Report on the Rice Monitoring Tour of the Caribbean
16-26 August, 1982

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Introduction

Among the activities of the International Rice Testing Program for Latin America (IRTP), the monitoring tours are considered to be one of the most important. These monitoring tours have the following objectives: to become acquainted with the present research status, production systems, and problems affecting rice production in the region; to observe the performance of materials distributed through the IRTP nurseries, and to give national rice program scientists the opportunity to become acquainted with the new technology and problems affecting the crop in other countries.

In August 16-26, 1982, IRTP for Latin America conducted a monitoring tour of the Caribbean region, comprising Jamaica, Haiti, and the Dominican Republic.

This report presents the different aspects related to rice production, acreage, varieties, production systems, and research activities observed by the monitoring tour group in the countries visited.

Participants

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Derrick Smith	Rice Production Manager of the Black River Upper Morass Development Company (BRUMDEC), Santa Cruz, Jamaica.
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Rice Acreage and Production

Even though rice acreage in the countries visited is small, compared with that of other Latin American countries, the crop has special importance since thousands of small farmers depend on it, and it is a basic staple in people's diet.

Table 1 shows rice area, production, and yield for the 1981 harvest season.

Rice is produced on irrigated, direct-seeded, dry seed on dry soil in Jamaica, and by transplant, direct seeding with pregerminated seed and dry seed in the Dominican Republic. Seventy percent of Haiti's rice belongs to the irrigated transplanted system and the rest is favored upland.

The yields are low mainly because of soil problems, weeds and deficiency of good quality seeds.

The following sections of this report give in-depth descriptions of the rice situation, observations and recommendations in each of the countries visited.

Rice in Jamaica

Jamaica is a small country, with two million people concentrated mostly in the capital city, Kingston. Rice is the main component of their diet. Consumption reaches 25 kg of white rice per person per year. To supply this demand, the government imports 60,000 t of rice annually .

During 1970-1980, the Agricultural Ministry conducted with good success an evaluation project of rice materials introduced from CIAT and

Table 1. Rice acreage, production and yield in three Caribbean countries, 1980-1981 harvest.

Country	Area (thous.ha)			Production (thous.t)			Yield (t/ha)		
	Irrig.	Mech.upland	Total	Irrig.	Mech.upland	Total	Irrig.	Mech.upland	Nat
Jamaica	0.20	-	0.20			0.50	2.5		2.5
Haiti			47.88			119.710			2.5
Dominican Republic	113.96	-	113.96	371.62		-	3.26		3.26
Total	145.60	10.6	156.20						

JAMAICA

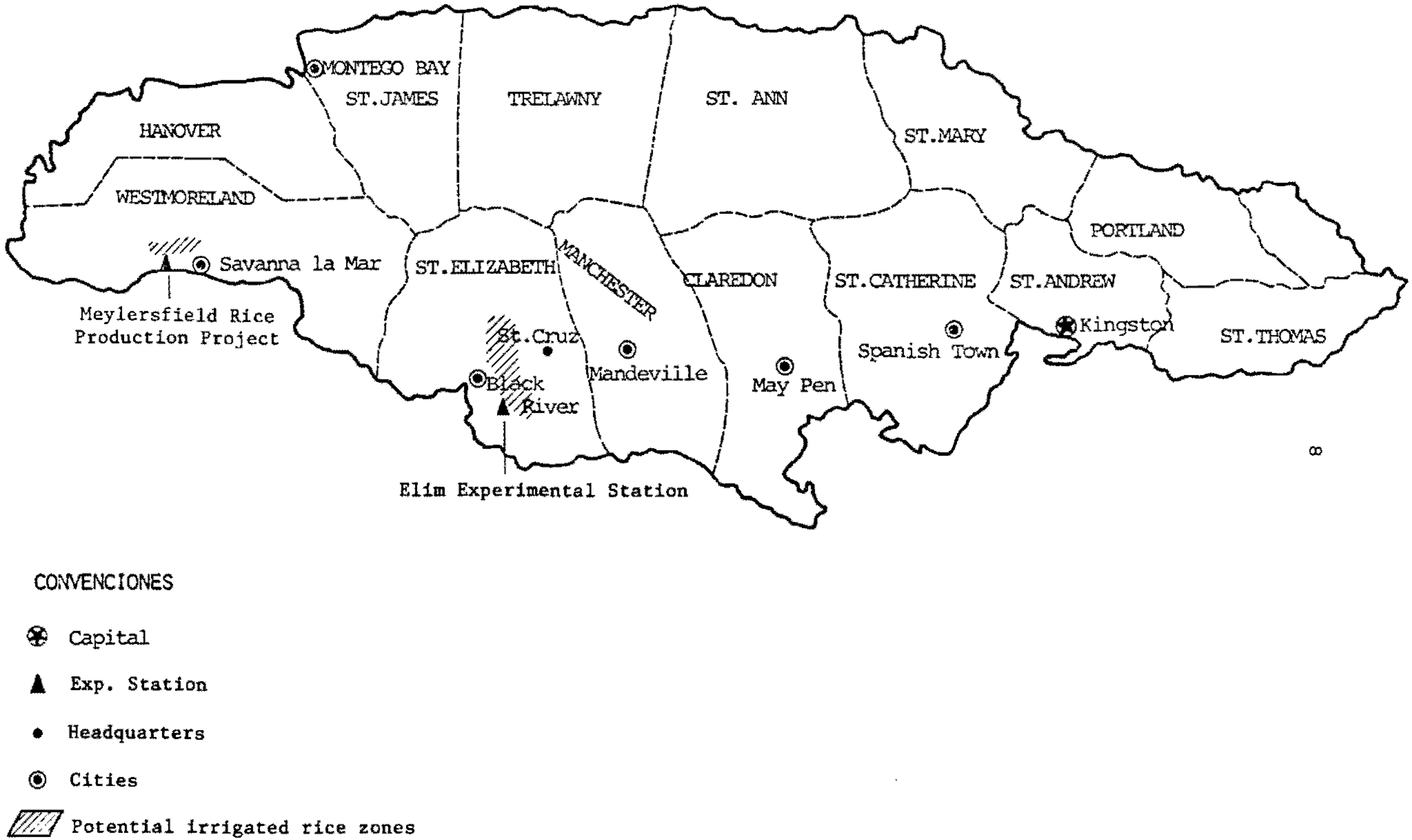


Figure 1. Sites and institutions visited by the monitoring group in Jamaica.

