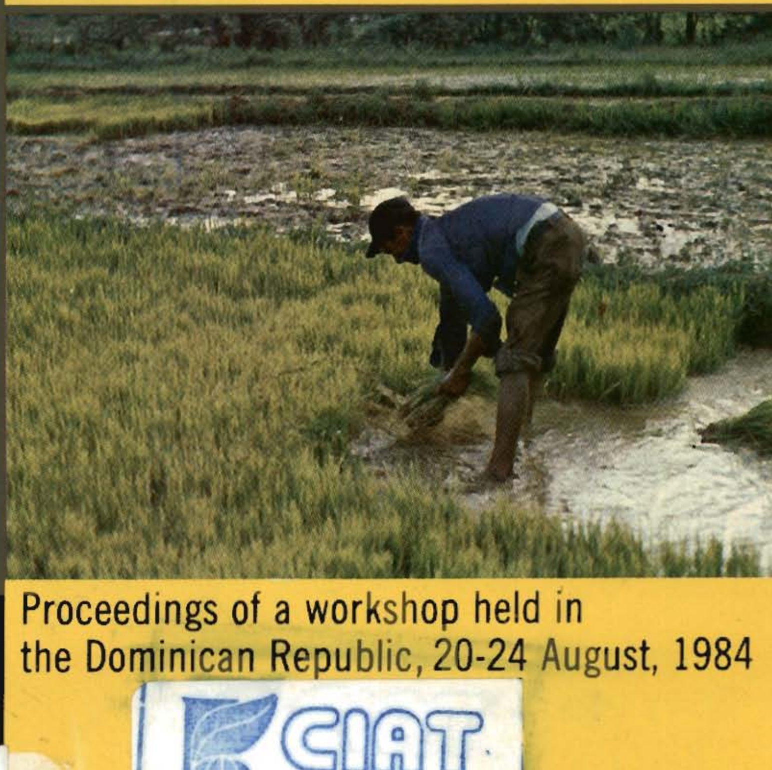
Workshop on the Caribbean Cooperative Rice Research Network



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...uto Superior de Agricultura (ISA), Dominican Republic
...etaría de Estado de Agricultura (SEA), Dominican Republic
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ISBN 84-89206-58-9

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Technical editor: Federico Cuevas

Organized and sponsored by:

Instituto Superior de Agricultura (ISA), Dominican Republic

Secretaría de Estado de Agricultura (SEA), Dominican Republic

United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), Caribbean Regional Headquarters

Centro Internacional de Agricultura Tropical, Colombia

Centro Internacional de Agricultura Tropical, CIAT
Apartado 6713
Cali, Colombia

ISBN 84-89206-58-9
Press run: 300 copies
Printed in Colombia
November 1986

CIAT (Centro Internacional de Agricultura Tropical). 1986. Workshop on the Caribbean Cooperative Rice Research Network. Proceedings of a workshop held in the Dominican Republic, 20-24 August 1984. Cali, Colombia. 128 p.

1. Rice — Production — Caribbean area — Congresses and conventions. 2. Rice — Caribbean area — Congresses and conventions. 3. Caribbean Cooperative Rice Research Network. I. Instituto Superior de Agricultura (Dominican Republic) II. Dominican Republic. Secretaría de Estado de Agricultura. III. United Nations. Economic Commission for Latin America and the Caribbean. Regional Headquarters. Centro Internacional de Agricultura Tropical.

Cover: Farmer removing rice seedlings from a traditional nursery in the Dominican Republic. Photo: Emilio Martínez.

Contents

Welcome Address

*Norberto A. Quezada**

With great satisfaction I would like to welcome all the participants of this Workshop on the Caribbean Cooperative Rice Research Network to Santiago and to the Instituto Superior de Agricultura. For those of us working in this Institute it is an honor that our campus was chosen for holding the Workshop and I want to express our sincere gratitude to the organizers. We also consider it an honor and recognize with satisfaction that the Centro Internacional de Agricultura Tropical (CIAT) selected a member of our faculty to actively participate in the organization of this Workshop.

This meeting is both unique and important. Unique because it is rare to see people from Caribbean countries gathered in one place to discuss scientific and technological cooperation. Important because, in my opinion, there are unexplored areas of collaboration, and results which could be shared, concerning the experiences of each Caribbean country with the production of this crop, rice, which has now become a major food staple for our people.

ISA feels proud of working with the Centro de Investigaciones Arroceras (CEDIA) in the areas of plant breeding, food technology, and rice production economics. Because rice is the most important food crop in the country, it is the most important crop in our limited research activities which are conducted according to the guidelines of CEDIA and the Secretaría de Estado de Agricultura.

Finally, I wish you success in your discussions and hope that this meeting continues with the same enthusiasm and expectations that we feel today, and that it ends with the same feeling of good will as was shown in its preparation.

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* Director, Instituto Superior de Agricultura (ISA), Dominican Republic.

Opening Address

*Leovigildo Bello**

Ladies and gentlemen,

Of all the crops rice has received the highest and most continuous support from the Dominican Government during the past few years because of its great importance in the diet of the Dominican people. The importance of rice in the Dominican diet is easily shown by the high per capita consumption which, in 1980, reached 54.8 kilograms.

To satisfy local demand without having to import, the Dominican Government implemented ambitious plans in the area of research and technology transfer which have allowed the country to reach the goal of self-sufficiency during the past three years.

The plans brought about significant increases in both production and productivity: in 1983 the total rice production increased 25 percent over that of 1981 and 1982 even though the area planted over the 1981-1983 period increased only 9 percent. These figures show that yields have increased significantly with a national average of 3.91 tons per hectare in 1983.

This success has been the result of the dedication of all the agronomists involved in research (an area in which work has been carried out since 1962), the transfer of new technologies, the promotion of rice in the country, and the political necessity to reduce as quickly as possible our high import levels.

It should be pointed out that the rice shortage existed despite the facts that this crop occupied 33.8 percent of the area dedicated to food crops; that the public agricultural sector maintained an adequate supply and distribution system for machinery, implements, and other agricultural

* Undersecretary of Research, Extension and Training, Secretaría de Estado de Agricultura, Dominican Republic.

inputs for rice cultivation; and that the Agricultural Bank of the Dominican Republic devoted 77.6 percent of its loans to rice cultivation.

These figures are necessary for understanding the importance of rice production improvement for the country and the Dominican government. The major objective of the government is to consolidate the infrastructure of rice production in order to ensure a national supply of rice capable of satisfying the demand of the Dominican people and settling the political discussion over the desirability of rice imports.

This is a particularly bright occasion. Bright because by starting this Workshop on the Caribbean Cooperative Rice Research Network, we are complying with the mandate of a similar activity held in Port-of-Spain, Trinidad and Tobago, in 1983. On that occasion the directors of agricultural research of the member countries of the Committee for Development and Cooperation in the Caribbean (CDCC) recommended the creation of a network to facilitate cooperative research in areas of common interest, stressing that research cooperation should be given high priority.

We open this Workshop and welcome the participation of representatives from member countries of CDCC, that is, rice specialists from Belize, Cuba, Dominican Republic, Guyana, Haiti, Jamaica, Suriname, and Trinidad and Tobago. The major objectives of this Workshop are to present detailed proposals for the guidance of cooperative activities and to present specific policy measures necessary for their implementation according to the guidelines given by the United Nations Economic Commission for Latin America and the Caribbean (UNECLAC) whose regional headquarters are in Port-of-Spain, Trinidad and Tobago. UNECLAC's guidelines are not mere whims of some specialists but are the results of detailed field studies on rice research conducted in each rice-producing country within the geographical area of the CDCC.

Those analytical studies, then, serve as the basic documentation for the discussions of this Workshop. In addition, we have an important document, prepared by the organizers and sponsors of this international Workshop, and which summarizes the rice situation in the Caribbean countries.

On behalf of the Dominican "Concentración Nacional" government, the Secretaría de Estado de Agricultura, and in my own name, I welcome all the professionals and rice specialists to the hospitable Dominican land. I would also like to take advantage of this opportunity to stress the importance of your work in the consolidation and development of the

Caribbean Cooperative Rice Research Network which will be born as a consequence of the common interest of our countries and of the following international organizations: UNECLAC, the Caribbean Council for Science and Technology (CCST), and the Centro Internacional de Agricultura Tropical (CIAT).

There are very few opportunities as this one to work together for the common well-being of our people in the Caribbean. Let us make it possible for this embryo to grow quickly into a rice plant with high genetic potential, improved resistance to pests and diseases, and, above all, high yields and early maturity.

Please receive the warm welcome of the Dominican government and its people. Our desire is that the time you spend with us will be as fruitful as possible for all and each one of our countries.

Thank you.

Objectives of the Workshop

*C. Walter**

Mr. Under Secretary for Agriculture, Director of ISA, Director of the Department of Agricultural Research, ladies and gentlemen, and fellow participants:

First, I would like to express our thanks to the government of the Dominican Republic and to the administration of the Instituto Superior de Agricultura for providing us with these excellent facilities for holding the Workshop.

This Workshop on the Caribbean Cooperative Rice Research Network is the result of a cooperative effort between the Centro Internacional de Agricultura Tropical, the International Rice Research Institute, the Secretaría de Estado de Agricultura, the Instituto Superior de Agricultura of the Dominican Republic, and the Caribbean Regional Headquarters of the United Nations Economic Commission for Latin America and the Caribbean.

The realization of this meeting brings me a great sense of satisfaction. It was only in September, 1983, at a meeting with the permanent secretaries of agriculture and the directors of agricultural research, when the setting up of a Caribbean cooperative rice research network was recommended. The objectives of the network were to collaborate on research problems of common interest, and to facilitate consultations and exchange of information between scientists. The facts that all the rice-producing countries of the Caribbean should have decided to participate in this Workshop and the proposed network, and that various agencies had cooperated in the organization of this activity can be considered as achievements, albeit the first steps.

* Agricultural Officer, United Nations Economic Commission for Latin America and the Caribbean (UNECLAC), Caribbean Regional Headquarters, Trinidad and Tobago.

The importance of rice in the diet of the Caribbean people, its importance in the economy of producer countries, and the financial costs for importer countries are all well known. Increase in rice production and improvements in Caribbean food security are closely linked.

The task before us can be stated precisely: to prepare a research program of the most important problems of common interest to the rice-producing countries of the Caribbean. This is not a conference, but a working session, and its success will be determined by our ability to formulate and, eventually, to implement a program for cooperation in rice research which will address and help solve the existing constraints to rice production in the Caribbean.

Rice in Belize

*Eulalio García**

Belize is a young country located in the northeastern tip of Central America, between Mexico and Guatemala. With a population of only 150,000 people and an area of 23,000 square kilometres, the country is considered as a potential food exporter to the English-speaking Caribbean.

Only 10 percent (about 80,000 hectares) of the total land suitable for agriculture is under cultivation and of this 10 percent, half is under pasture. Sugar cane is the major crop and mainstay of the Belizean economy—accounting for over half of the total export earnings and for about one-fourth of the cultivated area (Table 1).

Table 1. **Major crops and area (ha) planted, Belize, 1982.**

Crop	Area
Sugar cane	25,091
Maize	11,125
Citrus	4,452
Rice	3,310
Beans	2,833
Bananas	647

SOURCE: Ministry of Natural Resources, Department of Agriculture. Annual Report, 1982.

Maize and rice are the major cereal crops grown in Belize. Both are used as an integral part of the diet—depending on the ethnic group. Maize is mainly consumed by the Mayas and is the center of their "slash and burn" ("milpa") agricultural system. Rice is the staple food for city dwellers.

* Principal Agricultural Officer, Ministry of Natural Resources, Department of Agriculture, Belmopan, Belize.

General Status of the Rice Industry in Belize

Rice is grown throughout Belize—particularly in Toledo District where 43 percent of the total rice crop was grown in 1982 (Table 2). In that year the total rice area was 3310 ha and the average yield was 2.44 ton per hectare.

With the exception of Big Falls Ranch—a large irrigated rice project—rice in Belize is grown under the upland system on small farms.

In 1982 the rice area decreased because of a reduction in the area planted in Big Falls Ranch (Table 3). This project has had financial constraints and its future role is not very clear at present.

Except for the rice produced by Big Falls Ranch which is milled on the ranch and destined mainly for the external market, the marketing of rice is channeled through the Belize Marketing Board. The Board purchases rice paddy at a maximum 18-percent moisture and pays premium prices for paddy with lower moisture contents (Table 4). There is a 10 percent deduction for any paddy with more than 7 percent dirt and foreign matter.

Table 2. **Rice area (ha) and yield (t/ha) in the different districts and in Big Falls Ranch, Belize, 1982.**

District or Ranch	Area	Yield
Corozal	123	2.21
Orange Walk	121	1.68
Belize	121	1.88
Cayo	136	1.67
Stann Creek	259	2.02
Toledo	1416	2.08
Big Falls Ranch	1134	3.24
Total/average	3310	2.44

SOURCE Ministry of Natural Resources, Department of Agriculture, Annual Report, 1982

Table 3. **Total rice area (ha) in the districts and in Big Falls Ranch, Belize, 1979-1982.**

Year	Districts	Big Falls Ranch	Total
1979	1740	1052	2792
1980	1983	1295	3278
1981	2145	1821	3966
1982	2176	1134	3310
Average	2011	1325	3336

Paddy has to be delivered by the farmers to the Board's centers in Punta Gorda, Big Falls, Toledo, Belmopan, and Belize City. If the rice is delivered elsewhere, farmers are charged \$B0.02 (US\$0.01) per pound for freight and handling. The maximum premium price paid to producers is \$B0.26 (US\$0.13)/lb.

The Belize Marketing Board sells milled rice at a price of \$B0.50/lb. Table 5 shows the amount of rice purchased and sold by the Marketing Board during the period 1981-1983. A reduction can be seen in the amount of rice sold by the Marketing Board, decreasing from 1503.3 t in 1981 to 763.4 t in 1983. Because per capita rice consumption continues to be 22.7 kilogram per year it appears that people are buying their rice from other sources. It is thought that there has been an increase in demand for Mexican rice, particularly after the devaluation of the Mexican currency which has made Mexican rice cheaper to import.

Table 4. **Prices (in \$B)[a] per kilogram for rice paddy according to percent of moisture content, Belize Marketing Board, 1983.**

Moisture content	Price (\$B)[a]
18.0	0.308
17.9 - 17.0	0.352
16.9 - 16.0	0.396
15.9 - 15.0	0.440
14.9 - 14.0	0.484
13.9 - 13.0	0.528

a. Exchange rate \$B2.00 = US\$1.00 (Nov. 1984).

SOURCE. Belize Marketing Board.

Table 5. **Rice purchased and sold (t) by the Belize Marketing Board, 1981-1983.**

Year	Paddy purchased	Milled rice sold
1981	2120.9	1503.3
1982	2841.4	932.3
1983	1871.7	763.4

SOURCE. Belize Marketing Board

Rice Production Systems

Irrigated rice in Belize is restricted to Big Falls Ranch. The country has great potential to produce upland rice because of its rainfall pattern. Total rainfall increases from north to south (Figures 1 and 2), with a rainy season from June to November.

Upland rice in Belize is currently either grown under the milpa system by the Mayas or mechanized. Under the milpa system rice is planted as a cash crop and the Mayas rarely eat it. Milpa rice represents about one-fourth of the total rice produced in Belize and is regarded as the best quality rice produced in the country.

The milpa system is described by the Mayas as a piece of bushland, cleared and burnt, planted with maize, followed by a crop of beans in the dry season, and then allowed to return to bushland.

The milpa is started in January with a clearing of the forest. After the undergrowth has been dried for one or two months, the area is burnt between the end of April and the first part of May. The Maya farmer normally clears 2.8 ha of which 2 ha are planted with maize and 0.8 ha with rice.

Planting begins by mid-May by making a hole with a stick and throwing the seeds into it. The seeds used are saved from the previous crop and it has been estimated by the Toledo Rural Development Project (TRDP) that a planting density of 27 kg/ha of seed is used. Old American varieties such as "Bluebonnet 50" are commonly used.

All cultural practices are done by hand although some farmers use hand threshers provided by the Department of Agriculture. The cropping calendar and production costs are shown in Figure 3 and Table 6. It can be noticed that harvesting begins in September when rainfall is still high. Such conditions affect the moisture content of the grain at harvest which in its turn affects the selling price.

As indicated in Table 6, production costs are estimated as $B496.59 (US$248.29)/ha. With an average productivity of 2 t/ha the cost to produce a kg of paddy is $B0.25 (US$0.12) which indicates that milpa farmers make a profit in rice growing—they even make a profit when selling at the minimum guaranteed price of $B0.14 (US$0.07)/lb or $B0.308 (US$0.15)/kg.

