to be tested, but alternative uses are still being considered. However, all discussions with officials of STP during this evaluation suggested that those areas found most appropriate for mechanized use are, in fact, those receiving primary consideration for food crops.
3. Technical assistance provided under the project was considered satisfactory but expertise was not made available for all the target crops. Additional technical inputs were needed. This was not a result of a failure of IITA to meet the terms of its contract to provide technical assistance, as onions and sweet potatoes were not included in the agreement with that Institute.

4. The intensive training provided was satisfactory. A desire for future training to be in Portuguese speaking countries was expressed.
5. Equipment acquisition was the only unsatisfactory phase of the project. At this point, only one-half of the funds available for equipment have been spent. The manner in which the Sao Tomeans would like the remainder of this project phase handled is specified in the evaluation (Section V).
6. While meeting its production objectives, the scale of the project has been too small to impact on amount of funds expended for import of food crops. However, the productive potential of STP is great and self-sufficiency in food crop production appears to be an achievable objective.