IRRI. Varieties CICA 4, CICA 9, and CICA 8 were selected for commercial cultivation. However, the crop acreage did not exceed 200 or 300 ha, mainly due to lack of infrastructure in the potential zones.

Potential Zones

Jamaica has two zones with potential to produce rice, located in the St. Elizabeth and Westmoreland parishes. The government established there two rice development projects in order to increase production and reduce importations.

Black River Upper Morass Development Company (BRUMDEC). BRUMDEC is a descentralized governmental company created to adequate the swampy lands in the St. Elizabeth parish.

The total project area is 4653 ha of swampy lands flooded by the Black River and its tributaries. The project hopes to adequate 3640 ha with irrigation and drainage canals; 3440 ha have been adequated, of which 1416 ha are peat soils and 2024 ha are mineral soils with a pH of 6.2-8.4

The adequated areas have good drainage canals, which also serve for irrigation, and good penetration roads.

Meylersfield Production Project. The total area of this project is 801 ha located in the Westmoreland parish. This development project was proposed by the government in 1975. Drainage was initiated in April, 1977, by the Agricultural Engineering Division of the Ministry of Agriculture. Financial and technical assistance were provided under the Netherlands Bilateral Assistance Programme. Initially, the project was intended to protect the area from flooding by means of drainage works; later, it was expanded to include construction of an irrigation system and penetration roads to serve rice production.

Studies in part of the already adequated area (172 ha) indicated that 21% of it is affected by sea salts carried by the rivers. However, detailed studies showed that salinity can be reduced to levels acceptable for rice production through the combined effects of irrigation with fresh water from the Cabarita river and drainage. Another 30% of the area consists of acid sulphate soils, and 15% are potentially acid peat soils.

Most of the adequated area is divided into 2 ha plots which are intended by the government for rice production by small farmers.

Production Systems

In St. Elizabeth commercial production of rice is done under irrigation, with direct seeding using dry seed in dry soils, or pregerminated seed in puddle soils. All practices are completely mechanized, from land preparation to harvest.

In the Westmoreland parish production will be done under the irrigated-transplanted system. All practices will be mechanized, except transplant which will be manual.

Varieties

In the mineral soils in St. Elizabeth, CICA 8 and CICA 9 varieties are cultivated; they show good adaptation and high yields. For the peat soils, BRUMDEC is evaluating USA materials with good promise.

In soils with salinity problems in the Westmoreland parish, IR 2053 line from IRRI and CICA 9 are the most appropriate varieties.

Limiting Factors

Main problems limiting rice production expansion in Jamaica, in order of importance, are the following:

1. Lack of appropriate varieties for the peat and saline soils.
2. Lack of personnel trained in breeding, pathology, and seed production.
3. Little experience in land preparation, water management, and weed control.

4. Lack of certified seeds.

5. Lack of infrastructure for the processing and milling of rice and seed production.

Observations

The team visited the IICA central office and BRUMDEC farms in Kingston and Santa Cruz, respectively. Rice experiments were observed in the Elim Experimental Station and the Meylersfield production project.

Mr. Percy Aitkem-Soux, IICA Director in Jamaica, received the team and explained the different activities in cooperation with the government, especially those related to the development of agricultural production projects. IICA is cooperating with the BRUMDEC rice project through technical advice in breeding and rice production. Vivian Chin, breeder and former Rice Program Director in Guyana, is heading this technical advisory team.

In Santa Cruz, the team visited the BRUMDEC headquarters, and was received by Mr. L. Logan, Project Director. Mr. Logan stated that BRUMDEC has responsibility for rice research and production. Their goal is to develop the areas with potential and provide the necessary technology to produce rice needed by the country. The present country needs are 60,000 t of rice, all of which are imported. Consumer price is US$0.43/lb and US$0.34/lb for distributors. BRUMDEC serves as intermediary in the importation and sale of white rice to consumers at US$0.32/lb. In this way, it controls and stabilizes rice prices for distributors and consumers.

Experimental Station and Elim Production Project

In this experimental station the team was received by S. Satoh, Japanese consultant and soils specialist, who is in charge of germplasm evaluation, fertilization trials and basic seed multiplication.

In a yield trial six varieties were being evaluated (CICA 8, Naylamp, Lebonnet, Belleview, Tanioka No. 5, Starbonnet), and nine promising lines (CICA 9-3, CICA 9-7, CICA 4-1, CICA 4-2, 7152, 7153, 7140, IR 2307, IR 930 x IR 665). These materials were transplanted in May and were in the flowering-to-ripening stage. We observed the presence of brown spot, narrow brown spot and leaf scald in the different materials. Some CICA 8, CICA 9-3, and Belleview plants were observed affected by the hoja blanca virus. This disease had not been reported in the past in Jamaica. Lines CICA 4-1, CICA 4-2, and IR 2307 were superior to the others.

Fertility trials of CICA 8 variety consisted of nitrogen doses (75, 100, 125 kg N/ha) combined with four seed densities (60, 80, 100, and 120 kg seed/ha).

Another fertility trial was aimed at determining the most appropriate time for nitrogen application to CICA 8 direct seeding in order to obtain optimum yields. Another trial was to determine the effect of N, P, and K on growth and productivity of CICA 8 transplants.

CICA 8 is used in all fertility trials since it is the variety with the best performance, and it is being recommended for commercial plantings.

For basic seed multiplication they had ¼ ha of CICA 8 transplant. Hoja blanca virus was observed in this plot which was at maximum tillering stage.