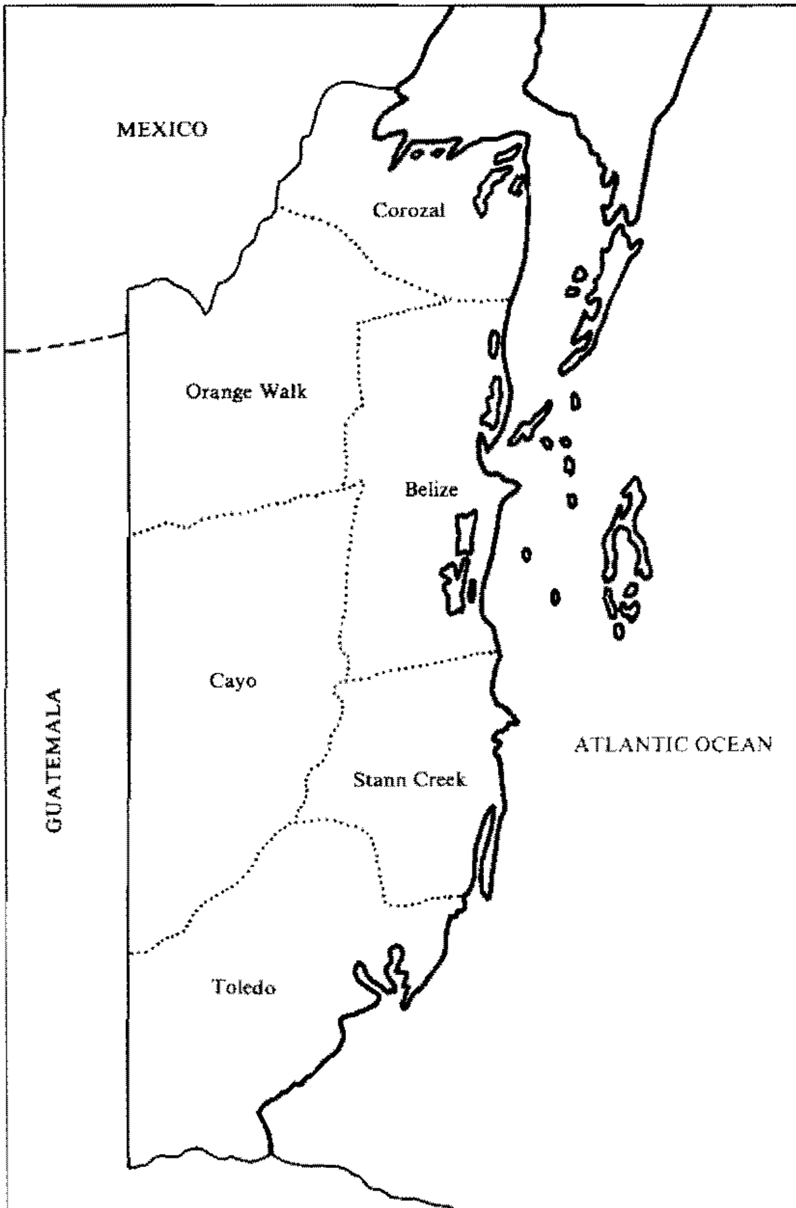

Figure 1. *The districts of Belize.*

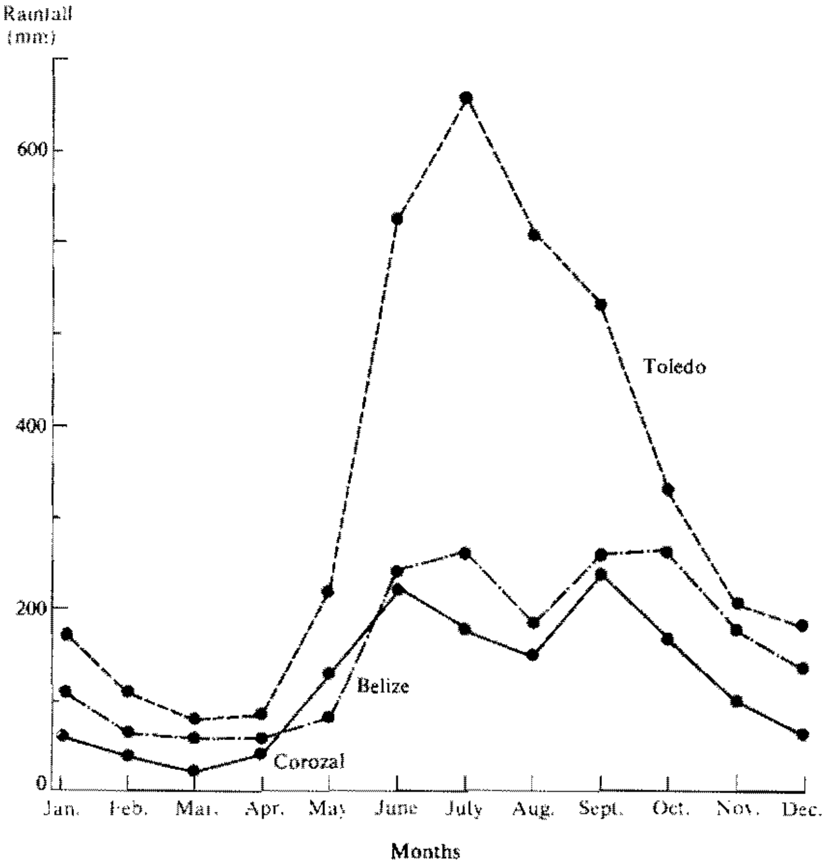

Figure 2. *Rainfall patterns in three districts of Belize.*

Mechanized upland rice is being encouraged by the government in order to take advantage of the large extents of uncultivated areas and good climatic conditions. This type of cropping system would put the country in a rice-exporting position—probably exporting to the Caribbean rice market. Mechanized rice farms are larger than milpa farms, having an average size of 40 ha.

The cropping calendar is similar to that followed by the milpa system, but activities such as clearing, planting, and harvesting are mechanized, and inputs such as fertilizers, herbicides, and insecticides are used.

In Toledo District the machinery used is usually hired from the Department of Agriculture at subsidized prices. Charges per hectare range

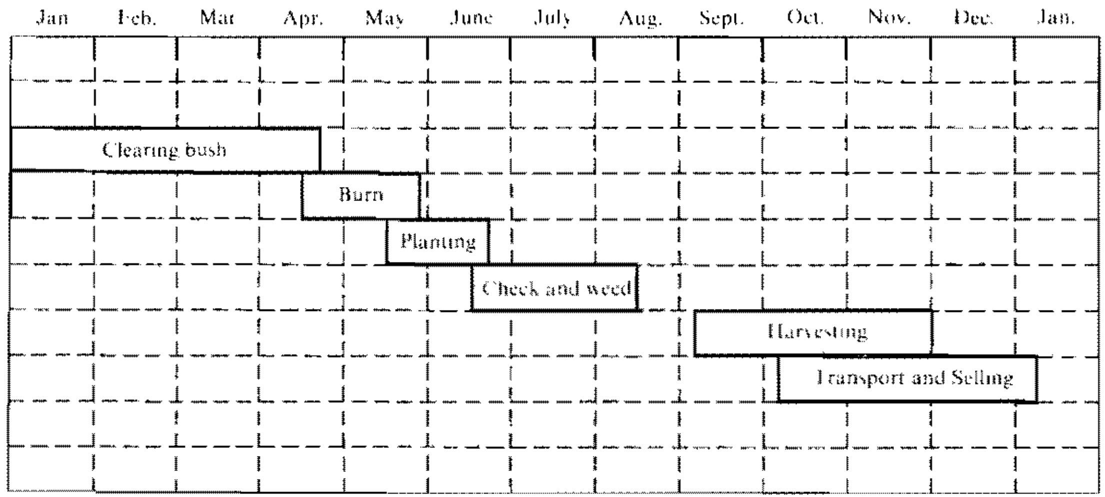

Figure 3. *Cropping calendar of milpa rice in Belize.*

Table 6 **Costs of production per hectare of milpa rice in Toledo District, Belize, 1983.**

Activity	Days	Time (hr)	Rate/hr ($B)[a]	Cost[a] ($B)	Cost[a] (US$)
Clearing	15	90	1.13	101.70	50.85
Burning	1	6	1.13	6.78	3.39
Planting					
Seed[b]				9.45	4.72
Sowing	13	78	1.13	88.14	44.07
Weeding/surveillance	3	18	1.13	20.34	10.17
Maintenance of field	2	12	1.13	13.56	6.78
Harvest	13	91	1.88	171.08	85.54
Transport	4	28	1.88	52.64	26.32
Threshing	1.5	10.5	1.88	19.74	9.87
Sale	1	7	1.88	13.16	6.58
Total	53.5	340.5		496.59	248.29

a Exchange rate. $B2.00 = US$1.00 (Nov 1984)
b. 27kg/ha. $B0.35/kg.

SOURCE: Economic Analysis of Lowland Farming Systems. Toledo Rural Development Project, 1983.

from $B740 (US$370) to $B1480 (US$740) for land clearing, $B110 (US$55) for plowing; $B69 (US$34.50) for harrowing; and $B110 (US$55) for harvesting. These charges are estimates, assuming average efficiency since services are charged per hour.

Table 7 shows costs of production for farmer Adolfo E. Norales of Punta Gorda, Toledo, and indicates that total costs were $B1293.34 (US$646.67)/ha of which about 50 percent were machinery charges. The farmer produced 3500 lb/acre (3900 kg/ha), that is, he produced a kg of paddy at the cost of $B0.33 (US$0.16). In order to make a profit he would have to sell paddy with a maximum moisture content of 17.9 percent at $B0.16 (US$0.08)/lb, or $B0.352 (US$0.176)/kg. To do that harvesting would have to be delayed, thus bringing problems of shattering and weeds.

Most farmers plant the variety CICA 8 but the available seed is heavily contaminated with red rice. Red rice problems are so serious that farmers use a piece of land for only a maximum of three years and then use new land to avoid red rice infestation.

Research and Extension

Rice research was mainly the responsibility of Big Falls Ranch, but they have had to scale it down because of financial constraints. The variety CICA 8 was released—based on their trials. Currently there are two

Table 7. **Costs of production per hectare for mechanized upland rice in Toledo District, Belize, 1983.[a]**

Activity	Cost[b] ($B)	Cost[b] (US$)
Land clearing[c]	370.00	185.00
Land preparation		
Plowing	110.00	55.00
Harrowing	69.00	34.50
Planting		
Seed (90 kg at $B1.00/kg)	90.00	45.00
Sowing and covering	29.80	14.90
Weed control		
Propanil (2.5 gal)	140.00	70.00
2,4-D (1 gal)	36.00	18.00
Fertilizer	103.78	51.89
Insecticide	43.24	21.62
Hand labor	9.26	4.63
Harvesting		
Combine	110.00	55.00
Hand labor	148.26	74.13
Bags	6.00	3.00
Transport	28.00	14.00
Total	1293.34	646.67

a. Costs for farmer Adolfo E Norales, Secretary, Grain Growers Association, Punta Gorda, Toledo.
b. Exchange rate $B2.00 = US$1.00 (Nov 1984)
c. Calculated for land use for three years.

institutions engaged in research: the Toledo Research and Development Project (TRDP) and Caricom Farms Limited. TRDP is a research and development project funded by the British government and headquartered in Toledo District. In the past the project carried out considerable research to develop technology for the lowlands of Toledo in order to attract farmers from the uplands. This initial objective has changed to that of improving both the milpa and mechanized upland systems with emphasis on red rice control. The staff of TRDP is composed mainly of British agronomists and social scientists with limited participation from Belizean counterparts. The project will end in another couple of years and it is not yet clear whether it will continue.

Caricom Farms Limited is a project which intends to establish pilot rice farms in central and northern Belize. They are currently conducting some agronomic research and are working to establish seed-producing farms. A Guyanese agronomist is conducting rice research, but as he must also carry out research on crops other than rice, rice research is very limited.

There is no rice extension service as such, although there is interest for locating a rice extension agent in Toledo. To date technology transfer to rice farmers is done through the Machinery Service of the Ministry of Public Works or through informal channels.

Constraints to Increased Production

Red rice infestation caused by poor seed quality is one of the major constraints to increased rice production, particularly if the product is aimed for the external market. If seed quality is not improved new rice fields run the risk of being contaminated by red rice.

The marketing system and, in particular, the moisture-content requirements contribute to poor milling performance and to increased weed infestations in the fields and in commercialized rice. The drying, milling, and storage capacities of the Belize Marketing Board need to be increased in order to encourage rice production and exportation.

The use of a single variety (CICA 8) and/or varieties of the same cycle causes a glut at harvest time and consequently harvesting under poor conditions. Germplasm evaluation is needed to identify varieties with different maturity cycles, higher yield potential, and which could be harvested in the dryer months.

The Department of Agriculture has recognized that there is a lack of trained staff for supporting increases in rice farming. At least two agronomists are needed to be trained in both research and production. Regional collaboration could help to overcome this and other above-mentioned constraints—in particular, the identification of germplasm suited to Belizean ecological, climatic, and farming conditions.

Rice in Cuba

*Alfredo Gutiérrez Yanis and José Martínez Grillo**

Cuba is located in the Caribbean and is the largest island of the region with an area of 114,000 square kilometres. Agriculture is one of the most important sectors of the country's economy; rice is one of the most popular cereals in the Cuban diet and is grown for local consumption. It is a profitable crop and the production costs per ton of paddy rice are estimated at Cub$140 to Cub$150[1].

General Status of the Rice Industry in Cuba

The policy for the development of the rice industry is based on improving rice production by increasing the yields. See Table 1 for information about area, production, productivity, and industrial yields during 1981 and 1982, and Table 2 for milling yields in 1981 and 1982. The harvested rice is handled and milled by the branches of the Ministry of Food Industry.

There are three ministries involved in rice production and marketing: Agriculture, Food, and Internal Commerce. The Ministry of Agriculture produces the rice and sells it to the Ministry of Food which turns it over to the processing plants at a selling price of Cub$206/t. This price is corrected after milling, depending on the content of whole grains and broken grains. The Ministry of Food sells the milled rice to the Ministry of Internal Commerce which in turn sells it to the consumers at a price of Cub$0.52 per kilogram.

Rice Production Systems

Rice-growing areas are located in the southern part of the provinces of Pinar del Rio, La Habana, Matanzas, St. Spiritus, Camagüey, and

* Director, Instituto de Investigación de Arroz, Havana, Cuba, and Officer, Dirección Nacional de Arroz, Ministerio de la Agricultura, Havana, respectively.

1. Exchange rate: Cub$1.00 = US$1.11 (Nov. 1984)

Table 1. **Rice area, production, and productivity, Cuba.**

Year	Area harvested (ha in thousands)	Production (t in thousands)	Yield (t/ha)
1981	135.0	460.9	3.33
1982	130.0	519.8	3.78

Table 2. **Milling rice yields for the 1981-1982 period as shown by laboratory trial results, Cuba.**

	Yield (%)		
Year	Milled rice	Whole grain	Broken grain
1981	66.7	51.9	14.8
1982	65.8	47.2	18.6
Average	66.2	49.5	16.7

Granma. With the exception of temperature, the climatic factors are favourable to rice production throughout the year. Temperatures are lower during the period from November to March, specifically during December to February when night temperatures are lowest, and can affect the rice crop during the reproductive stage even provoking sterility. Therefore the rice-planting calendar in the western provinces is from December to July and in the eastern provinces it is from December to mid-August.

There are significant differences in yield according to planting dates: the December to January plantings are more productive than those of July to August. The rice crop cycle also varies according to the month of planting (Table 3).

Table 3. **Effect of the month of planting on rice crop cycle, Cuba.**

Planting period	Germination period (days)	Cycle from germination to harvest (days)
December-February	12-15	155
March-April	10	140
May-August	7	125

Varieties and seed production. There are four varieties grown commercially in the country: J-104, IR 880, Caribe 1, and Naylamp. All are improved semidwarfs.

The Ministry of Agriculture produces and certifies all seed categories through a program that assures that all commercial fields are planted with good quality seed. This program involves several steps: first, original and basic seeds are produced by experiment stations; second, registered and certified seeds are produced by a specialized enterprise which sends the seeds to other enterprises; and third, each of these enterprises has a farm which specializes in certified seed multiplication. These farms obtain a second generation which is then used for commercial production.

The certification of each seed category and the supervision of each area of production is the responsibility of a group of specialists who are the counterparts of those specialists producing the seeds.

Land preparation. There are four methods used in land preparation—each of them with different objectives. They are dry, dry-disinfection, dry-puddling, and puddling-double-cropping. They represent 50, 20, 20, and 10 percent of the rice-production area respectively.

Dry-land preparation is used to assure plant establishment during the dry season. It gives the highest yields. This method involves surface harrowing (except in areas where weed populations are dense enough to require plowing), cross harrowing, application of fertilizers, and smoothing and compacting the land with a roller before and after sowing. Sowing is done by drills in cross form.

Dry-disinfection land preparation is used in areas heavily infested by varietal mixtures or highly competitive weeds. Land is prepared dry and levies are built. Weeds are induced to germinate by irrigation or rain and then are controlled by nonselective herbicides. Seeds are broadcasted over clear water.

Dry-puddling land preparation is used to assure plant establishment during the wet season. During the dry season dry plowing, fertilization, and the construction of levies are carried out. During the wet season the fields are flooded and the soil is continuously puddled to control the weeds and to level the fields. Seed is broadcasted over standing water.

Puddling-double-cropping is the method applied to allow a second crop during the year in the same land area. It involves the restoration of damaged levies and continuous puddling—identical to the technology of dry puddling.

Sowing. The methods used for sowing are by mechanized drills in dry prepared areas and by aerial broadcasting in areas prepared by the dry-disinfection, dry-puddling, and puddling-double-cropping methods.

Weed control, pests, and diseases. Weed control is preemergent for aggressive grasses and postemergent for grasses, *Cyperaceae*, and broad-leaved weeds. All applications are aerial. Qualified personnel constantly monitor the incidence of diseases and pests by means of inspections and samples of insect populations. They also determine the need for chemical treatments, select the products and dosages to be applied, and evaluate the effectiveness of the applications.

Fertilization. The requirements for phosphorus (P), potassium (K), and zinc (Zn) are established by using agrochemical cartograms for each rice-producing area. Nitrogen (N) dosages are recommended according to variety and are applied in three applications.

The fertilizers P, K, and Zn are broadcasted and incorporated to the soil prior to sowing. In dry land-preparation this application also includes the first portion of N. For the other land preparation methods, the first application of N is applied five days after germination. The last two applications of N are applied at maximum tillering and at panicle initiation.

Irrigation and drainage. Water consumption per hectare is estimated at 15,000 cubic metres. Water management is achieved by irrigating for germination during 24 to 36 hours, draining 24 hours after irrigation, using water flushings according to soil moisture until plant height permits flooding, and permanent flooding until harvesting.

Harvesting and storage. Rice is harvested according to grain moisture, variety, and in accordance with recommendations from researchers. The best time to harvest usually occurs 35 days after 50 percent flowering. The harvested paddy is sent to driers where moisture is reduced to 12.5 percent. After drying the grain is either stored or milled.

Research and Extension

Rice research is carried out in a central station and three experiment stations. The institutions involved are the Ministry of Agriculture, the Ministry for Higher Education, and the Academy of Sciences. Research personnel consists of 40 professionals in different fields and 75 technicians.

Agricultural extension work is closely related to the central station, the experiment stations, and the rice enterprises.

Major research projects include:

The improvement of varieties through hybridization and selection in order to identify those with early to intermediate maturity cycles, resistance to pests and diseases, good cooking and milling qualities, and adaptability to agroclimatic conditions;

Determination of the most appropriate agronomic practices for the commercial production of the most promising varieties;

Pesticide testing;

Rationalization of land preparation and sowing practices;

Integrated control of *Sogatodes*;

Determination of levels of damage caused by insects and their control;

Improvement of water management practices;

Crop rotation; and

Use of organic matter for soil improvement.

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Rice in Dominican Republic

*Jesús Vargas Medina and Federico Cuevas Pérez**

The Dominican Republic, founded in 1493 as Santo Domingo, was Spain's first colony in the New World. It occupies two-thirds of Hispaniola island, located between latitudes 17°30' and 20°00' north and longitudes 68°30' and 72°00' west, with an area of 48,000 square kilometres.

The value of agricultural production in the country increased by 25.7 percent to RD$100 million (US$33.9 million)[1] during the period 1975-1981. However, its share within the Gross Domestic Product (GDP) decreased by 0.7 percent from 17.0 to 16.3 percent during the same period (Table 1). Although its proportional contribution to the GDP is de-

Table 1. **The proportion of agriculture in the Gross Domestic Product (GDP), Dominican Republic, 1975-1981.**

Year	GDP (million of RD$)[a]		Proportion
	Total	Agriculture	%
1975	2288.9	388.3	17.0
1976	2422.9	417.3	17.1
1977	2564.6	426.3	16.6
1978	2619.9	445.0	17.0
1979	2745.6	444.3	16.2
1980	2899.1	464.6	16.0
1981	2996.3	488.1	16.3

a Exchange rate RD$2.95 = US$1.00 (Jan. 1985)

SOURCE: Secretaría de Estado de Agricultura Plan Operativo. 1982.

* Deputy Director, Centro de Investigaciones Arroceras (CEDIA), Juma, Bonao, Dominican Republic; and Deputy Director for Research, Instituto Superior de Agricultura (ISA), Santiago, and Consultant, Centro Internacional de Agricultura Tropical (CIAT), respectively.

1. Exchange rate RD$2.95 = US$1.00 (Jan. 1985).

creasing, the agricultural sector continues to be a fundamental component of the Dominican economy.

The main crops planted in the country in 1980 are shown in Table 2. Sugar cane occupied the largest land area followed by coffee, cocoa, and in fourth place, rice with 111,000 hectares.

Rice is a very important crop in Dominican life, both economically and nutritionally. Its economic importance is based on the facts that 84 percent of the crop is marketed and that the rice industry has a labor component of 80 percent. In nutritional terms it provides 27 percent of the calory intake of families with a monthly income of RD$100 and who represent 45 percent of the population.

Table 2. **Main crops and area planted, Dominican Republic, 1980.**

Crop	Area (ha)
Sugar cane[a]	274,316
Coffee	157,250
Cocoa	116,173
Rice	111,559
Beans	73,404
Plantain	33,462
Tobacco	19,187

a. Area for sugar cane is that of 1978.

SOURCE: Secretaria de Estado de Agricultura. Plan Operativo. 1982.

General Status of the Rice Industry in Dominican Republic

The rice crop has had a large increase during the period 1973-1982: the area harvested rose from 84,848 to 103,030 ha and the average yield from 3.22 to 3.91 t/ha (Table 3). Even with those increases in area and yield, the country failed to reach self-sufficiency during that period. In 1979 and 1980 it had to import variable amounts of milled rice (Table 4) to provide for increases in population and per capita consumption. Per capita consumption was more than 50 kilograms of milled rice during those two years. However, such a high increase could have been caused by a decrease in the supply of rice's substitutes in the Dominican diet such as plantains, cassava, and sweet potato as a result of the cyclone "David" in August 1979.

Table 3. **Area of paddy rice planted, its production and yield, Dominican Republic, 1973-1982.**

Year	Area (ha)	Production (t)	Yield (t/ha)
1973	84,848	273,861	3.22
1974	79,105	241,957	3.05
1975	72,327	234,964	3.24
1976	91,837	294,281	3.20
1977	85,515	294,821	3.44
1978	91,823	328,564	3.57
1979	100,628	381,538	3.79
1980	111,559	400,209	3.58
1981	111,308	399,127	3.58
1982	103,030	403,100	3.91

SOURCE: Departamento de Fomento Arrocero, Dominican Republic.

Table 4. **Milled rice supply and consumption, Dominican Republic, 1973-1982.**

Year	Supply (t)			Apparent consumption (t)	Per capita consumption (kg)
	Production	Importation	Initial inventory		
1973	178,010	29,686	22,589	208,150	46.9
1974	157,272	72,500	22,135	296,730	45.3
1975	152,727	49,510	45,177	211,717	45.0
1976	191,283	31,922	35,697	227,695	47.0
1977	191,634	64,474	31,207	242,636	48.7
1978	213,567	10,473	44,679	208,029	40.5
1979	248,000	—	60,690	277,937	52.4
1980	260,136	40,374	30,753	299,297	54.8
1981	259,433	62,983	31,966	265,926	47.3
1982	262,015	—	88,456	260,109	44.9
1983	—	—	90,362	—	—

SOURCE: Departamento de Fomento Arrocero.

The current government policy is to reach rice self-sufficiency. To implement such a policy the government has banned rice imports since August 1982 and has taken several measures to insure profitability in rice cultivation.

In 1976 the Dominican Republic had 127 rice mills distributed throughout all rice-growing regions. Milling capacity was 137.3 tons per hour (Table 5). The storage capacity of the mills was 215,349 t.

Since 1976 the Instituto de Estabilización de Precios (INESPRE) has established silos in different parts of the country, increasing the country's rice storage capacity. INESPRE has a storage capacity of 85,000 t.

Paddy rice is marketed through the millers or directly sold to INESPRE which controls the rice marketing system and who also buys all milled rice under a monthly quota system. INESPRE sells milled rice through the distribution channels, including the rice sold directly to the consumer in a program of "Ventas Populares". In June 1984, the minimum price for paddy with 20 percent moisture and 5 percent dirt matter was RD$34.79 (US$11.79) for 100 kg. The fixed price for the consumer was RD$0.84 (US$0.28)/kg of "natural grade rice" which contains about 20 percent of broken grains.

Table 5. **Number and capacity of rice mills in seven zones of the Dominican Republic, 1976.**

Zone	Mills (no.)	Capacity: Milling (t/hr)	Capacity: Storage (t)
North central	19	31.2	36,459
Northwest[a]	19	30.8	53,111
Northeast	18	26.3	34,357
Central	26	13.9	24,586
East	19	5.0	5,633
Southwest	23	29.4	60,949
South	3	0.7	254
Total	127	137.3	215,349

a. Includes Santiago.

SOURCE: Departamento de Fomento Arrocero.

Rice Production Systems

Rice is grown throughout the country (Figure 1) with a greater concentration in zones located east of La Vega City (about 50 percent) and northwest of Santiago de los Caballeros (about 25 percent). Rice farms have an average size of 6.2 ha. Fifty percent of the area is occupied by collective farms and farmers' associations organized under the Instituto Agrario Dominicano (IAD). On the collective farms the farmers perform all the activities for rice cultivation together and share the benefits generated by the farms as a whole. On the other hand, in farmers' associations, producers obtain credit, buy inputs, and market their rice together, but each farmer is directly responsible for the efficiency and productivity of his land and receives profits according to his land's yield.

Credit is handled mainly by the Banco Agrícola de la República Dominicana. This government bank gives credit to those rice farmers who follow an investment plan. This plan includes several outlays for different steps according to the development of the crop.

Varieties and seed production. Rice seeds are marketed according to the steps indicated in Figure 2. The Centro de Investigaciones Arroceras (CEDIA) produces the basic seed and multiplies the varieties approved for certification up to the registered category. The Departamento de Fomento Arrocero (DFA) buys all the registered seed and sells it to selected seed producers and to seed-processing companies.

Seed producers obtain certified seed and sell it to DFA who processes and distributes it. Private seed-processing companies such as Productora de Semillas Dominicanas C. por A. (PROSEDOCA) and Semillas Sureñas S.A., buy registered seed from DFA and sell it to affiliated seed producers who in their turn produce certified seed. These certified seeds are later bought by the above-mentioned companies.

Each step of seed multiplication and processing is controlled by seed inspectors from DFA, the seed-processing companies, and the Department of Seeds (Secretariat of Agriculture).

In addition to marketing the varieties approved for certification, the DFA and seed companies sell seed of unauthorized varieties that are demanded by the farmers. In this case, the seed is labeled "improved" and its marketing system includes the selling of seeds to DFA by the seed-processing companies.

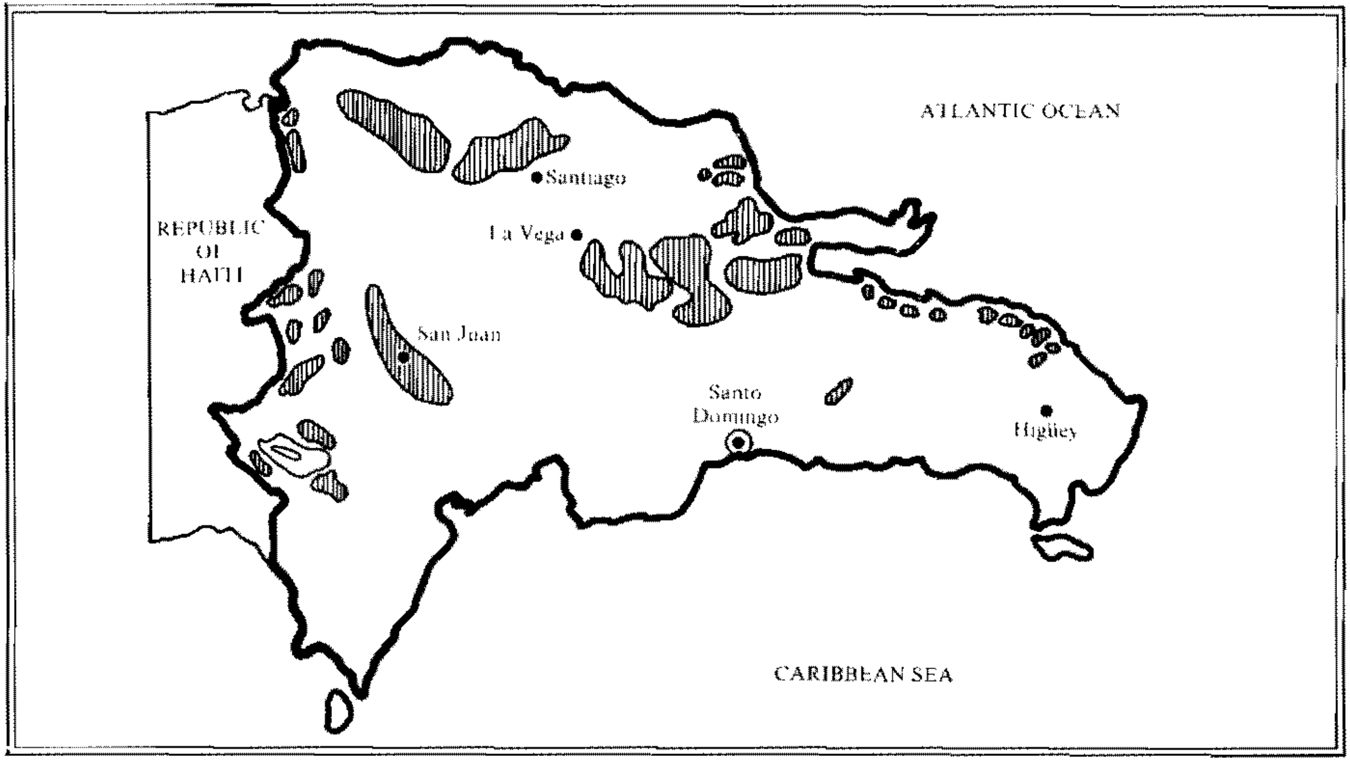

Figure 1. *Rice areas, Dominican Republic, 1982.*

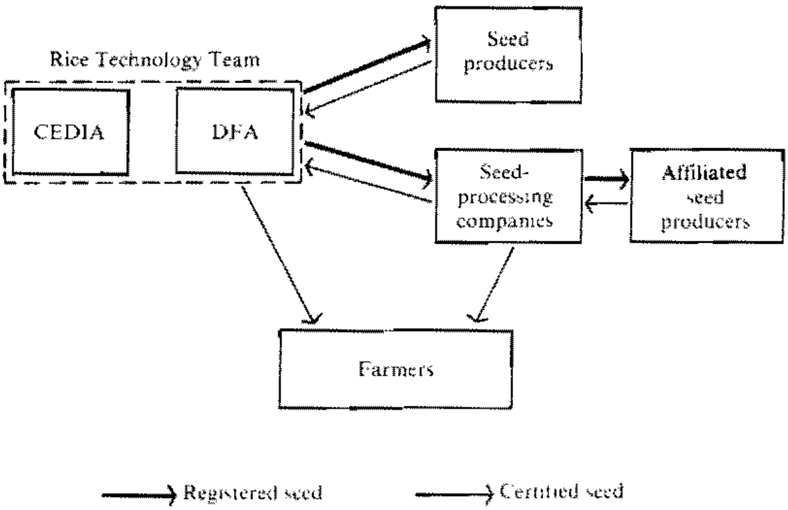

Figure 2. *Production and distribution systems for rice seed in the Dominican Republic.*

SOURCE Cuevas-Perez Federico. 1984. Costo de producción de semilla de arroz en República Dominicana. Instituto Superior de Agricultura.

The rice seed sold by the DFA in 1983 is shown in Table 6. A total of eight varieties were sold, of which five were approved for certification (Juma 58, Juma 57, Juma 51, Tanioka, and IR-6). The varieties with the highest seed demand were Juma 58, Juma 57, and Tanioka.The traditional variety "Mingolo" (the only variety of its kind in the formal seed market) was fourth in sales with 276.8 t, all of which were sold during the first season (November 1982 to April 1983).

Sowing. Recommended planting dates for rice are December to March (spring crop) and May to July (winter crop). The respective harvesting months are May to July and October to November (Figure 3). The spring crop is larger than the winter crop because farmers who practice late (April) plantings do not have the opportunity to plant a second crop. Some of them follow the popular practice of taking advantage of the regrowth for a second crop, locally called "retoño" (ratoon crop) (Figure 4). The most popular variety for ratooning is Mingolo which partly explains why its seed is only sold during the first season.

Ninety-five percent of Dominican rice is grown under irrigation, although a few zones of the country have a deficit of irrigation water. Most of the area—about sixty percent—is transplanted by hand. In the past

Table 6. **Rice seeds sold by Departamento de Fomento Arrocero according to variety and season, Dominican Republic, 1983.**

Variety	Quantity by season[a] (t)		Total
	First	Second	(t)
Juma 58	823.6	719.6	1543.2
Juma 57	1229.6	304.4	1534.0
Juma 51	111.2	8.0	119.2
Tanioka	658.8	266.9	925.7
Mingolo	276.8	0.0	276.8
ISA-21[b]	77.8	115.6	193.4
ISA-40[c]	60.4	47.6	108.0
IR-6	21.0	9.0	30.0
Total	3259.2	1471.1	4730.3

a. First season from November to April and second season from May to October.
b. CICA 9.
c. CICA 8.