The peat soil trials consisted of evaluating five USA varieties (Starbonnet, Labelle, Nortai, Lebonnet, Belleview) in comparison with CICA 8. In general, the American varieties had better performance than CICA 8 which was severely affected by eyespot disease (Drechslera gigantea).

All materials were severely affected by foliar diseases and dirty panicle. In Labelle the presence of sheath blight and hoja blanca virus was evident. Among the American varieties, Belleview and Labelle were outstanding, yielding 2-3 t/ha in these peat soils.

Meylersfield Project. This project is located near Savannah la Mar. Its soils are saline because of the tidals. ~~The area is~~ 801 ~~ha in~~

extension, and the government intends it for commercial exploitation by small farmers.

We observed several small farmers' plots transplanted with Buffalo variety, which is tolerant to salinity and has the ability to elongate in semi-deep water (1-1.20 m depth). Most of this area is already adequated with drainage and irrigation canals and is divided into 2 ha plots to produce rice by the transplant method. Previous experiences have indicated that two crops per year can be obtained.

Recommendations

After their visit, the team discussed and made the following recommendations:

Evaluation and selection of varieties

- To continue with evaluation and selection of materials on mineral and peat soils. Materials required for mineral soils should be tolerant to hoja blanca virus and foliar and grain fungus diseases with a duration cycle of 100-120 days, and with good grain quality. In order to select them we suggested evaluating IRTP materials distributed by CIAT in the observational nurseries.

- For peat soils IRRI germplasm was suggested for evaluation, as well as USDA and Dominican Republic materials.

- To evaluate the Labelle variety in semi-commercial plots; it has shown good performance on peat soils.

- For soils with salinity problems, it was suggested to evaluate IRRI and CIAT germplasm distributed in the salinity nurseries.

- To evaluate IR 2053 line in semi-commercial plots; it has shown salinity tolerance in several previous tests in this region.

Diseases and pests

- To make a recognition of diseases and pests and determine yield losses. For this purpose, it was suggested that pathologists, entomologists and nematologists of the Ministry of Agriculture collaborate with BRUMDEC scientists.

- To enforce treatment of seed for commercial plantings. This protects seed from damage caused by fungi present in the soils and assures good germination.

Training of personnel

- BRUMDEC should increase its technical personnel. A pathologist and a seed production specialist are a priority need. These personnel could be trained at CIAT.

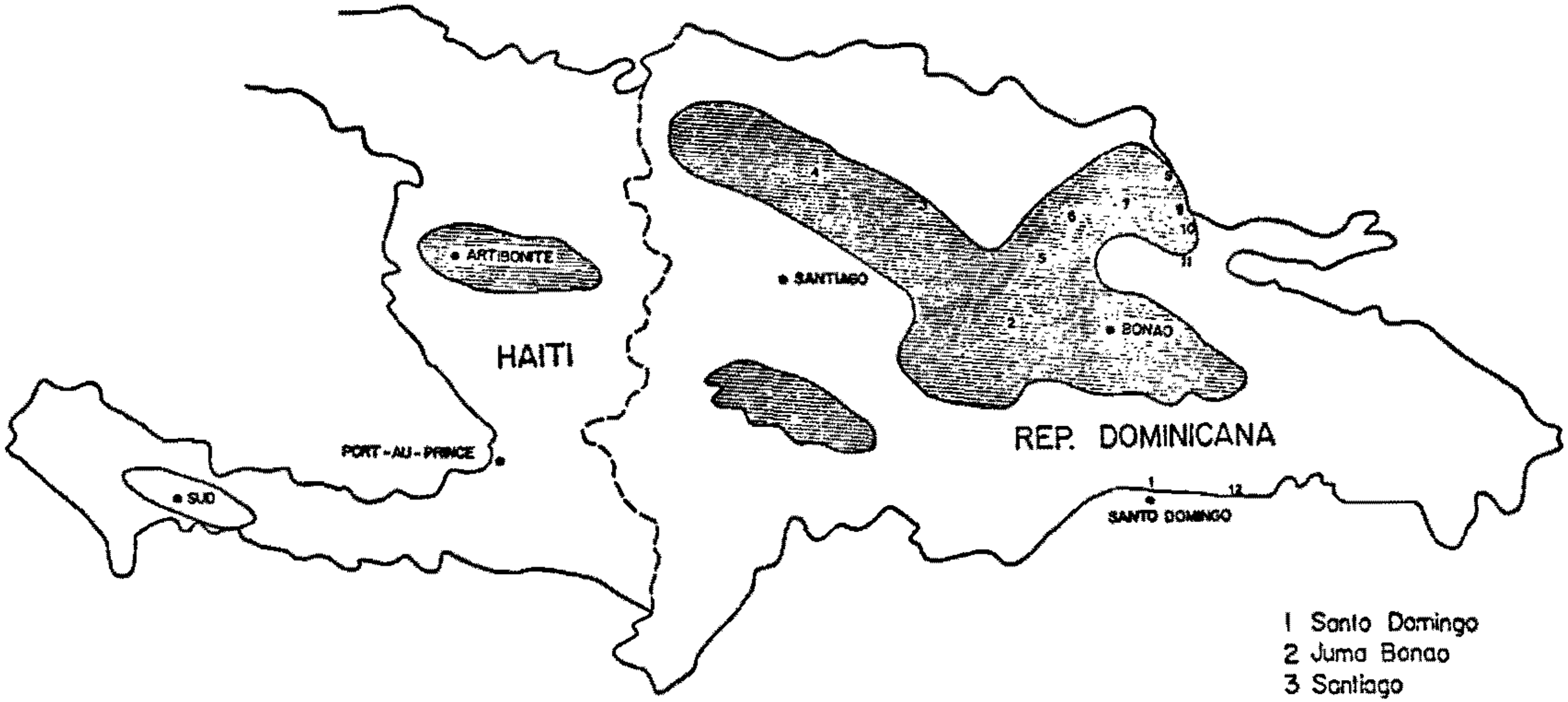
Rice in Haiti

Rice is the principal component in the diet of Haitians. They consume 33 kg of white rice per person per year. The highest harvest was that of 1979-1980, when 42,103 ha were planted, 31,473 ha under irrigation and the rest under upland conditions. Total production was 200,290 t of paddy, of which 95% corresponded to the irrigated area with a yield of 5.4 t/ha; upland yield was 2.85 t/ha. At present the country is self-sufficient, the last importation having been made in 1976-1977, when 20,000 t of white rice were imported.