SOURCE: Departamento de Fomento Arrocero.

three years mechanical transplanters have been introduced and have been successful to the extent of justifying investment by a private company, Agrocentro C. por A., to provide transplanting services.

Land preparation is started with dry plowing and harrowing, followed by puddling in flooded soil. Puddling is normally done with small hand tractors although some farmers use heavy machinery. Weed control includes the application of propanil plus 2,4-D, followed by one or two sessions of hand weeding. Hand weeding is necessary because of water control problems. The DFA is currently carrying a demonstration campaign to increase the use of preemergent herbicides.

Cultural practices and harvesting. Recommended rates for applying fertilizers in most areas are 100, 35.2, and 66.4 kg/ha of nitrogen (N), phosphorus (P), and potassium (K), respectively. Fifty percent of P and of K and 40 percent of N should be applied 7 to 10 days after transplanting; the rest of the P and K and 40 percent of N three weeks later; and the remaining 20 percent of N at panicle initiation. A recent farmers survey showed that N application is higher (120 kg/ha of N) and those of P and K lower (26.4 kg/ha of P and 49.8 kg/ha of K) than recommended. Farmers normally increase N rate at panicle initiation.

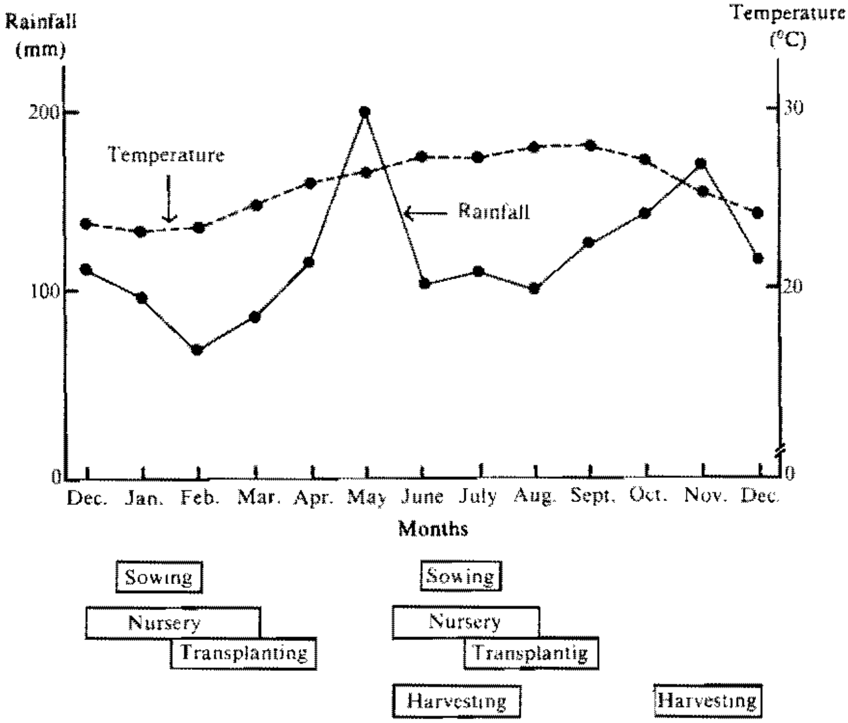

Figure 3. *Double-cropping of rice in the Dominican Republic.*

Insect and disease problems are not very serious. Farmers apply insecticide (Azodrin and/or Lorsban) against the stink bug *(Oebalus* spp.) three times a season. The most common diseases are those caused by *Pyricularia* sp. and *Helminthosporium* spp. which may require preventive applications of fungicide.

Harvesting is done either by hand or by using combines. Hand harvesting involves cutting with a sickle and threshing by beating the panicles with a stick or against a wooden bench.

The production costs, as estimated by the DFA in March 1984, are shown in Table 7. The costs shown are those of farmers with high technology use and who also have higher yields. (The DFA used those estimated costs to recommend a new support price for rice which was then under revision.) According to DFA, the farmers, with a cost of RD$1771.87 (US$600.63)/ha, obtained yields of 5.7 t/ha of paddy rice. It should be noticed that the largest component of production costs is labor (34 percent), followed by seed and chemical inputs (29 percent).

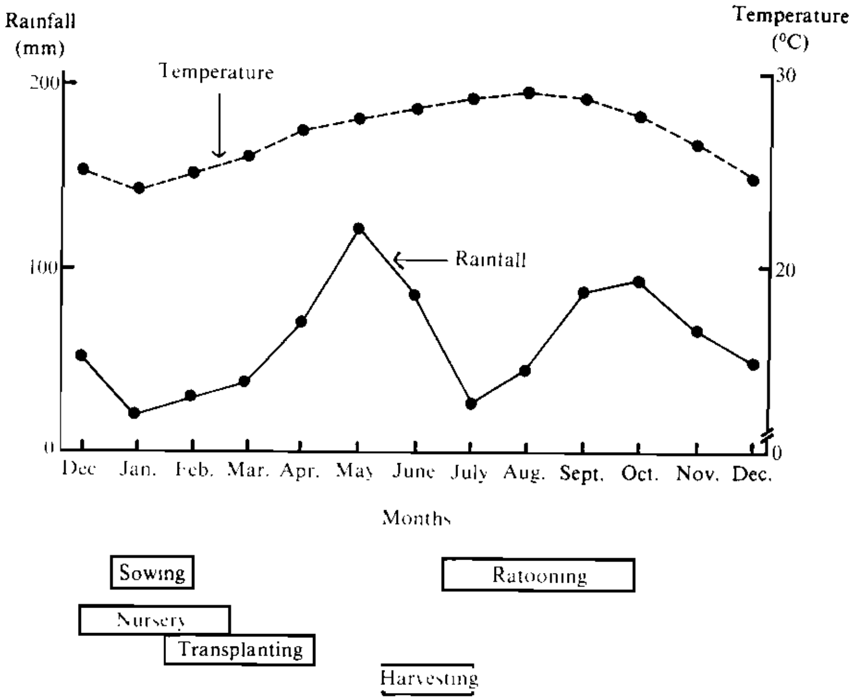

Figure 4. *The spring crop and the ratoon of rice in the Dominican Republic.*

Research and Extension

Rice research and extension in the Dominican Republic are closely related because the different institutions working in these activities have their offices in the same place, Juma, Bonao. Research is the responsibility of the Centro de Investigaciones Arroceras (CEDIA), whereas the Departamento de Fomento Arrocero (DFA) and the Centro de Capacitacion Arrocera (CENACA) are responsible for extension.

Although the above-mentioned institutions are under different departments of the Secretaría de Estado de Agricultura (CEDIA under the Departamento de Investigaciones Agropecuarias, CENACA under the Departamento de Extensión y Capacitación, and DFA under the Subsecretaría de Producción) they work in conjunction as the national rice technology team.

Table 7. **Production costs per hectare for rice farmers with high technology, Dominican Republic, 1984.**

Activity	Detail	Price per unit (RD$)	Cost/ha[a] (RD$)	Cost/ha[a] (US$)
Land preparation				
First plowing			51.67	17.51
Second plowing			43.72	14.82
Harrowing			39.74	13.47
Puddling			55.64	18.86
Leveling	Mechanical/hand		119.24	40.42
Levees	Mechanical/hand		55.69	18.88
Subtotal			365.70	123.96
Seed and chemical inputs				
Seed	145.0 kg	0.53	76.85	26.05
Fertilizers				
15-15-15	575.0 kg (2 applic.)	0.39	224.25	76.02
Urea	72.0 kg	0.43	30.96	10.49
Insecticides				
Azodrin	1.6 litre	20.00	32.00	10.85
Lorsban	0.24 litre	100.00	24.00	8.13
Herbicides				
Propanil	12.7 litre	8.00	101.60	34.44
2,4-D	1.0 litre	6.00	6.00	2.03
Rat control				
Racumin	0.45 kg	8.82	3.96	1.34
Rice bran	7.2 kg	0.18	1.29	0.44
Plastic gallon container	5	0.73	3.65	1.24
Subtotal			504.56	171.30
Labor				
Planting	Manual transplant		143.00	48.48
Nursery	Maintenance		23.25	7.88
Application of herbicides	—	—	25.44	8.62
Application of fertilizers	3 applications	7.95	23.85	8.08
Application of pesticides	4 applications	7.55	30.20	10.24
Canals			31.80	10.78
Hand weeding			127.00	43.05
Harvest and transport	63.5 bags of 3 kg	2.50	159.00	53.90
Subtotal			563.54	191.03
Other direct costs				
Water use			13.50	4.58
Interest			120.20	40.75
Subtotal			133.70	45.33
Indirect costs				
Social security			12.72	4.31
Farm maintenance			25.44	10.15
Salaries			25.44	8.62
Subtotal			63.60	23.08
Unforeseen			70.00	23.73
Total			1,701.10	578.43

a. Exchange rate RD$2.95 = US$1.00 (Jan. 1985)

CEDIA is the official rice research institution. It is organized into seven divisions: Varieties, Agronomy, Basic Seed, Mechanization, Irrigation, Plant Protection, and Soil and Fertilizers. In addition CEDIA has the support of a Chinese agricultural mission and that of the Instituto Superior de Agricultura (ISA).

The Chinese mission was responsible for the foundation (November 1962) and the development of CEDIA. It is formed by five agronomists who provide direct advice in carrying out research. Through a collaborative agreement the ISA participates in rice research in the areas of plant breeding, socioeconomics, and cooking quality.

The rice varieties Juma 58 and Juma 57 were released by CEDIA in 1972; these are the most popular rice varieties among farmers. However, the rice improvement program continues at CEDIA and the number of crosses have increased, in the last years, to 102 crosses in 1981. The main objective of the rice breeding program is to release varieties resistant to *Pyricularia* sp. and/or tolerant to salinity.

Research is concentrated at CEDIA's central research station (45 ha) in Juma, Bonao, and in two substations, one in Nagua (15 ha) and the other in Laguna Salada (6 ha). The Nagua substation is used for field selection for resistance against *Pyricularia* sp. and the Laguna Salada substation screens for tolerance to salinity.

Rice training is organized by CENACA for agronomists and farmers. Up until 1983 this Center organized, for rice agronomists, 11 courses with an average duration of three months each.

Constraints to Increased Rice Production

The major constraints to rice production are those of infrastructure. For example, the lack of machinery, deficiency in water control, and credit expenditure problems have slowed down the expansion of double-cropping. At the national level the cropping intensity is only 1.28.

It has been suggested that early maturing varieties may increase the chances of double-cropping in areas with good water control. For this reason CEDIA is searching for varieties with a cycle of 120 days, that is, two to three weeks earlier than Juma 58 and Juma 57.

The national deficit of machinery for timely land preparation partly explains the popularity of ratooning northwest of Santiago. This system, although it assures output during the second season, produces less rice than a normal planting.

Water control problems result in weed problems and less efficient use of nitrogen fertilizer. For the last few years red rice, together with other seed quality problems, has become a serious problem and has increased the problems of weed control.

For the area of rice production to expand saline soils must be brought under cultivation. CEDIA is consequently working to identify rice varieties tolerant to salinity.

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Rice in Guyana

*Lomas K. Tulsieram and Harri B. Persaud**

Guyana has a land area of 214,970 square kilometres and a total population of 797,000, 64 percent of whom represent the rural population and 36 percent of whom make up the urban population.

Physiographically Guyana can be divided into five natural regions: the coastal plains; the alluvial plains and lowlands; the "White Sand" plateau and older pediplanes; the crystalline shield uplands; and highlands, mountains, and plateaus. The coastal plains stretch across the northeastern face of the country, varying in width from 16 to 25 km, and occupying a total area of 1.8 million hectares. Thirty-eight percent of this area contains the country's most fertile agricultural land (FAO-UNSF, 1966). However, only 102,540 ha (14.6 percent) are suitable for rice cultivation and of these approximately 65 percent are already under cultivation. The remaining area requires extensive drainage and irrigation facilities.

Guyana is divided into ten administrative regions. Six of these share the coastal plains in which rice production is concentrated. The acreage available in the six regions and the percentage occupied by rice are presented in Table 1.

The History of Rice Cultivation

Rice in Guyana dates back to the early eighteenth century when it was introduced from Carolina, U.S.A. Similar and subsequent introductions were unsuccessful as it did not provide a cheap source of food for supplementing the diet of the slaves. This failure could be attributed to the lack of knowledge of rice culture by the slaves and to the planters' consistent refusal to permit rice growing outside the environs of the sugar plantations (Ramgopaul, 1964).

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* Plant Breeder, Rice Program, Georgetown, Guyana, and Principal Agricultural Officer, Ministry of Agriculture, Georgetown, respectively.

Table 1. **Distribution of rice lands in Guyana.**

Region	Agricultural area	
	Available (ha)	Occupied by rice (%)
North West and Pomeroon	7,519	8.4
Essequibo Islands and coastal area	16,146	74.2
West Demerara	9,995	22.3
East Demerara	18,848	61.6
West Berbice	13,377	88.2
East Berbice	24,322	71.6

SOURCE: Rural Farm Household Survey, 1982, Guyana

Success came with the influx of indentured immigrants from India. They brought with them an indigenous knowledge of rice cultivation and rice formed a major component of their diet. Rice cultivation expanded rapidly and soon moved out of the confines of the sugar plantations. By 1853 there were 62 ha under cultivation and in 1908 Guyana was a net exporter (Pawar, 1971). Production and export continued to increase and by 1953 over 30,612 ha were under cultivation.

General Status of the Rice Industry in Guyana

Economic perspective. Rice is one of Guyana's three major export products—the others are sugar and bauxite. Rice and sugar dominate the agricultural sector and represent approximately 44 percent of total exports. Rice accounted for 27.3 percent of the total export of these two commodities during the period 1977-1981 (Table 2).

Beside being one of the major foreign exchange earners, rice is the staple food of most of the population with a per capita consumption of 90 kg per year. Additionally rice production provides a livelihood for an estimated 150,000 people in the fields, factories, warehouses, and offices.

Structure of the rice industry. The major operations of the rice industry are administered by the Guyana Rice Board (GRB) whose major responsibilities are:

To develop the rice industry and promote the expansion of export trade;

To supervise the disposal of paddy and milled rice; and

To control the manufacture, purchase, sale, and distribution of paddy, milled rice, and their byproducts and virtually to engage in any and all operations of the rice industry.

The GRB is linked to wider governmental administrations through two principal organizations: the Ministry of Agriculture and the Guyana State Corporation (GUYSTAC). The Ministry reviews those of GRB's activities which are related to agriculture such as rice research, rice production, storage, and shipment. GUYSTAC is in charge of personnel and financial management.

The GRB is governed by a board of directors which include farmers, millers, representatives from GUYSTAC, and employees and administrative personnel from GBR. Its principal executive officer is the general director whose responsibility is to report to the board and carry out its policies as well as to supervise GBR's operations.

The organizational and administrative system is formed by six national division managers and four regional managers. The latter report to their respective divisional managers who in turn report to the general director.

The Production, Research and Extension Services Division and Marketing Division play a central role in the day-to-day operations of the GRB. The Production, Research and Extension Services Division has the responsibility for the overall management of the operations of the three

Table 2. **Export value of the two major agricultural commodities, rice and sugar, Guyana, 1977-1981.**

Year	Commodity (G$ millions)[a]		Rice proportion
	Rice	Sugar	(%)
1977	66.8	192.2	25.8
1978	96.0	240.0	28.6
1979	8.0	240.0	30.0
1980	87.5	221.5	25.9
1981	110.0	305.9	26.4
Average			27.3

a. Exchange rate: G$4.12 = US$1.00 (Nov. 1984)

SOURCE: Ministry of Economic Development, Statistical Bureau, 1982.

state farms, the drying and storage facilities, and the rice mills. Until recently the Division supervised and coordinated research and extension activities as well as the importation, sale, and distribution of all agricultural inputs such as fertilizers, pesticides, and spraying equipment, which were sold at subsidized prices.

The Marketing Division is responsible for establishing markets and for controlling the grading of all rice to be sold. It also classifies all rice marketed by the GRB through the respective section and gives guidance on the types of rice demanded by local and external markets.

Proposed reorganization of the industry. The current administrative organization of the GRB has been under review and it has been proposed that, as of July 1984, three new entities will be set up to administer the rice industry: the Guyana Rice Export Board; the Guyana Rice Milling Corporation; and the National Rice Grading Authority.

In addition it has been decided that, as of 1 January 1984, the research and extension activities of the GRB should be placed under the Ministry of Agriculture to be later transferred to the proposed National Agricultural Research Institute when it is established[1].

Purchasing, processing, and marketing. The GRB purchases whatever quantity of paddy or milled rice offered to it at prices fixed according to grades.

Prices for paddy and rice bought from farmers are determined according to a GRB's recommendation which is based on available information on production costs. The Rice Action Committee, the Ministry of Agriculture, and the Rice Producers' Association are involved in the gathering of that information. The GRB's recommendation is reviewed by GUYSTAC but the final approval is given by the Cabinet.

The prices for paddy and milled rice are established by grade and varietal grouping. This encourages farmers to produce a high quality product. As a consequence, a premium price is paid for paddy and milled rice produced from new improved varieties (Tables 3 and 4).