Consumer prices of top class rice range between US/0.65-0.70/lb, while the second class costs US$0.52/lb.

Crop Zones

There are two main zones differentiated by irrigated and upland cropping systems. The irrigated zone is located in the Artibonite



1 Santo Domingo
2 Juma Bonao
3 Santiago
4 Laguna Salada
5 Zona Arrocera Rincon - Puente
6 San Francisco de Macoris
7 El Pozo
8 Nagua
9 Comedor Chen
10 Arroz Tallo (Familiar)
11 Aguacate (Finca Reforma Agraria)
12 Aeropuerto

Irrigated
Upland

Figure 2. Sites and institutions visited by the monitoring group in Haiti and Dominican Republic.

Valley and the upland zone is in the North, Northeast, and South of the country.

The Artibonite Valley has a total area of 40,000 ha of which 30,000 ha can be irrigated for rice cultivation. In 1982, 28,000 ha were transplanted to rice. In this area three ecologic zones can be differentiated:

<u>High zone</u>. It has an altitude of 60-90 masl and occupies 15% (4200 ha) of the actual area planted to rice (28,000 ha). Soils are alluvial with a pH of 7.8-8.4. Rice is transplanted for one or two crops and then it is rotated with beans, maize or tomato. Rice is planted in the rainy season, from March-October, and from November-February other crops are planted.

This zone is disease free, although in some plantings brown spot and narrow brown spot are present, both of minor importance. The absence of blast and other rice diseases can be attributed to high temperature and low relative humidity. The main rice problems are water shortage and lack of technology on fertilization and use of certified seed.

This is a small farm area, with the following land distribution:

0.1- 1.0 ha	32%
1.1- 1.9 ha	29%
2.0- 4.0 ha	40%

4.1-12.0 ha 22%

12.0- > 5%

Medium zone. This zone has an altitude of 10-20 masl and occupies 25% (7000 ha) of the total area. Soils are alluvial, with a pH of 6.8-8.2, and well drained. The zone has enough water supply and no soil or disease problems.

Rice is the main crop, with two crops per year, the first one in February-June and the second one in July-December. Some farmers make rotations with beans, onions or tomatoes.

Low zone. It has an altitude of 0-10 masl and occupies 60% (16,800 ha) of the rice area (28,000 ha). Soils have a pH of 7.0-8.5 and are clayed and difficult to drain; they present salt problems and Zn deficiency.

Varieties

Ti-Fidelle is planted in 75% of the area in the high, medium, and low zones; MCI-65 and MCI-3 occupy 5%, and Madame Gougousee 2% of the high and medium zones. The rest of the area in the low zone is planted with the traditional varieties Buffalo, Folton, and Careu Pangnol, LCC, Trois grappes, Neg-Papdiou, and Ti Poule Poule.

Production Costs

Production costs per ha estimated two years ago for the three zones by the Chinese Mission were the following:

Land preparation	US$120
Seed planting	100
Fertilizers and application	90
Weed control	25
Insect and rat control	28
Harvesting	150
Transportation	60
Drying	20
Land rental	160
	US$753

With an average yield of 3.0 t of paddy per ha, the net cost is US$251/t. However, actual costs, according to information given, are: US$508.20/ha for the Ti-Fidelle variety, which yields about 2.77 t/ha; this results in a net cost of US$183.46/t. For the improved variety MCI-65, costs are US$682.60/ha. This variety yields about 5.5 t/ha, resulting in a net cost of US$124.11/t.

Observations

In Haiti, the monitoring tour team visited the headquarters in Damien of the Institute of Agricultural Research and Services, DARNDR, of the Ministry of Agriculture, where contact was made with the research officers. Also the team visited the Development Agency offices in the Artibonite Valley, ODVA.

The Director of this project explained to the group the different activities they are carrying out to increase rice production and productivity. They are oriented to the generation and transfer of technology, for which they conduct diagnostic studies of production systems, identification of crop problems, varietal improvement, agroecologic studies, and cultural practices.

Experimental Station

The Mauge Experimental Station, an agricultural and a machinery center in Deseaux, were also visited.

The Mauge Experimental Station has an area of 12 ha, 9 of them devoted to research and rice seed multiplication. The rice program in this station is staffed with three technicians, one breeder, one production agronomist, and one pathologist (part time). The Chinese Mission collaborates with a breeder and a production specialist.

The basic seed multiplication fields were observed, as well as the ones for germplasm evaluation and fertilization trials.

A basic seed multiplication plot of 0.5 ha with the MCI-65 variety at maturity stage was observed. This variety originates from the Philippines and it is well adapted in the irrigated zone of the Artibonite Valley. It is intermediate in height, with long grain, and tolerant to Zn deficiency. This plot was in good condition, free of diseases and insect damage.

The germplasm under evaluation pertained to the yield (VIRAL-T) and observational (VIOAL) IRTP nurseries sent from CIAT in 1982. The materials were recovering from transplanting, and the differences at 40 days of age were minimal to be evaluated.

Varietal differences in response to Zn deficiency were observed in the trial on varietal response to nitrogen. MCI-65 was highly resistant, Ti-Fidele resistant, while Madame Gougousse (Dawn) and MCI-3 (from Taiwan) were susceptible.

Deseaux Agricultural Center

In this center the team visited a milling and processing plant. This plant has five silos for hot air drying with a total capacity of 750 tons, and a concrete yard where rice is threshed and dried.

Normally, farmers harvest the panicles by hand and take them to the mill for threshing and drying.

This mill is processing three classes of white rice: Class A with 1-2% broken grain; class B with 7% broken grain, and Class C with 15-20% broken grain. The broken rice is used to produce rice flour. It is packed in 1-2 lb bags and distributed to the market at a price of US$0.25/lb. Pure rice flour is used to make cakes and mixed with wheat flour for making bread.

Agricultural Machinery Center

The Government, with the collaboration of the Chinese Mission, established in November, 1981, the Agricultural Machinery Center with the aim of serving the Artibonite Valley farmers with leveling and land preparation. This center is administered by Haitian technicians with technical assistance given by the Chinese Mission.

The center has 110 small tractors and 105 well trained operators for leveling and land preparation. The farmers pay for this service US$120/ha, half the amount after seeding and the other half after harvesting. This cost is low if compared to that of private enterprises which charge US$180/ha.

Land preparation and leveling were observed in puddle systems. Fields ready for transplanting had good preparation.

Recommendations

The monitoring tour group discussed and made the following recommendations:

Varietal improvement

- The program should continue with evaluation of introduced germplasm, especially with segregating populations coming from CIAT and other sources.

- Evaluation of populations is critical since the program lacks the necessary facilities to establish a crossing project.

- Production ecosystems and problems limiting production should be defined in order to determine more precisely the varietal improvement objectives.

Seed production

- A production program of certified seeds should be initiated. The utilization of certified seeds is, at present, partially restricted to the development projects. The rest of farmers use their own seed or the one available in the markets. The program should be oriented first to the purification and multiplication of basic seed of the main varieties such as

Ti-Fidele, Madame Gougousse and MCI-65, and then to the production of certified seeds.

- A seed processing plant should be established. The present rice area in the Artibonite Valley and the type of small farmers justify this investment.

- Dr. R. Cheaney's experience, at present AID technical advisor in Haiti, will be valuable in the establishment of the seed production program.

Agronomy

- Fertilization experiences are few, therefore, we suggested to expand the fertilization trials in the different ecologic zones to determine the needs for the main nutrients N, P, and K, and other elements.

- For purposes of transferring technology, the team recommended to establish production projects at farm level to compare improved technology vs. farmer technology and organize field days for all farmers in the area.

Personnel training

We were informed that scarce finances do not allow training of the technical personnel. However, the group considered it to be a priority, especially in breeding, pathology and seed production.

At present the government has development projects with IDB and AID cooperation. Funds from these institutions should be used to train personnel in the International Agricultural Centers or to organize in-country short courses with technical assistance from CIAT or other institutions.

Also, the team considered important to have short courses for trainers who eventually train personnel at the local level.

Rice in the Dominican Republic

Rice is one of the most important cereals in the diet of the Dominican Republic population. Fifty-eight kg of white rice are consumed per person per year. Crop acreage, production and consumption increased during the 70's and in the first two years of the 80's (Table 2). During these years production has been insufficient to cover demand, and the government has been importing white rice.

In 1981 total production was 371,620 t of paddy (278,715 t of white rice) on 113,962 ha. In 1982 the government imported 18% of the national demand.

Production Systems

Rice is irrigated and transplanted in the Dominican Republic. Direct seeding is practiced on a small scale, with dry seed on dry soil, or with pregerminated seed on puddle soil.

Ratoon cropping (retoño) is common in the area transplanted with Mingolo variety. It is practiced as follows: After harvesting the first crop (named flower), farmers let the field rest for one week and do not allow it to dry up. Then, they cut with machete (this task is named "chapeo") the culms of the first crop at 10-15 cm. Twelve days after chapeo, they irrigate the field to encourage shoot development. Fifteen to twenty days after irrigation, they fertilize with 200 kg/ha of 16-20-20; 20 days after this fertilization, 180 kg/ha of ammonium sulphate are applied.

Table 2. Rice acreage, production, yield, imports and consumption in the Dominican Republic, 1970-1981.

Year	Area (ha)	Production of white rice (t)	Yield of white rice (kg/ha)	Rice imports (t)	Per capita consumption (kg)
1970	82,955	136,774	1,648	2,3	35.7
1971	75,471	136,725	1,811	0,4	35.2
1972	80,503	131,028	1,627	8,620	34.1
1973	85,848	178,010	2,073	29,339	38.2
1974	79,105	157,290	1,988	63,910	48.2
1975	72,237	152,727	2,111	46,096	39.2
1976	74,099	191,283	2,581	32,272	44.7
1977	85,515	191,634	2,240	63,636	45.9
1978	91,823	213,567	2,325	19,090	44.4
1979	100,628	228,550	2,271	-	45,2
1980	109,622	275,925	2,517	40,466	52.1
1981	113,962	278,715	2,445	63,409	57.6

SOURCE: Fomento Arrocero.

Ratoon crop of Mingolo variety has a 90 days cycle, its first crop ranging between 130-150 days. As an average, Mingolo ratoon crop produces 50% of what is produced in its first crop, with production costs 60% lower than those of the first crop.

Culm Rice

Culm rice is production system practiced by small farmers in the Aguacate zone, northeast of the country. This is a familiar cropping system that has been traditionally practiced for the last 50 or 60 years in small areas ranging from 1/4 to 3 ha. In this system, farmers use the traditional variety named Ingles; it is a tall variety with medium size grain, a duration cycle longer than 180 days; it is resistant to salinity and shows good performance in organic soils. This system consists of making seed beds of 300-500 m^2 in swampy areas. When plants reach the maximum tillering stage (50-60 days after planting), farmers start pulling them out and taking them to the transplanting site, where they cut the foliar area and separate the tillers or culms from part their roots. Then they transplant 1 or 2 culms per hill, in wet plots previously cleaned by machete of all weeds and native grasses. After transplanting, the crop depends exclusively on rainfall. Farmers do not use inputs of any sort and obtain yields of 2 to 3 t/ha. Planting is done in August and harvesting in December or January. Harvesting is done manually and the product is used to repay bank credits, for family consumption and individual sales. Paddy for family consumption is stored and husked in piles for daily or weekly consumption.