The GRB's milling capacity is about 50 percent of that of the private mills (Table 5) but it controls more than 50 percent of the milling operations of the rice industry. This can be attributed to the fact that the privately owned mills are not fully operational and, in addition, lack the

1. The reorganization of the industry and the establishment of the Institute are now reality

Table 3. **Prices of paddy approved by Guyana Rice Board, January 1984.**

Grade[a]	Price[b] (G$/kg)
Extra A	0.52
A	0.50
B	0.47
C	0.44
D	0.40

a. Grades Extra A to C include the approved varieties Starbonnet and Rustic, and others. Grade D is for other varieties only.
b. **Exchange rate: G$4.12 = US$1.00 (Nov. 1984).**

SOURCE: Guyana Rice Board.

Table 4. **Prices paid for milled rice by Guyana Rice Board, January 1984.**

Parboiled		White	
Grade	Price[a] (G$/kg)	Grade	Price[a] (G$/kg)
Extra Super	0.98	Extra A	0.94
Super	0.94	A	0.91
Extra No. 1	0.90	B	0.86
No. 1	0.85	C	0.79
Extra No. 2	0.80	Extra A	0.64
No. 2	0.77	B	0.58
No. 3	0.66		
Broken	0.58		

a. Exchange rate: G$4.12 = US$1.00 (Nov. 1984).

SOURCE: Guyana Rice Board.

Table 5. **Rice mills and milling capacity, Guyana.**

Owner	Mills	
	No.	Capacity (t/hr)
Private	82	77.75
Guyana Rice Board (GRB)	9	38.00
Total	91	115.75

SOURCE: Guyana Rice Board, 1983.

facilities for storing and drying the amount of paddy proportional to their milling capacity. Exports and local sales have varied over the years as shown by Table 6. Currently the local market captures approximately 33 percent of the total rice sold by the GRB. Local rice prices are fixed by GRB according to grades (Table 7) and reflect a premium price for quality.

Most of Guyana's rice for export is distributed in the Caribbean area—Jamaica and Trinidad and Tobago usually capture between 50 to 85 percent of total exports (Table 8). The most important category of export rice is white rice of the first quality (White A). It is exported in bulk.

Table 6. **Rice production and sales, Guyana, 1974-1983.**

Year	Production (t)	Sales (t)	
		Export	Local
1974	165,608	36,322	32,340
1975	178,206	78,358	44,144
1976	103,723	71,814	36,282
1977	214,908	66,657	45,835
1978	184,930	104,759	39,288
1979	144,285	54,000	35,547
1980	169,057	81,008	37,283
1981	165,596	78,010	30,038
1982	181,599	—	41,529
1983	147,811	—	30,389

SOURCE: Guyana Rice Board, 1983.

Table 7. **Selling prices of milled rice fixed by Guyana Rice Board, January 1984.**

Presentation	Quality	Price (G$/kg)[a]
Bulk	Super	1.06
	No. 1 parboiled	0.98
	No. 1 white	0.98
Packaged	Guyana White	1.36
	Indian Maid[b]	1.41

a. Exchange rate: G$4.12 = US$1.00 (Nov. 1984).
b. Parboiled rice.

SOURCE: Guyana Rice Board, 1983.

Table 8. **Rice exports (t in thousands) according to major destination, Guyana, 1975-1981.**

Destination	Quantity per year						
	1975	1976	1977	1978	1979	1980	1981
Jamaica	32.3	29.2	30.6	35.5	37.9	35.7	32.7
Trinidad	23.8	31.2	23.6	37.2	26.2	31.9	33.1
Barbados	7.5	7.1	6.6	5.9	4.4.	4.2	2.7
Cuba	9.6	—	—	—	—	—	—
St. Vicent	1.9	0.9	2.1	1.7	1.7	1.4	0.8
Antigua	1.3	1.3	1.1	1.1	1.0	0.4	—
Others[a]	7.4	2.1	2.9	23.3	12.8	13.4	8.7
Total	83.8	71.8	66.9	104.7	84.0	87.0	78.0

a. Include other Caribbean countries, the German Democratic Republic, Netherlands, and Libya.

SOURCE: Guyana Rice Board, 1983.

Parboiled rice has lost importance and in 1981 it accounted for only 5 percent of total exports which included both bulk and packaged types.

The GRB generally receives very favourable prices which normally are higher than world market prices because of: government-to-government negotiations; transport costs that make Guyana prices very competitive for neighbouring countries; the benefit provided by the 15 percent subsidy, common in the external tariff; and 45 percent of the rice is packaged—this represents an increase in prices of 9 to 17 percent over bulk rates.

According to present trends it appears that Guyana is losing its traditional markets, especially the Jamaican market. Besides accepting more reasonable terms of purchase from other sources, Jamaica and Trinidad and Tobago are consolidating their own efforts in rice production.

Rice Production Systems

Farm size and yield. A large proportion of rice is grown by medium-sized and small farmers. Seventy-three percent of the farms are 15 acres (6.1 ha) or less and 17 percent are between 15 and 25 acres (6.1 to 10.1 ha) (Table 9). The 1978 Rural Farm Household Survey revealed that these two groups together produced a little over 60 percent of all rice—the former group contributed approximately 45 percent of total production.

Table 9. **Distribution of rice farms according to size, Guyana.**

Farm size (ha)	Farms (no.)	Proportion (%)	Accumulated percentage
Less than 1.0	555	8	8
1.0 to 2.0	924	14	22
2.1 to 4.0	1923	29	51
4.1 to 6.0	1294	22	73
6.1 to 10.0	1146	17	90
10.1 to 20.0	483	7	97
20.1 to 40.0	160	2	99
More than 40.0	149	1	100
Total	6634		

SOURCE: Rural Farm Household Survey, 1978

While total paddy production fluctuated over the period 1970-1983, with production reaching a peak in 1977 (Figure 1), paddy yield per hectare remained relatively stable in the early seventies. A gradual increase in yield per hectare was observed from 1974 to 1983 (Table 10). This is attributed mainly to improved water control in some areas and rapid increase in the acreage put under improved high-yielding varieties (Table 11).

Cropping systems. Almost all the rice crop is monoculture. Guyana's equitable temperature (mean annual temperature ranges between 20 and 29°C) and seasonal rainfall have given rise to a cropping pattern in which approximately 44 percent of the available rice land is double-cropped and around 18 percent is single-cropped (Small, 1982).

Generally a larger acreage is cultivated in the second crop (Figure 2), but the importance of the first crop has increased through time and now contributes to approximately 40 to 45 percent of total rice production.

The two harvests are delineated by the wet seasons during which the crops are established. The first crop is planted during the shorter of the wet seasons from mid-November to January and is harvested in March and April. The longer rainy period begins in May when the second crop is established. Harvesting is usually achieved in September and October (Figure 3).

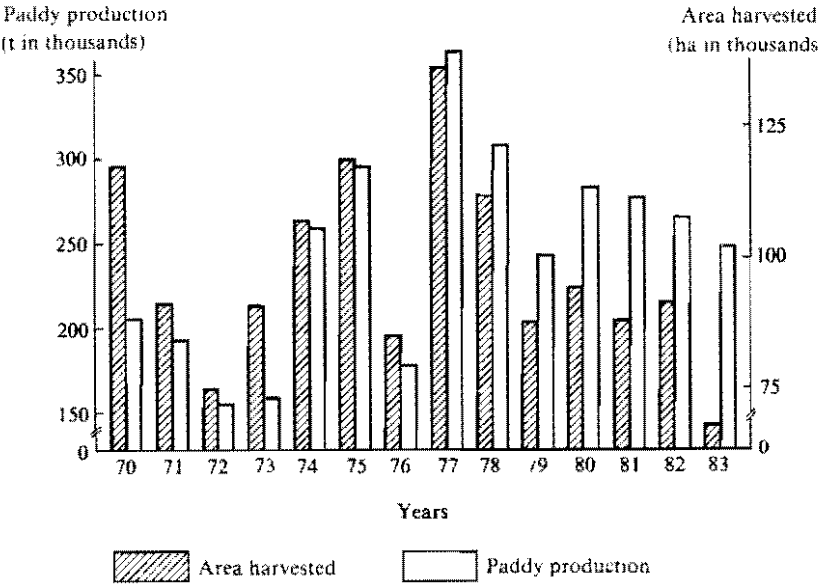

Figure 1. *Paddy production and area harvested, Guyana, 1970-1983.*

Table 10. **Paddy area harvested, production, and yield per hectare, Guyana, 1970-1983.**

Year	Area harvested (ha)	Production (t)	Yield (t/ha)
1970	119,667	222,403	1.858
1971	94,529	187,479	1.983
1972	79,785	149,740	1.877
1973	93,198	152,315	1.634
1974	106,171	260,415	2.453
1975	117,017	297,011	2.538
1976	84,368	172,873	2.049
1977	137,123	358,185	2.612
1978	115,314	308,116	2.672
1979	90,595	240,479	2.654
1980	97,195	281,763	2.899
1981	89,415	275,963	3.086
1982	93,737	262,664	2.802
1983	72,420	245,985	3.397

SOURCE: Guyana Rice Board, 1983.

Table 11. **Rice varieties grown in Guyana, 1983.**

Variety	Origin
Rustic	Guyana
Starbonnet	U.S.A.
N	Guyana
S	Guyana
T	Guyana
No. 79	Guyana
IR 22	Philippines
Bluebelle	U.S.A.

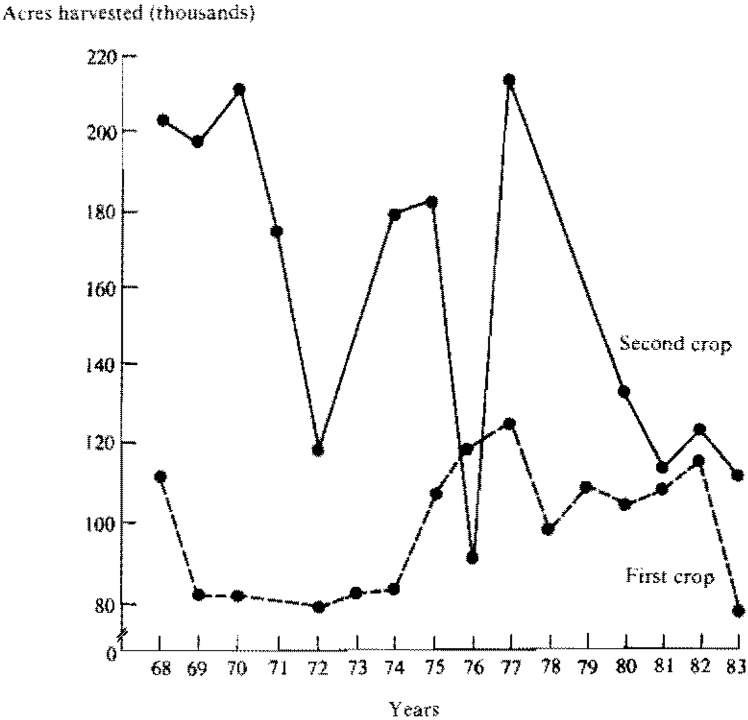

Figure 2. *Acreage harvested in the first and second crops, 1968-1983.*
One acre = 0.4047 ha.

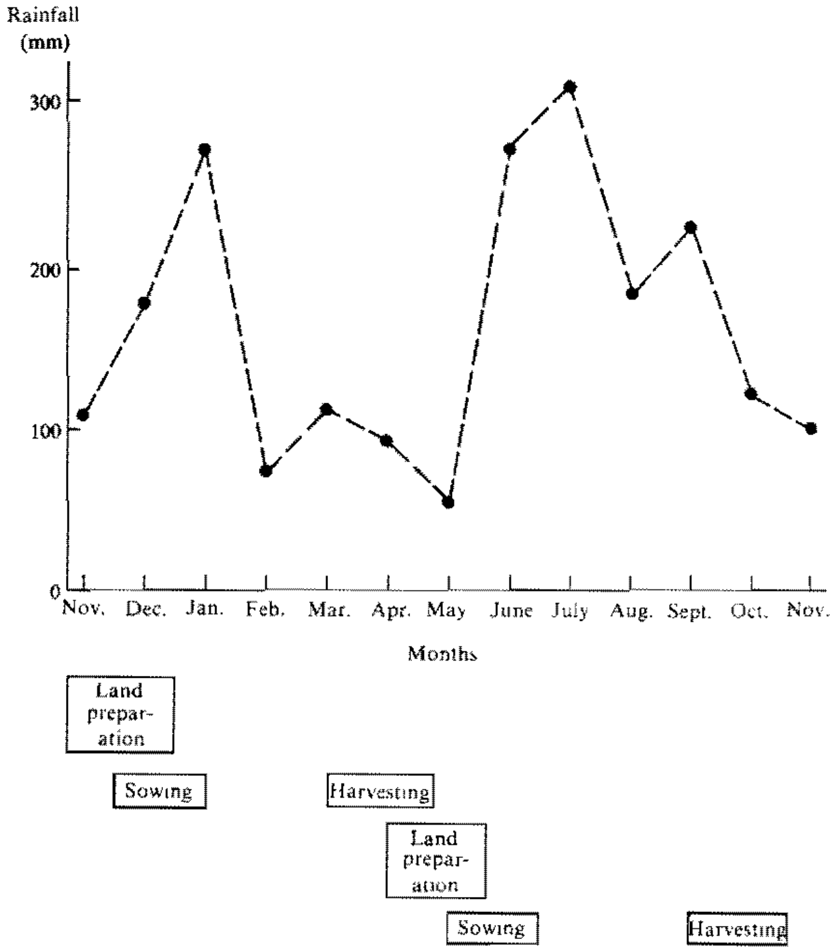

Figure 3. *Rice cultivation calendar in Guyana.*

Cultural practices. In Guyana wetland culture is practiced—primarily for its advantage in weed control. Normally, after harvesting, the crop residues are burnt and plowing starts immediately. The field is then flooded, puddled, and leveled. Pregerminated seed is sown 48 to 72 hours later. The field may or may not be drained after sowing. If it is, reflooding is practiced 5 to 7 days after drainage.

Based on soil fertility studies, recommendations have been made to farmers to apply nitrogen (N) and phosphorus (P) at rates of 60 kg/ha of N and 13.2 kg/ha of P. These quantities are applied in two or three split applications—the first application with all the P and approximately 20 kg/ha of N 21 days after sowing.

Among the more economically important insect pests is the paddy bug *(Oebalus poecilus)* which causes both quantitative and qualitative losses. The leafminer *(Hydrellia* spp.) and the heartworm *(Rupella albinella)* are also of importance, especially in years when environmental conditions seem to promote reproduction and infestation.

Rice blast *(Pyricularia oryzae)* is the most significant of the foliar diseases. Brown leaf spot *(Helminthosporium oryzae)* is of lesser consequence.

Crop losses due to blast varies with location, season, and variety. All the present commercial varieties range from moderately susceptible to susceptible. However, farmers can continue to plant these varieties because the majority of rice lands are in close proximity to the Atlantic and therefore to its ocean breezes which reduce infection. Inland areas are more severely hit, especially during the second crop. Farmers practice chemical control at early stages of symptom recognition.

There is a high incidence of grass weeds and Cyperaceae, especially in locations with inadequate irrigation and poor cultural practices. Maraina grass *(Ischaemum rugosum)* is the major weed, followed by jussia *(Fimbristylis miliacea)*. Broad-leaved weeds, especially aquatic ones, can seriously limit production if adequate control measures are not taken.

Production costs. As seen in Table 12, the total cost of production per hectare is on the average G$773 (US$187.62)[2]. However, for every 140 pounds harvested the costs are G$6.65/ha (that is, for every 63.64 kg the costs are US$1.61/ha). If the average yield is 3.4 t/ha the harvesting costs would be G$355.28 (US$86.23)/ha which means that the real total cost per hectare would be G$1128 (US$273.78). The farmers producing paddy grade A at G$0.50 (US$0.12)/kg earn G$1700 (US$412.62)/ha while those producing grade C at G$0.44 (US$0.10)/kg earn G$1496 (US$363.10)/ha. The net return per hectare is therefore G$571.72 (US$138.76) and G$367.72 (US$89.2) respectively.

Research and Extension

Rice research and extension services have been, in the past, administered by the Production, Research and Extension Division of the Guyana Rice

2. Exchange rate: G$4.12 – US$1.00 (Nov. 1984).

Table 12. **Rice production costs, Guyana, 1982.**

Activity	Cost[a]	
	(G$ kg/ha)	(US$ kg/ha)
Land preparation	272.81	65.47
Sowing		
Seed	89.57	21.50
Labor (1/4 man-days)	8.65	2.07
Cultivation		
Fertilizers	182.51	43.80
Insecticides	40.47	9.71
Herbicides	46.48	11.15
Labor (3 man-days)	51.89	12.45
Maintenance of drains and ditches	8.65	2.07
Indirect costs		
Land charges	24.71	5.93
Drainage and irrigation charges	18.53	4.45
Subtotal	743.27	178.60
Interest (12%/month)	29.73	7.13
Total	773.00	185.73

a. Exchange rate: G$4.12 = US$1.00 (Nov. 1984).

Board, but, as from 1 January 1984, they were transferred to the Ministry of Agriculture.

Research. Research activities are centralized at the Rice Research Station (RRS) of the Mahacia-Mahaicony-Abary Rice Development Project. The station is organized into various sections and departments according to research disciplines: plant breeding, plant pathology, entomology, soil fertility, weed control, water management, and foundation seed production.