Cropping Areas

In the Dominican Republic rice is planted in the San Juan, La Vega, San Cristóbal, Boano, Duarte, Santiago, Puerto Plata and Villa Vásquez provinces, where two crops per year are planted, one in the spring, December-July, and the other one in summer, May-November.

Varieties

Main varieties for transplanting and direct seeding are Juma 57 and Juma 58. Mingolo predominates in the transplanted area; it is also used as a ratoon crop. Other varieties, grown at a lower scale are Tanioka, IR 6, ISA 21, ISA 40, Inglés largo and Toño Brea.

Production Costs

Inquiries made in the different zones in the 1981 harvest indicated that production costs vary according to variety and production zone. Table 3 shows production costs per ton for the most commonly cultivated varieties in various zones of the country.

Limiting Factors

Main problems affecting rice production in the Dominican Republic are:

- Salinity, alkalinity and Zn deficiency
- Red rice
- Lack of high yielding varieties tolerant to salinity
- Sheath blight, leaf scald, brown spot and hoja blanca are important diseases.

Observations

In Santiago the monitoring tour team visited the Instituto Superior de Agricultura (ISA) and the PROSEDOCA seed processing plant; the Centro de Investigación Arrocera (CEDIA) in Juma; also, CEDIA research activities and several rice farms in Santiago, La Vega and Duarte provinces were observed.

Table 3. Rice production costs in various zones of the Dominican Republic, 1981 harvest.[a]

Zone	Variety	Yield (t/ha)	Cost/t (US)
Mao-Villa Våsquez	Mingolo	4.4	405.0
	Mingolo[b]	2.6	332.0
La Vega	Juma 58	5.6	372.4
San Juan	Juma 58	7.4	317.6
Central	Juma 57	4.8	394.8

a. Official exchange rate: 1US = 5 Dominican pesos.
b. Ratoon crop.

Instituto Superior de Agricultura

The Instituto Superior de Agricultura (ISA) is a training center on agricultural sciences at secondary and university levels. It was established in 1962 by the Dominican government, with help from the Agency for International Development and the Development Association.

At secondary level, it offers a degree in agricultural sciences, which enables students to enter superior centers, or work as rural teachers or as agricultural extension agents.

At the university level, it confers the title of agronomist. The academic program offers nine specific options: Farm Administration, Agricultural Economics, Agricultural Education, Horticulture, Agricultural Mechanization, Forest Resources, Administration of Agrarian Reform, Irrigation Systems, and Food Technology.

ISA has a research department which works on cereals, oil palm, forest and food technology. Cereal research, including rice, comprises breeding and varietal selection. This program cooperates with the Rice Research Center of Juma.

PROSEDOCA

It is a private seed processing enterprise located in Santiago. It was established in 1970 by agricultural sector officials, the agricultural bank and financial institutions.

It produces and processes certified rice, maize, and sorghum seeds. It imports and distributes vegetable seed. The processing plant has four drying silos, two with hot air and a drying capacity of 15 t each in 10-12 hours, and two silos for continuous drying with 18 t capacity each, and drying efficiency of 3 t/hour. In addition, there is a warehouse for storage and processing (cleaning, classification and treatment of seed), and a well-equipped laboratory for purity and germination tests. Rice seed certification starts with foundation seed provided by CEDIA. The process comprises several steps:

- Securing farmers' fields

- Approval from the Agricultural Secretary

- Visits to the production fields by CEDIA and PROSEDOCA technicians

- CEDIA's approval of production fields

- Harvest and transportation of rice to the plant

- Seed processing

- Packing seed in 45 kg bags with the corresponding certification label

- Seed distribution.

PROSEDOCA pays farmers US$0.06/kg or rice seed; after processing it sells seed at US$0.12/kilo.

Rice varieties certified by PROSEDOCA are ISA 40, ISA 21, Mingolo, Juma 57 and Juma 58.

Farms visited in the Santiago Province

We visited the Bermúdez farm in the Maizal zone and the Héctor Fermin farm in Laguna Salada.

Bermúdez farm. It has an area of 258 ha; prior to Agrarian Reform it was owned by the Bermúdez family. In 1972 it was parcelled among 88 families that worked as farm laborers. This farm is part of the Agrarian Reform collective projects under communal exploitation.

The farm has housing facilities and schools; the Banco Agrícola facilitates credit for its exploitation. Also, it has good penetration roads and complete machinery for land preparation, harvesting and rice transportation. Rice exploitation began in 1974 and has given good results. Two crops per year are obtained, the first one named "flor" or first harvest after transplanting, and the second one named "retoño" or ratoon crop.

Tanioka and Mingolo varieties are planted. The "retoño" or ratoon crop is only practiced with Mingolo variety, since Tanioka does not produce well under such system.

Soils in this farm are clay-leam, with good drainage and a pH of 7.0. The first crop is fertilized with 250 kg/ha of the complete 16-20-20, which is applied 15 days after transplanting. Twenty days after first fertilization, 216 kg/ha of the same fertilizer are applied. At the initial flowering stage fertilization is done with 190 kg/ha of ammonium sulphate. The ratoon crop is fertilized with 200 kg/ha of the complete 16-20-20 and 180 kg/ha of ammonium sulphate.

Farmers stated that they obtain first harvest yields of Mingolo of 6 t/ha and 4 t/ha in ratoon crops.

In this farm we observed several ratoon crops and one first crop planted with Mingolo. Ratoon crops were 15, 30, and 40 days old, had good population and were free of diseases. The first harvest was under recollection and showed uneven maturity, lodging and mixtures with red rice named "arroz flechu".

Héctor Fermín farm. This farm is located in the Laguna Salada region where there are 12,500 ha affected by salts. Soils have a pH of 7.2-8.0, with drainage problems and Zn deficiency; salinity varies from 3.8 to 10.0 $mhos/cm^2$.

The farm is planted to the Mingolo variety, which is tolerant to salinity and Zn deficiency.