The objectives of the varietal improvement program are related to the selection and development of varieties for lowland irrigated culture. Such varieties must have characteristics superior to those of the existing varieties especially in regard to: agronomic performance in soils of the coastal plains; disease resistance; tolerance to pests, water stress conditions, and salinity; and grain and milling quality. Another objective is to maintain and multiply sufficient quantities of basic and foundation seed of the commercial rice varieties.

A number of improved varieties have been developed including S, T, N, Champion, and Rustic. Rustic occupies more than 50 percent of the total acreage under rice cultivation in Guyana.

Since one of the basic characteristics of improved varieties is their requirement for high levels of fertilization in order to develop their high-yielding potential, there is a need for thorough studies on varietal response to fertilizers. Investigations include the type of fertilizer to be applied, rate of application, number of split applications, and time of applications. Because optimum fertilizer requirements are determined from these studies, final recommendations to farmers must also take into account their ability to buy the fertilizers.

Work in the plant protection program is concentrated on the effective and economic control of insects, diseases, and weeds. It includes the evaluation of chemical products available for commercial use in order to identify the most suitable ones in terms of effectiveness, economy, and protection to both users and environment. The minimum effective rates and best times for application are also determined.

Water management studies are conducted primarily to investigate the effects of water depths on weed control and plant growth. Type and sequence of land preparation and their effects in weed control are also studied.

Extension services. The industry is assisted by an extension team operating in each of the different rice-growing regions. These teams are responsible for the transfer of new technology to rice farmers and for working in close collaboration with the farmers to identify production problems and to advise on corrective measures. The teams must be engaged, in their respective regions, in the field testing of new varieties, fertilizers, pesticides, water management practices, and land preparation recommendations developed by the Rice Research Station. Information resulting from these tests is used in the formulation of recommendations for the different regions.

Foreign consultants. The services of overseas consultants have been obtained over the years through various international programs. These consultants work either on specific project areas in the research station or they conduct applied research in the major rice-growing areas. One group who has been working in Guyana since 1980 is the U.S.-based International Research Institute (IRI). Together with a team of local counterparts, the IRI team works primarily in the areas of varietal improvements, soil fertility, and seed production. An achievement of their work so far has been the identification of a high-yielding variety for commercial production. This variety, Diwani, is resistant to blast, produces consistently higher yields than present commercial varieties and appears to be widely adapted to stress conditions.

Future research areas. One major area for future research is the development of systems capable of maintaining or even improving yields while reducing production costs. This research could involve the following activities:

Varietal improvement, including the selection and development of varieties with moderate high-yield potentials but requiring lower fertilizer inputs, and the selection and development of varieties resistant or tolerant to major insect pests and diseases;

Studies on the more efficient use of fertilizers;

Studies on the biological fixation and utilization of nitrogen in rice fields, for example, by blue-green algae or Azolla;

Studies to reduce land preparation costs by evaluating tillage operations and new agricultural implements;

Studies on more effective water management practices;

Studies of the impact of land preparation and water management practices on weed population and their control; and

Development of new systems to improve cultural practices in order to maintain yield and quality and limit the use of pesticides.

Conclusion

It can be said that Guyana has the potential and the capacity to increase its rice production. This is shown by the drainage and irrigation systems developed primarily for rice cultivation such as the Tapakuma Irrigation Project and the Mahaica-Mahaicony-Abary Agricultural Development Authority (MMA/ADA). It is also expected that when rice research is included within the proposed National Agricultural Research Institute, it will be intensified in order to support a vital and growing industry.

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Rice in Haiti

77UCl9

*Jean René Bossa**

Lying between latitudes 18° and 20° north and longitudes 72° and 74° west, the Republic of Haiti occupies the western portion of the island usually known as Hispaniola. It covers an area of 27,750 square kilometres, most of which is covered with mountains. In 1983 the population of Haiti was estimated as 5.3 million.

Agriculture is a very important component of the Haitian economy: it is the main source of foreign exchange and the means of employment for 61 percent of the active population (1.4 million). It occupies 907,800 hectares, that is, 32.6 percent of the country. Farms are very small—in fact 71 percent of the farms have an area of less than one "carreau" (1.29 ha) and only 0.3 percent are over 10 carreaux (Table 1).

In 1971 the Gross Domestic Product (GDP) of the Republic of Haiti was US$167.58 million and in 1978 it increased to US$186.9 million. However, the contribution of the agricultural sector to the GDP decreased from 47.7 to 40.5 percent. This reduction was due to the lower growth rate of agriculture when compared with other sectors of the economy.

Table 1. **Number of farms according to size, Haiti, 1971.**

Size (carreaux)[a]	Number	Proportion (%)
0 - 1	437,995	71.1
1.1 - 3	146,890	23.8
3.1 -10	29,650	4.8
More than 10	2,175	0.3

a. One carreau = 1.29 ha.

SOURCE: Plan Quinquennal du Secteur Agriculture, 1981-1986. DARNDR, Damien, September, 1981

* Rice Researcher, Organisme de Développement de la Vallée de L'Artibonite (ODVA), Ponte Sondé, Haiti.

General Status of the Rice Industry in Haiti

Rice is a very important crop in Haitian agriculture. Its consumption continues to increase (Table 2) and this fact has placed rice self-sufficiency in the top priority list of national agricultural policy.

In terms of human consumption rice is third after corn (34.4 kg per capita) and sorghum (22.0 kg). It is expected that rice consumption will reach a higher level as the country develops and the income of the Haitian people increases. In terms of area under cultivation, however, the rice crop is seventh among major food crops (Table 3). Mean rice production per year was 113,981 tons during the period 1977-1981 and mean yield was 2.41 t/ha (Table 4).

Table 2. **Rice consumption in Haiti, 1950-1982.**

Year	Total consumption (t)	Population (millions)	Per capita consumption (kg)
1950[a]	22,000	3	7.3
1960	51,000	4	12.8
1982	75,000	5	15.0

a. Before irrigation work in the Artibonite Valley.

SOURCE: Victor, Jn. André. Importance du riz en Haiti, "Cours national sur les techniques de production du riz".

Table 3. **Major food crops according to area (ha) in Haiti, 1977-1978.**

Crop	Area		
	1977	1978	Average
Corn	210,352	248,373	229,363
Sorghum	151,844	165,856	158,850
Beans	103,458	101,415	102,437
Plantain	72,953	72,953	72,953
Cassava	57,980	62,861	60,421
Sweet potato	62,950	55,550	59,250
Rice	40,036	51,614	45,825
Yam	30,653	33,643	32,148

SOURCE: DARNDR, Service de Statistiques Agricoles. Evolution de certains produits agricoles au cours des années 1977-1978.

Table 4. **Area, production, and yield of rice in Haiti, 1977-1981.**

Year	Area (ha)	Production (t)	Yield (t/ha)
1977	30,035	90,480	3.01
1978	51,616	113,550	2.20
1979	54,000	122,115	2.26
1980	52,790	124,050	2.35
1981	47,885	119,710	2.50
Average	47,265	113,981	2.41

Paddy rice is milled in more than 200 small mills distributed throughout the rice-growing regions of the country and in two state mills located in the Artibonite Valley. The traditional "pilon[1]" is also used. The two state mills are administered by the Organisme de Développement de la Vallée de l'Artibonite (ODVA). They handle only 2.5 percent of national rice production (about 1755 t). The remaining 97.5 percent of paddy is milled by private mills, and depending on the region, by the traditional "pilon ". These last two ways of milling rice handled about 117,000 t of paddy in 1981.

The state mills buy superior[2] paddy rice at US$0.44/kg and ordinary[3] paddy rice at US$0.31/kg. After processing ODVA sells the milled rice at US$0.92/kg for superior and US$0.79/kg for ordinary. The rice milled by ODVA is usually sold to state stores which then distribute it to supermarkets, retailers, and consumers.

Most rice is sold in the markets of l'Estere, Ponte Sondé, and Jean Denis at different prices according to the month of the year and according to the type of rice. Farmers come to the market to discuss prices with middlemen in order to sell under favourable conditions. Figures 1 and 2 give an idea of price variation in the market of l'Estere.

The price of rice is almost twice that of corn and sorghum which explains the higher consumption of the latter two crops (Table 5).

The Haitian Government is very interested in promoting the development of rice cultivation in traditional rice-growing areas and conse-

1. The "pilon" works on the mortar and pestle principle in which the rice is pounded by a wooden pole.
2. Varieties MGG, Starbonnet, and Quisqueya.
3. Varieties MCI-3, MCI-65, CICA 8, and Chia Seng.

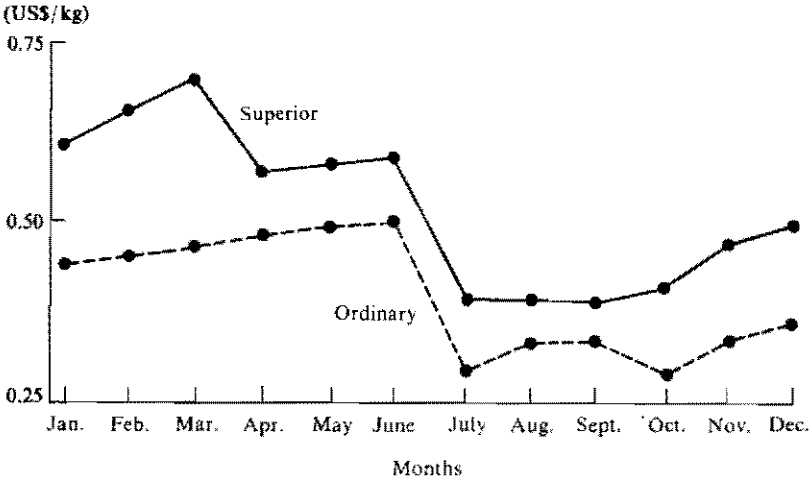

Figure 1. *Prices of paddy rice according to time of year, L'Estere, Haiti.*

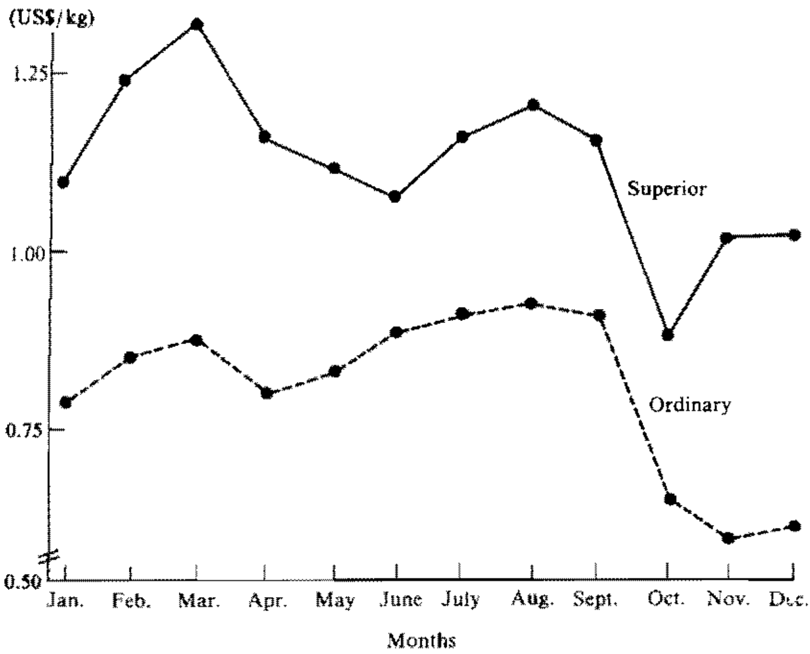

Figure 2. *Prices of milled rice according to time of year, L'Estere, Haiti.*

Table 5. **Production, importation, availability, and consumption of rice, corn, and sorghum in Haiti, 1976-1978.**

Year	Factor	Values by commodity			
		Rice[a]		Corn[b]	Sorghum
		Paddy	Milled		
1976-77	Production (t)	90,481.0	54,288.6	168,250.0	110,846.0
	Importation (t)	—	741.6	432.6	0.0
	Availability (t)	—	55,030.2	168,682.6	110,846.0
	Apparent per capita consumption[c] (kg)	—	11.5	35.4	23.3
1977-78	Production (t)	113,548.0	68,128.8	161,442.0	99,514.0
	Importation (t)		198.7	123.3	0.0
	Availability (t)		68,327.5	161,565.3	99,514.0
	Apparent per capita consumption[c] (kg)		14.1	33.4	20.6
Average	Production (t)	102,014.5	61,208.7	164,846.0	105,180.0
	Importation (t)		470.2	278.0	0.0
	Availability (t)		61,678.9	165,124.0	105,180.0
	Apparent per capita consumption[c] (kg)		12.8	34.4	22.0

a. Milled rice production is 60% of paddy. Rice importations may be underestimated because of the informal rice trade with the Dominican Republic.

b. All imported corn is assumed to be used for animal consumption.

c. Estimated figures, assuming a population of 4.75 million in 1977 and 4.83 million in 1978. Seed reserves, farmers' consumption, and end-of-year inventory are not included.

SOURCE: Population: IMF (International Monetary Fund). October 1982. International Financial Statistics.
Importation: DARNDR September, 1981. Plan Quinquennal du Secteur Agriculture, 1981-1986. Damien.

quently has reestablished ODVA in 1971, giving it the mandate to develop rice lands in the Artibonite Valley.

Rice Production Systems

Rice in Haiti is an indicator of water availability. Rice can be found wherever a source of water for flooding is available or in swampy areas.

Production areas. There are seven major rice-growing zones in the country (Table 6). The Artibonite Valley, with 42,000 ha, represents more than 80 percent of national rice production. The rainfall patterns of two zones in the Valley are shown in Figure 3. It can be seen that the monthly rainfall rarely exceeds 200 mm—the minimum needed for the development of the rice plant—meaning that upland rice culture is not very common in this zone.

Land tenure has very interesting characteristics. In the Artibonite Valley 60 percent of the farmers own their land, 20 percent rent it, and 20 percent are sharecroppers. The rental charge is US$200 per carreau[4] per crop (US$155/ha per crop). State farms benefit from the law of exception as of July 28, 1975, and pay ODVA (the body charged with the administration of the farms) a land rental fee varying from 5 to 10 percent of the crop. Sharecroppers pay the owners 50 percent of the crop.

Table 6. **Area, production, and yield of rice zones in Haiti.**

Zone	Area (ha)	Production (t)	Yield (t/ha)
Central Plateau	1,500	1,800	1.20
North West	1,600	2,240	1.40
South: Caribbean Sea	3,000	5,400	1.80
South: Golfe de la Gonâve	4,000	6,400	1.60
North	5,000	9,000	1.80
Artibonite	42,000	100,800	2.40
Others	1,000	600	0.60
Total/average	58,100	126,240	2.17

4. One carreau = 1.29 ha.

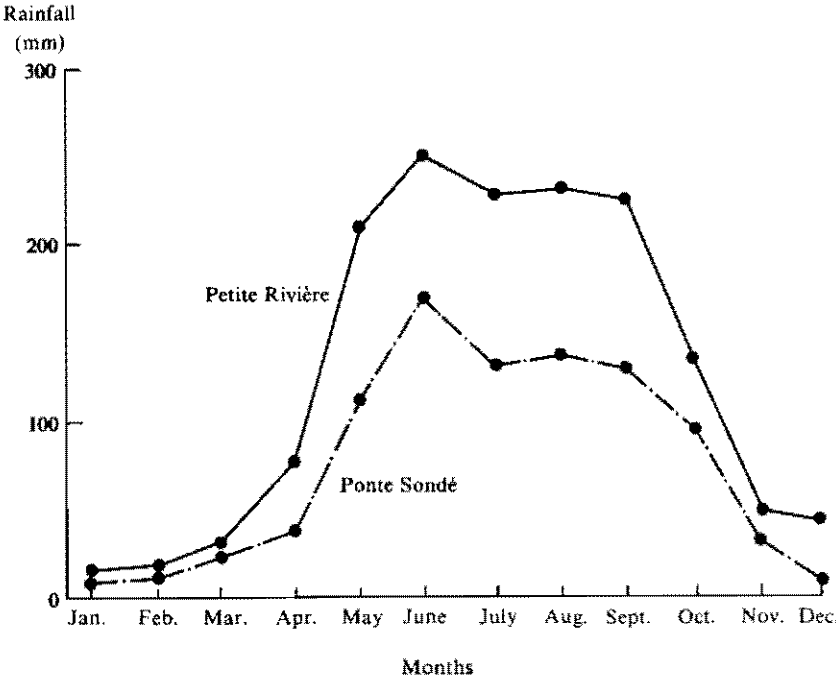

Figure 3. *Rainfall patterns of two rice-producing zones of the Artibonite Valley.*

Cropping systems. The most common cropping systems in the Artibonite Valley are shown in Figure 4. It shows that some farmers can obtain three crops per year by using early maturity varieties. However, the adoption of this practice is limited by the facts that the least mistake can be catastrophic and that rat control is necessary.

In general, farmers obtain two crops per year—the most important one occurring from June to December. After the second rice crop some farmers grow an upland crop such as onions, beans, tomato, sweet potato, or melon—the most popular being sweet potato.

The quantity of seed used varies between 65 and 125 kg/ha according to variety and season. The use of nurseries is a must but, despite ODVA's efforts, farmers continue to plant pregerminated seeds without using **canteros**[5].

5. **Cantero:** seedling bed built as a mound.

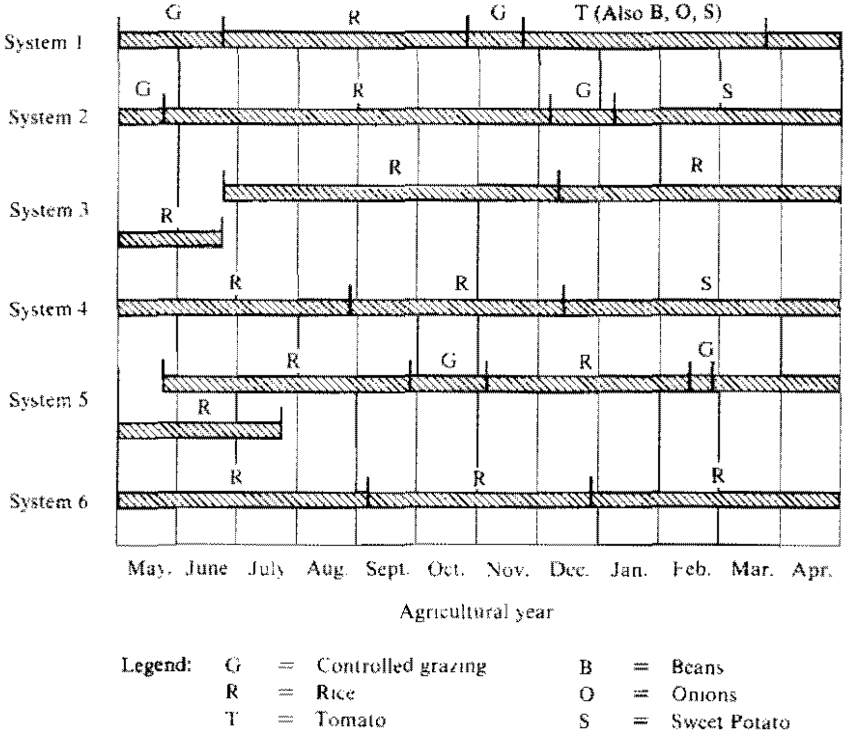

Figure 4. ***Principal cropping systems in the Artibonite Valley, Haiti.***

Transplanting is done when seedlings are 25 to 45 days old, depending on the cycle of the variety used. The relationship between the nursery area and the transplanted area varies between 1:25 and 1:20.

Varieties and seed production. A large number of rice varieties are planted in the Artibonite Valley, most of which have picturesque names (Table 7). The variety with the highest demand in the local market because of its good cooking quality is Dawn—commonly called Mme. Gougousee (MGG). Encouraged by its high market prices farmers continue to plant it wherever it can be developed, despite its being very susceptible to poor drainage and having a low-yield potential.

The variety Quisqueya was selected locally from a cross between MGG and Chia Seng and developed at the experimental farm in Maugé. It has been recently released with the objective of increasing yields since it can yield from 5 to 6 t/ha in less than 120 days and its cooking quality is similar to that of MGG.

Table 7. **Rice varieties planted in the Artibonite Valley, Haiti.**

Variety	Origin
Madame Gougousee (MGG)[a]	United States
MCI-3	Taiwan
MCI-65 (ODVA-1)	Taiwan
CICA 8	Colombia
Ti Fidele	Haiti
Folton	Haiti
Buffalo	United States
Toño Brea	Dominican Rep.
Quisqueya	Haiti
Riz jaune	Haiti
LCC	Haiti
Ti Campeche	Haiti
Ti Manchete	Haiti
Starbonnet	United States
Trois grappes	Haiti
Gros Pangnol	Haiti
Neg-Pap Di'ou	Haiti
Mazé Ta	Haiti
Ti-Poule Fine	Haiti
Rosita	Haiti

a. Also known as Dawn.

Haitian farmers obtain their rice seeds from either their last crop or from seed producers. The seed production process is as follows: basic seed is produced by ODVA at the experimental farm in Maugé and then it is multiplied by farmers in the state farms "Deseaux" and "Trois Bornes". Certified seed is processed and distributed by ODVA's seed technicians. Occupying first place in ODVA's seed program is the variety MGG (Tables 8 and 9).

During 1982-1983 in the Artibonite Valley the total area planted in rice was 45,000 ha. From January to June 19,000 ha were planted and from July to December 26,000 ha (ODVA, Rapport Annuel, 1983). If farmers were to use only the improved seed produced by ODVA at a density of 75 kg/ha, only 4.4 percent of the area (about 2000 ha) would be covered.

ODVA sells certified seed of superior varieties at US$0.57/kg and ordinary varieties at US$0.48/kg. ODVA also buys seed from the farmers and pays them a premium price of US$0.04/kg above the fixed prices of commercial paddy (US$0.48 superior and US$0.35 ordinary).

Land preparation and cultural practices. Rice-growing land is prepared by hand, with the aid of a hoe. This is done twice on wet soils with a two-to-three weeks interval. Dry land preparation is rare or nonexistent.

Table 8. **Basic and certified seed produced by ODVA, Haiti, 1982-1983.**

Variety	Quantity (t)	
	Basic	Certified
Madame Gougousee	192.68	297.69
MCI-3	14.90	3.24
Quisqueya	55.00	226.48
Others	—	12.18
Total	262.58	539.59

Table 9. **Certified seed sold by ODVA, Haiti, 1982-1983.**

Variety	Quantity (t)
Madame Gougousee	78.95
MCI-65	35.98
MCI-3	20.13
CICA-8	9.23
Starbonnet	3.95
Ti Fidele	0.22
Total	148.46

Recently ODVA, through the Center of Agricultural Machinery (CMA), began offering services of small tractors for land preparation. During the period of 1982-1983 CMA prepared only 825.62 ha (ODVA, Rapport Annuel, 1983). However, ODVA is in the process of introducing the use of water buffaloes to substitute manual labor in land preparation.

Weeding is also done by hand and is done twice a season. Harvesting is accomplished by cutting each panicle by hand. Threshing is then done by using feet. Harvesting is also accomplished by cutting the stems 4 to 5 cm above the soil and threshing them either with a thresher or by beating the stems against a hard object. During 1982-1983 CMA gave thresher services for 1959 ha (ODVA, Rapport Annuel, 1983).

Fertilizer application is the most widely spread of the improved technologies. During 1982-1983 the farmers of the Artibonite Valley bought a total of 2059 t of chemical fertilizers, especially urea, ammonium sulfate, and complete formulas (Table 10). In that period 30.5 percent of the fertilizer was bought with some form of official credit.

ODVA's prices for urea and complete formulas are US$0.31/kg and US$0.29/kg respectively, while private commercial prices are US$0.44 and US$0.35/kg.

Farmers who adopt improved technology usually apply 150 kg/ha of a complete formula in the first application and 107 kg of urea in the second application. If the farmers used the formula 15-15-15, they would be applying 22.5 kg of N-P-K/ha in the first application and 49.22 kg of nitrogen (N) in the second.

According to experiments carried out at the experimental farm in Maugé, the varieties MC1-3, CICA 8, and MGG respond to high doses of nitrogen. ODVA reports that the variety CICA 8 realizes its maximum yields with applications of N at 180 kg/ha, MCI-65 at 80 kg/ha, and Ti-Fidele at 60 kg/ha.

Production costs. It should be pointed out that a large proportion of the total costs are labor costs (59 percent). As can be seen in Table 11, farmers need to produce 1.8 t/ha of superior rice and 2.6 t/ha of ordinary rice to break even. However, because a large number of farmers do not use all available improved technology and 60 percent are land owners, their total costs are usually less.

For pest control farmers spend money in controlling rats and birds. They do not believe diseases merit special attention and consider only the stink bug *(Oebalus* spp.) as having sufficient economic significance to justify the use of chemical control.

Table 10. **Types of fertilizers used in the Artibonite Valley, Haiti, 1982-1983.**

Type of fertilizer	Use of fertilizer according to the source (t)				
	ODVA	ODVA/IDAI	Private commerce	Others[a]	Total
Urea	71.95	49.82	841.41	50.00	1013.18
Ammonium sulfate	70.18	86.18	158.64	54.54	369.54
Complete formula[b]	170.04	180.36	229.50	113.64	693.54
Total	312.17	316.36	1229.55	218.18	2076.26

a. Estimate.
b. Includes the grades 15-15-15, 12-12-20, 20-20-0, and 20-20-10

SOURCE: ODVA. Rapport annuel 1983

Table 11. **Production costs (in US$) per hectare of rice in Haiti[a], 1983.**

Item	Quantity	Cost/unit	Total cost
Seed[b]	116 kg	0.44	51.04
Nursery	4 man-days[c]	2.20	8.80
Land preparation	99 man-days	2.20	217.80
Transplanting	15 man-days	2.20	33.00
Weeding	30 man-days	2.20	66.00
Subtotal			376.64
Fertilizers[d]			
Complete	150 kg	0.32	48.00
Urea	107 kg	0.42	44.94
Application	0.8 man-days	2.20	1.76
Subtotal			94.70
Harvest[e]	60 man-days	2.20	132.00
Others			
Irrigation tax[f]	—	4.28	4.28
Water control	4 man-days	2.20	8.80
Rat and bird control	—	25.00	25.00
Land rent[g]	—	149.51	149.51
Subtotal			187.59
Total			790.93

a. Weighted averages of technologies used. Sources: Interviews with farmers and ODVA reports.
b. Refers to farmers who do not use improved seed. When they do use improved seed they require only 75 kg/ha at the price of US$0.57/kg.
c. A "man-day" has three sections: 05-08 hr (3 hours) at US$0.60; 09-13 hr (4 hours) at US$0.80; and 15-18 hr (3 hours) at US$0.60. It is assumed that farmers spend US$0.20 on food and/or rum.
d. Not all farmers use fertilizers. The prices given represent the weighted average of the prices of ODVA and private commerce. The complete formulas are: 15-15-15, 12-12-20, 20-20-0, and 20-20-10. Some farmers use ammonium sulfate instead of urea.
e. Harvesting panicle by panicle without the use of threshers.
f. Weighted average of taxes from the large and small irrigation systems.
g. Weighted average taking into account sharecroppers (50 percent of harvest), farmers who rent the land (US$155/ha per harvest) and state farms farmers (5 to 10 percent of harvest).
SOURCE: ODVA. Rapport annuel 1982, p.54.

Research and Extension

Rice research is mainly done at ODVA, particularly on the experimental farm in Maugé. The experimental farm has an area of 15 ha and conducts research on the major crops of the Artibonite Valley: rice, sweet potato, beans, tomato, onions, and others. However, most research work is concentrated on rice. The experimental farm has the permanent technical support of an agricultural mission from the Republic of China (Taiwan).

Research is closely related with extension work: the extension workers propose the research topics and carry the results to the farmers. The researchers present, for the consideration of officials from DARNDR[6], CRDA[7], FAMV[8], ODVA, and the Chinese Agricultural Mission, in an special meeting, the topics proposed by extension workers. The topics chosen in that meeting form the core of the research program for that year.

It should be mentioned that the program for a particular year should be consistent with the quinquennial rice research program. For 1984 rice research focused on the selection of new varieties and lines, fertilizer response, land preparation, weed and insect identification, control of rats and birds, and the description of cropping systems.

Haitian and Chinese researchers have introduced the varieties MCI-3, MCI-65, and CICA 8. They are now working on the extension of the variety Quisqueya which was locally selected from a single cross between MGG and Chia Seng.

Having the support of the research and extension programs, ODVA works to improve farmers' skills by organizing specific courses on rice and legume crops and on small-tractor maintenance. ODVA also organizes national courses on rice-production technology for technicians.

Constraints to Increased Rice Production

Rice-production systems are not very well understood and documentation is generally scarce.

The use of populations instead of pure varieties hampers the full realization of yield potential even under good growing conditions. The appropiate description of the existing varieties could help in the production of certified seed.

Most rice lands in the Artibonite Valley have drainage and/or salinity problems. Although ODVA is working on soil rehabilitation further research could play an important role in increasing production in the short term by recommending appropiate technological packages.

6. DARNDR: Département de l'Agriculture, des Ressources Naturelles et du Développement Rural, Haiti.
7. CRDA: Center for Agricultural Research and Documentation, Haiti (transl.).
8. FAMV: Faculté d'Agronomie et de Médecine Vétérinaire, Université d'Etat d'Haiti.

Personnel training is one of the priorities listed in the "Quinquennial Plan for the Agricultural Sector 1981-1986". The document indicates that there are 300 agronomists working with DARNDR and that there is a need for 700 more in order to satisfy the demands of the agricultural sector. The document also estimates that, in order to transfer improved technology to the farmers, there is a deficit of 1450 extension workers.

The creation of a Caribbean rice research network could greatly contribute to the solution of some of the problems of rice cultivation in Haiti.

Rice in Jamaica

7706 18

C. McDowell, O. Gilpin,
E. Lindo, K. Eisberg, and*
*D. Smith***

Jamaica has a population of 2.2 million and a total area of 10,987.6 square kilometres of which 55.2 percent is arable (Table 1) and is now under an agricultural recovery program.

Although the Gross Domestic Product has declined in the last few years the agricultural sector has always shown growth. However, the major traditional crops, sugar cane, bananas, citrus, and cocoa, have been declining so that these growth figures have been achieved through nontraditional crops in horticulture, fruits, vegetables, and yams.

The government's main strategy for achieving rapid growth in the agricultural sector is through its Agro 21 program. This program is described as "a new national approach to agriculture that combines the implementation of modern technology with adequate planning and targeted markets to make agriculture a commercial proposition. The program will be a vehicle for accomplishing six vital objectives in the agricultural sector". These objectives are the:

Development of unused and underused lands of the country;

Increase of the export agriculture in a range of specific crops;

Introduction of new employment opportunities in agriculture;

Integration of small farmers into the new opportunities offered by the Agro 21 Program and to make modern technology available to them to help improve their production;

Development of nontraditional crops on a wider basis by increasing production of existing crops and by introducing new crops; and

* Jamaican Ministry of Agriculture.
** Black River Upper Morass Development Corporation (BRUMDEC), Jamaica.

Reduction of dependency on imports wherever possible by substituting domestically grown crops.

It is against this background of government priorities that we will look at the present rice situation in Jamaica.

Table 1. **Land use and distribution in Jamaica, 1970[a].**

Use	Area (ha in thousands)	Proportion (%)
Improved pastures	80.94	9.2
Natural pastures	41.68	3.8
Sugar cane	67.86	6.2
Coconut	40.47	3.7
Bananas	34.00	3.1
Cocoa	10.92	1.0
Citrus	10.11	0.9
Coffee	6.07	0.5
Corn	3.23	0.3
Miscellaneous tree crops	11.29	1.0
Other crops	16.67	1.5
Idle farm land	91.05	8.3
Other farm land	172.48	15.7
Total farm land	586.77	55.2
Forestry	265.07	24.1
Other woodland not on farms	161.47	14.8
Urban	40.47	3.7
Swamp land	20.23	1.8
Mining	2.83	0.3
Barren	1.61	0.1
Subtotal	491.68	44.8
Total land use	1078.45	100.0

a. Based on information from: Jamaican Ministry of Planning. 1971. A National Physical Plan for Jamaica, 1970-1990. Kingston.

The History of Rice Cultivation

Rice cultivation in Jamaica started more than a century ago when, **according to records, 3.25 bushels (114 kg) of rice seeds were imported** from India in 1874. There is a strong belief, although there are no records to confirm it, that rice cultivation began in the seventeenth century.

The seeds imported in 1874 were distributed to interested farmers. By 1889 the venture was considered successful and many parts of the country were identified as being ideally suitable for rice growing.

Subsequent to the period 1874-1889, rice cultivation has had a checkered history with peak productions during the two World Wars when importation was uncertain because of the high risks of transportation.

In 1952 a rice agronomist was appointed to the Department of Agriculture. Together with a consultant from the Food and Agriculture Organization of the United Nations (FAO), he began a large-scale work in rice research and development. In 1953 the Agriculture Development Corporation (ADC) became involved in rice production and subsequently established a mill in 1954. Several acres of rice were grown in the parishes of Clarendon, St. Catherine, St. Elizabeth, and Westmoreland, with smaller acreages in St. Mary, St. Thomas, and Trelawny.

During the past three decades there has been a gradual decline in rice production despite the introduction of high-yielding varieties such as IR 8, CICA 4, CICA 9, and others, the visit of a rice specialist from CIAT, the establishment of the Japanese-Jamaican Rice Project at Elim, and the increase in the price of paddy. Nevertheless, because we have, at present, most of the necessary basic materials and technology there are excellent possibilities for recovery.

The General Status of the Rice Industry in Jamaica

The same effort put into agriculture as a whole is being put into the rice industry, but major results are yet to be seen. The reason for this is twofold: first, the rice industry has deteriorated to a great extent—from 2600 farmers growing rice in the parishes of Westmoreland and St. Elizabeth in 1966 to only 341 in 1979 (Table 2). A lot of effort will be needed to return to the previous level of production and even more to increase it significantly to reduce importation (Table 3).