In this farm the CEDIA rice program evaluates segregating populations (F4-F5) and germplasm from the salinity and alkalinity nursery (VIOSAL) from CIAT.

Rice zones in the Vega Province

In the Vega province 15,500 ha are planted in the spring season (December-July) and 6100 ha in the summer season (July-November). Rice seeding is direct with pregerminated seed in puddle soils prepared by tractor or animal traction (horses). Varieties Juma 57 and Juma 58 are predominant. In this zone transplanting is limited because of the high costs of labor.

Rice farms larger than 200 ha predominate in this area, owned by private farmers, who practice complete mechanization from seeding to harvest.

In the Rincon and Puente Macu regions leveling and puddling activities and several crops at the tillering stage were observed. In the Pozo zone we visited the Rice Experimental Station established in 1977. This station has 16 ha devoted to research and production of foundation seed. Irrigation trials are done with different water depths, fertilization, chemical control or sheath blight and yield trials with promising materials. The presence of sheath blight, leaf scald, brown spot and hoja blanca diseases was observed in the different experiments and foundation seed fields planted with Juma 58, Tanioka and Juma 57 varieties. Tanioka had an incidence of 10-15% hoja blanca.

El Pozo region is a potential rice zone with an extension of 10,100 ha, 2800 ha of organic soils and 7200 ha of mineral soils; 5200 ha are planted to rice, and the rest to pastures, fruit trees and forest. The government has a development plan for this region, named AGLIPO, which contemplates increasing the rice area from 5200 ha to 8000 ha all irrigated with water from the Nagua and Juna rivers.

Traditional crop zone. We visited the Aguacate zone, a swampy area or organic soils northeast of the country, where we observed the traditional system "Arroz de tallo", practiced by small farmers, which was already described. Some small farmers are dedicated exclusively to culm or seedling production for sale to other small farmers.

Rice research center. The Rice Research Center (CEDIA) belongs to the Agricultural Research Department of the State Secretary of Agriculture. CEDIA is located in Juma, 18°N, with an altitude of 178 masl and a precipitation of 1280 mm annually.

Its duties are to generate new technology and produce foundation seed of improved varieties.

In order to generate new technology, rice research is conducted on the following areas:

Soils and fertilization

- Analysis and classification

- Dose and time of application of N, P, K fertilizers

- Deficiencies and toxicities.

Cultural practices

- Time and densities in direct seeding
- Age for transplanting
- Post-harvest losses
- Weed control
- Disease and insect control

Agricultural machinery

- Equipment management
- Innovations in mechanized transplanting.

Irrigation and drainage

- Consumptive use of water
- Irrigation intervals
- Water depths.

Varietal improvement

- Evaluation of introductions
- Purification of local varieties
- Hybridizations.

CEDIA is staffed with scientific personnel in the different areas and receives technical assistance from four scientists of the Chinese Mission.

Dr. Federico Cuevas, Coordinator of the Varietal Improvement Program of CEDIA and ISA, informed us on results obtained from 1964 to 1981. He stated that between 1964–1981, 600 crosses were made and the varieties Juma 1, 32, 57, 58, and Juma 51 were selected. With them an increase in yield and grain quality was obtained, but their duration cycle could not be shortened.

The monitoring tour group also visited the seed processing plant, the manufacturing plant of seed bed boxes, the water use trials and the germplasm collection field.

Seed processing plant. This plant has the necessary equipment for cleaning, drying and seed classification; it has a warehouse with a storage capacity of 1000 t, with controlled air at 22°C and 70% relative humidity.

Genetic foundation seed of Juma 57, Juma 58, Tanioka and IR 6 varieties is processed in this plant. They produce also certified seed in farmers' fields, and count on four field inspectors and three technicians to handle laboratory tests and supervise processing and seed distribution activities.

Seedbed plant. This plant has a germination chamber (dark rooms) and complete equipment to manufacture with Chinese Mission technology, wooden boxes, 28 x 58 cm and 3 cm deep, for seedlings used in foundation seed production and demonstration fields for mechanized transplanting.

Seedbeds are prepared placing newspapers on the bottom of the boxes where a mixture of soil, fertilizers and insecticide is placed. On this layer 220 g of seed are broadcast, then they are moistened, fumigated and covered with a soil layer. After this process, boxes are placed in a germination chamber (dark room) for a few days. When plants are 14 days old, they are transported to the field for transplanting. The cost of a seedbed box is US$0.08. For one hectare 160 boxes costing US$12.80 are needed. Mechanized transplanting is done in rows 28 cm apart, putting 3 to 5 seedlings in hills 16 cm apart. With the use of transplanters, 1 ha/day is transplanted at a cost of US$12.16. With manual transplant, a minimum of 16 laborers is required to transplant 1 ha/day at a cost of US$22.40.

CEDIA experiences with mechanized transplant indicate the following advantages over manual transplanting:

- Transplant depth is uniform

- Plants have higher tillering and uniform development

- Uniformity in population density of 18 plants/m^2

- Increase in yield by about 15%

- Transplant costs are reduced by about 50%.

Experimental field. We observed irrigation experiments to determine water requirements. Several trial results indicated that there were no varietal differences in the consumption of water. An average of 1.7 mm/day is required. In Juma clay loam soils, water consumption is 20-21 mm/day, including use plus percolation, which ranges between 1-16 mm/day.

Studies on irrigation intervals and water levels indicated that good yields are obtained with irrigation intervals of 5 to 10 days with à total water supply of 900 mm. During the first 15 days of age of the seedling the most desirable water depth is 5 cm. Then, and up to maturity, the water depth may vary from 8 to 10 cm. Critical periods requiring more water are 15 days after transplanting and at flowering stage.

We observed good genetic variability regarding plant type, grain type and maturity in the collection of parents and introductions, and in the F_2 population.

Intensive Development Projects

Eng. Gilberto Abrew informed that these projects belong to the Division of Production Support of the Department of Rice Promotion. Their aim is to increase production and productivity through transfer of new technology.

These projects are developed in pilot farms belonging to small and medium-sized farmers, in the main rice zones. The following activities are carried out:

- Technical development of the crop from land preparation to harvest

- Infrastructural development of the area and designing of farms

- Human development of beneficiaries regarding organization and training

- Coordination with credit and educational institutions.

These projects have a duration of four years and two main aims: economic and educational. The economic aim is to increase productivity by 40%, reduce costs 10% and increase farmers' benefits more than 400%. The educational aims are to increase the level of knowledge of farmers and technicians involved in rice production.

Eng. Abrew informed that on the basis of project production data in 12 farms, they attained a yield increase of 44 to 100%.

Recommendations

Based on observations of field production and research activities as well as on information received on production projects, the monitoring team made the following recommendations:

Varietal improvement

- To increase the number of crosses for selection of high yielding varieties resistant to sheath blight and hoja blanca, tolerant to salinity, with a short duration cycle and good grain quality.

- To increase germplasm for evaluation, especially for salinity and hoja blanca problems.

- To establish a regional trial with promising materials (national and introduced, 10 lines maximum) in comparison with commercial varieties.

- To collect and purify traditional varieties and use them as resistant sources for salinity tolerance and ratoon ability.

Seed production

- To intensify production of foundation seed of varieties recommended by ISA, which are being commercially planted.

Cropping systems and production projects

- To make a complete description of the production system and limiting problems.

- Production projects, encompassed in the "Intensive Development Areas" are of special importance for transferring new technology, therefore, they must receive all necessary support in order that they accomplish their proposed aims.

Research support

Research is basic in the generation of new technology, therefore, it must receive all the government support needed so that research projects may be carried out with continuity and efficiency. In this respect, personnel training is fundamental. CEDIA technical personnel needs to increase their knowledge, especially in the areas of breeding, pathology and production.

Appendix 1. Institutions and sites visited by the monitoring group

Jamaica

Offices of The Instituto Interamericano de Cooperación Agrícola, IICA, Kingston.

Headquarters of the Compañía de Desarrollo Black River Upper Morass in Santa Cruz.

Experimental Station and Production Project in Elim.

Production Project in Meylersfield, Savanaah la Mar.

Haiti

Instituto de Investigaciones y Servicios Agrícolas, DARNDR, in Damien, Puerto Principe.

Instituto de Desarrollo del Valle de Artibonite, ODVA.

Experimental Station in Mauge.

Deseaux Agricultural Center.

Deseaux Agricultural Machinery Center.

Dominican Republic

Instituto Superior de Agricultura, ISA, in Santiago.

Seed Processing Plant, PROSEDOCA, Santiago.

Agr. Reform Development Project, Bermúdez Farm in Maizal, Santiago.

Héctor Fermín Farm in Laguna Salada.

Rice Experiment Station in El Pozo.

Traditional crops in Aguacate zone.

Rice Research Center, Juma, Bonao.

Appendix 2. Scientific, technical, administrative personnel and rice producers contacted by the monitoring tour group

Jamaica

Elim Experimental Station (BRUMDEC)

Vivian Chin, IICA technical advisor

S. Satoh, Japanese technical advisor

Derrick Smith, Director Production Projects BRUMDEC

Barrington Rogers, Research Assistant BRUMDEC

C. Linton, Research assistant BRUMDEC

Meylersfield Production Project

Rose, Ministry of Agriculture

Kindness, Ministry of Agriculture

Headquarters of Black River Upper Morass Development Project (BRUMDEC) in Santa Cruz

L. Logan, General Manager

Haiti

Research and Agricultural Services Institute

DARNDR in Damien, Puerto Principe

Julio Barthelemy, Director

Robert Cheaney, AID Technical Advisor

Artibonite Valley Development Organization

Jean Andre Victor, Director

Denis Daline, Agronomy Division

Mauge Experimental Station

Jacques Alix, Director

Jean Rene Bossa, Assistant

Chow Feng Yeang, Director

Chen Chao Tien, Chinese Mission

Song Wang, Chinese Mission

Agricultural Machinery Center, Deseaux

Tai, Chinese Mission

Frantz Joseph, Haitian

Dominican Republic

Instituto Superior de Agricultura, Santiago

Wilfredo Moscoso, Technical Director Edible Crops

Seed Plant, PROSEDOCA, Santiago

Alberto Bisonó, Director

Centro de Investigaciones Arroceras (CEDIA), Juma, Bonao

Manuel E. Gonzâlez, Varieties Div. in charge

Desiderio Amarante, Varieties Div. Assistant

Jesús Vargas M, Crop Protection Div. in charge

Omar Medina, Assist., Crop Protection Div.

Venicio Castillo, Irrigation and Drainage Div., in charge

Gustavo E. Peña, Soils and Fertilizers Div. in charge

Guillermina Gerónimo, Assistant, Soils and Fertilizers Division

Franklin Pérez, Cultural Practices Div., in charge

Víctor E. Rozon, Assist., Cult. Practices Div.

Ramón Martínez, Mechanization Div., in charge

Andrés Guerra, Foundation Seed Div., in charge

Lucas Guzman, Assist. Foundation Seed Division

Julio César López, Exp. Station, El Pozo, in charge

Gilberto Abreu, Production Support Div., in charge

Aníbal Santos, Assist. Production Support Div.

Rafael Ulloa, Assist., Production Support Div.

Ricardo Cepeda, Assist., Production Support Div.

Víctor Cosme, Assist., Production Support Div.

Daniel Morales, Assist., Production Support Div.

Luis Perez, Seed Division, in charge

José Sánchez, Assist., Seed Division

Luis F. Beras F., Director Rice Development

Daniel Marte, Supervisor Rice Development

Chinese Technical Agriculture Mission

Y.T. Hsieh, Advisor, Varieties Division

______________, Mechanization Advisor

Rice Training National Center

Pedro J. Federo, Director

José S. Vargas, Assistant

Martiza Rodríguez, Assistant

Luis Pérez Sánchez, Assistant

Juan Ramón Peguero, Assistant