Table 2. **Number of rice farmers in two parishes[a] of Jamaica, 1966 and 1979.**

Parish	1966	1979
Westmoreland	2000	303
St. Elizabeth	600	38
Total	2600	341

a. The parishes discussed are the leading rice-growing areas of Jamaica.

SOURCE: Ministry of Agriculture.

Table 3. **Volume and value of rice imported by Jamaica, 1978-1983.**

Year	Volume (t)	Value[a] (CIF) (J$)
1978	45,505	25,983,781
1979	27,919	19,616,836
1980	52,037	44,684,557
1981	42,771	42,846,854
1982	39,146	29,862,409
1983	56,953	44,768,256

a. Exchange rate J$4.73 = US$1.00 (Nov. 1984).

SOURCE: Department of Statistics. External Trade Statistics.

Second, the rice crop is a traditionally small-scale enterprise and, in order to take advantage of modern rice technology, improvements need to be made, especially in the areas of irrigation and drainage. These improvements are now underway and their effects will be seen in a fairly short period of time.

The principal rice-growing areas in Jamaica can be summarized in three projects—Black River Upper Morass Development Corporation (BRUMDEC), Meylersfield, and Bogue Estate. BRUMDEC is an autonomous government corporation; Meylersfield is a rice development project of the Ministry of Agriculture in cooperation with the Dutch government; and Bogue Estate is a private enterprise. In 1983 these projects harvested a total of 1102.77 acres (446 ha) with an average yield of 3140 kg/ha (Table 4).

Table 4. **Rice crops of the principal projects, Jamaica.**

Project[a]	Crop	Variety	Area (ha)	Yield (kg/ha)
Meylersfield	1983 I	CICA 8	29.54	4577
	1983 II	CICA 8	60.70	3558
BRUMDEC[b]	1983 I	CICA 8	173.52	2701
	1983 II	CICA 8	61.10	2847
Bogue Estate	1983 II	CICA 8	121.41	3369

a. Meylersfield and BRUMDEC are government projects. Bogue Estate is private.
b. Black River Upper Morass Development Corporation.

SOURCE: Ministry of Agriculture. Meylersfield Development Project.
BRUMDEC. 1983. Monthly Report, December.
Mr. Roger Clark.

Milling is associated with the above-mentioned projects because the small mills available in rural areas are not able to cope with increased production. BRUMDEC has a 0.5 t/hr mill; Meylersfield a 1.0 t/hr; and Bogue Estate and old 0.25 t/hr mill; Both BRUMDEC and Bogue Estate have recognized that limited milling and storage capacity will hamper their plans to expand rice production and are obtaining new mills and storage facilities which will be installed in the near future.

The price for both paddy and milled rice are fixed. Paddy rice is sold at the farm at a price of J$0.55 (US$0.12)[1]/kg and milled rice has a fixed price of J$1.65 (US$0.35)/kg. Those prices, however, are due for revision because of complaints from farmers. Some people have reported that when there is a deficit of milled rice prices increase to J$2.42 (US$0.51)/kg.

The relative price of rice is low when compared with the prices of yams, plantains, and other sources of starch. The farmgate price for yam ranges from J$0.84 to J$1.10 (US$0.18 to US$0.23)/kg and that of plantain from J$0.57 to J$0.70 (US$0.12 to US$0.14)/kg.

If one considers that Jamaicans consume both rice and one or more starchy foods and that one pound of rice will feed more people than one pound of any of the other crops, the tendency is for rice consumption to increase. In fact Jamaica's per capita consumption of rice increased from an average of 19 kg in 1970 to 24.8 kg in 1983.

Rice Production Systems

The average rice farm size in Jamaica used to be one acre (0.4047 ha). However, with the new development farm sizes will increase. The Meylersfield Project started growing rice in late 1982 by allocating groups of five farmers to three five-acre plots, so that each farmer had three acres in three parts of the Project's farm. After two crops the five-acre plots were given to only two farmers (2.5 acres each) in two different parts of the Project's farm, so the area for each farmer was increased from three to five acres.

Cultivation in Meylersfield. The general cropping system for Meylersfield is shown in Figure 1. Land preparation and transplanting of the first crop is completed between February and April and harvesting between July and August. The second crop is transplanted in September and October and harvested in January and February. It should be noted that

1. Exchange ra... J$4.73 = US$1.00 (Nov. 1984).

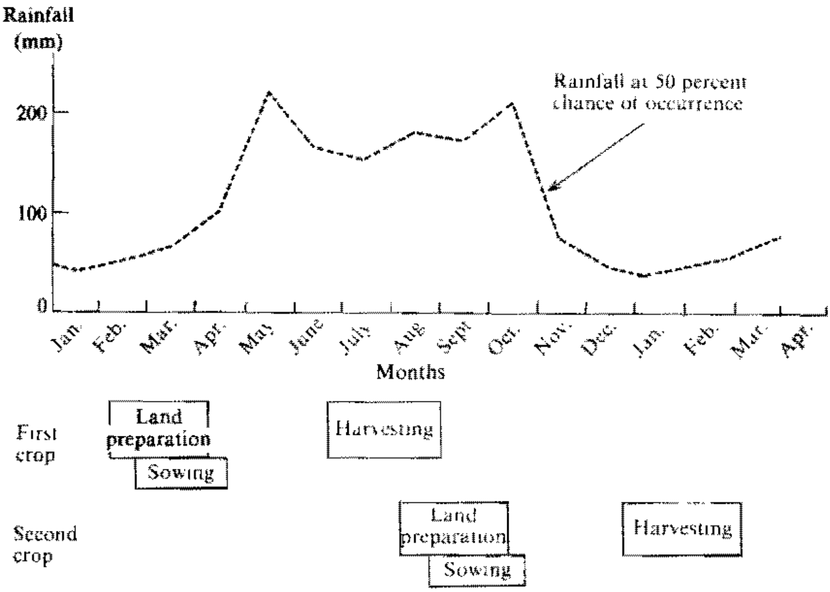

Figure 1. ***Rainfall patterns and rice-cropping calendar at Meylersfield, Jamaica.***

harvesting is done by hand and threshing with a stationary thresher. The first crop of 1983 was harvested under rainy conditions which meant that some rice could not be milled because of the impossibility of drying it.

Land preparation in Meylersfield is accomplished with tractors and, apart from the use of threshers and the chemical herbicide Basagran, all activities are carried out by hand. Fertilization practices include four applications: one basal application at planting of 25.8 kg/ha of urea, 80.7 kg/ha of diammonium phosphate, and 15.69 kg/ha of muriate of potash (26.4 kg/ha of N, 7.5 kg/ha of P, and 6.7 kg/ha of K); the second application of 25.8 kg/ha of urea (11.86 kg/ha of N) at maximum tillering; the third application, similar to the basal, at panicle initiation; and the fourth of 25.8 kg/ha of urea at 50 percent flowering. The total nutrient application per acre is 76.48 kg of N, 15 kg of P, and 13.4 kg of K.

The total cost of production for Meylersfield is given in Table 5. Note that the price for seed, some of which was imported, is J$1.00/lb (US$0.46/kg). With the current price of J$0.25/lb (US$0.11/kg) for commercial rice the farmers must produce 4024 lb/acre (4514 kg/ha) to break even.

Table 5. **Costs of rice production in Meylersfield, Jamaica, 1983.**

Activity	Quantity per acre	Cost/unit (J$)	Total cost[a] (J$/acre)	(US$/ha)[b]
Nursery	2 man-days	15.00	30.00	15.67
Seed	11.34 kg	2.20	25.00	13.05
Land preparation	1.6 hours	45.00	72.00	37.61
Transplanting	15 man-days	15.00	225.00	117.55
Weed control				
Basagran	0.72 gallons	115.34	83.04	43.37
Application	3 hours	1.88	564	2.95
Hand weeding	7 man-days	15.00	105.00	54.85
Fertilizer				
Urea	47.62 kg	0.50	23.81	12.43
Diammonium phosphate	65.31	0.50	32.65	17.06
Muriate of potash	12.7 kg	0.44	5.60	2.92
Applications	4 hours	1.88	7.52	3.93
Harvesting				
Hand cutting	17 man-days	15.00	255.00	133.21
Threshing	8 hours	10.00	80.00	41.79
Others				
Transportation		100.00	100.00	52.24
Total			1050.27	548.63

a. Exchange rate: J$4.73 = US$1.00 (Nov. 1984).
b. Metric conversion: 1 acre = 0.4047 hectare.

Cultivation in BRUMDEC and Bogue Estate. The cropping systems of BRUMDEC and Bogue Estate are very similar to that of Meylersfield as far as planting dates are concerned. However, their cultural practices are slightly different because both Bogue and BRUMDEC use more machinery and chemicals and handle larger plots. Because broadcasting pregerminated seed demands good land preparation and leveling and good water control, BRUMDEC has had problems with weed control and lodging because soil conditions during land preparation had not been adequate.

Weed control is achieved by applying propanil and 2,4-D, although, if water control is correct, there is no major weed problem. However, there seems to be a potential for red rice problems. The source of red rice is thought to be the seed and BRUMDEC has complained that some of the contaminated seed were obtained from the Agricultural Development Corporation. It appears that the fields themselves are contaminated because rice had been previously grown in those fields and farmers had had to abandon them because of red rice.

Fertilization is done in two applications, one basal with 112 lb/acre (125.52 kg/ha) of 12-24-12 and the other at panicle initiation with 112 lb/acre of ammonium sulphate. The actual nutrient application is 41.36

kg/ha of N, 5.83 kg/ha of P, and 10.38 kg/ha of K. Research conducted on BRUMDEC's farm suggests that the phosphorus and potassium levels used are too high. However, it was considered that 12-24-12 was the formula most readily available.

BRUMDEC is producing its own seed and will sell it to the other projects at a price of J$0.97 (US$0.20)/kg. The only variety being distributed is CICA 8, although its high lodging is putting some pressure on research to obtain a new variety. The variety trials carried out so far suggest that CR 1113, Tanioka, Juma 58, and Juma 51 could be distributed. The variety which has given the highest yields on peat soils is Labelle, but only BRUMDEC is using it.

The production costs for BRUMDEC in 1982 are given in Table 6. Note that a high proportion of the total costs results from the mechanization of land preparation and fertilization. Also note that it was necessary to apply zinc chelate which indicates that minor elements can be a problem in the Upper Morass.

Water management, pests, and diseases. The water used for irrigation in Meylersfield is pumped from the Cabarita River and for both BRUMDEC and Bogue Estate it is gravity-fed from the Black River.

The major rice disease in Jamaica is rice blast. This has been controlled by the use of resistant varieties such as CICA 8 rather than by the use of chemicals. Other diseases present are those of leaf spot caused by *Helminthosporium* sp. and *Cercospora* sp. They are not of economic importance and no control measures are taken against them.

At Meylersfield the major insect pest is the brown stink bug *(Oebalus* spp.) which is chemically controlled. This insect has also been observed at BRUMDEC and Bogue. However they are not of economic importance.

Research and Extension

Rice research in Jamaica is the responsibility of BRUMDEC who have a 30-acre experimental plot on their farm. Research has grown together with the developmental side of the corporation and is responsible for identifying the varieties now grown on BRUMDEC's farm.

BRUMDEC has researched the use of fertilizers (using minor and major elements) and new planting equipment. The varieties BRUMDEC has investigated are listed in Table 7. It should be noted that most of the variety trials are carried out in fairly large plots whenever sufficient seeds are available.

Table 6. **Production costs of rice on mineral soils, BRUMDEC, Jamaica, 1982.**

Activity	Cost[a] (J$/acre)	Cost[a] (US$/ha)[b]
Land preparation		
Harrowing (three times)	160.00	83.36
Erecting levees	5.00	2.60
Leveling (twice)	40.00	20.84
Subtotal	205.00	106.80
Planting		
Seeds	35.20	18.84
Transport	5.70	2.97
Broadcasting	3.21	1.67
Subtotal	44.11	23.48
Fertilizers		
Cost of fertilizers	74.00	38.55
Basal application	2.50	1.30
First top dressing	3.50	1.82
Final top dressing	3.50	1.82
Transport	8.00	4.17
Zinc chelate application	33.50	17.45
Subtotal	125.00	65.11
Weed control		
Costs of chemicals	61.00	31.78
Application	25.00	13.02
Hand weeding	9.80	5.11
Subtotal	95.80	49.91
Harvesting		
Combine	50.00	26.05
Transport	20.00	10.42
Subtotal	70.00	36.47
Others		
Irrigation and drainage	60.50	31.62
Maintenance	19.00	9.90
Subtotal	79.50	41.52
Total	619.41	323.29

a. Exchange rate J$4.73 = US$1.00 (Nov. 1984)

b. Metric conversion 1 acre = 0.4047 hectare

The fertilizer experiments conducted on the station were started, prior to BRUMDEC involvement in research, by a Japanese mission. Later a group of BRUMDEC's researchers, headed by Derrick Smith and IICA

Table 7. **Varieties on BRUMDEC rice research station, Jamaica, as at 31 December, 1982.**

Variety or line	Age (days)	Area	Origin
CICA 8	70	8.50 acres	CIAT[a]
CICA 8	120	0.85 acres	CIAT
IR 42	120	0.85 acres	IRRI[b]
IR 36	102	0.85 acres	IRRI
IR 50	102	0.85 acres	IRRI
CR 1113	102	0.85 acres	Costa Rica
Bellevue	42	1350 square feet	U.S.A.
Labelle	42	1350 sq. ft.	U.S.A.
Starbonnet	42	1350 sq. ft.	U.S.A.
7140	42	3750 sq. ft	CIAT
7152	42	3750 sq. ft.	IRRI
7153	42	3750 sq. ft.	IRRI
Leah	73	2800 sq. ft	U.S.A.
Belmont	73	2800 sq. ft	U.S.A.
Rustic	38	0.13 acres	Guyana
Nortai	30	1.70 acres	U.S.A.
N	35	100 sq.. ft.	Guyana
Champion	36	150 sq. ft.	Guyana
Mingolo	80	300 sq. ft.	Dominican Republic
Juma 51	80	300 sq. ft.	Dominican Republic
Juma 58	80	300 sq. ft	Dominican Republic
Juma 1	80	300 sq. ft.	Dominican Republic
Tanioka	80	300 sq. ft.	Dominican Republic
IR 6	80	300 sq. ft.	Dominican Republic
ISA 21	80	300 sq. ft.	Dominican Republic
Lebonnet	42	1350 sq. ft	U.S.A.
CICA 9	55	4 10-foot rows	CIAT
CICA 9-7	55	4 10-foot rows	CIAT

a. CIAT Centro Internacional de Agricultura Tropical, Colombia.
b. IRRI International Rice Research Institute, Philippines.

(Instituto Interamericano de Cooperación para la Agricultura) Consultant Vivian Chin, has been conducting fertilizer trials on different soils.

Some testing is being carried out with a mechanical transplanter which is expected to improve yields without requiring further improvements in land preparation.

The major research interest of BRUMDEC is to generate a technology for peat soil. They have been trying to identify a variety that would perform well under these conditions. So far the variety Labelle appears to be the best and Juma 58 appears to have some potential.

The agronomists working at Meylersfield have also set up fertilizer trials to identify the best fertilizer treatments for their conditions.

Extension is related to the three projects. BRUMDEC's findings are informally discussed with the members of the other projects. Meylersfield is a special project as far as extension is concerned. They have selected a group of small farmers and are teaching them to work with new technology in the expectation that once the educated farmer leaves Meylersfield he will extend the new technology to other farmers.

Major Constraints to Increased Rice Production

Because the political atmosphere favors the expansion of rice cultivation, the demand for agronomists trained in rice production will increase, creating the urgent need to train several agronomists quickly.

Land preparation is also a problem. With the exception of Meylersfield and parts of BRUMDEC, rice lands are not properly leveled to give maximum return in terms of yields and efficiency of husbandry practices. There are also problem soils such as peat on both BRUMDEC and Meylersfield. More research is needed to adapt appropriate varieties to properly utilize these areas.

The price of J$0.25/lb paid to farmers for paddy has remained unchanged for the last five years and is now under review. Most probably the price will increase, offering an incentive for increased production on more private lands.

Future of the Rice Industry

The government policy on rice is to increase production to self-sufficiency. This entails meeting a target of approximately 60,000 tons of rice annually.

At present rice yields on the major projects average 3000 lb/acre (3369 kg/ha) per crop of paddy. It has been shown that with improved technoloy such as land leveling, a target of 4000 lb/acre (4500 kg/ha) per crop of paddy can be achieved in the near future. At Meylersfield 6300 lb/acre (7076 kg/ha) has been achieved. To obtain an average of 4000 lb/acre and a final production of 60,000 tons an area of 10,117 ha is necessary, assuming a 60 percent recovery of milled rice and two crops a year on the same land area.

Land is now the most limiting of the components of production. New areas with available water and potential for rice cultivation are: 3439 ha in St. Elizabeth (BRUMDEC and private); 688 ha in St. Catherine (private and Amity Hall); and 971 ha in Westmoreland (Meylersfield and private). The most important of these areas are in St. Elizabeth, the Lower Morass, and some lands of the Hollan Sugar Estate. It is estimated that approximately 2000 ha will be available for growing rice when this area is developed. More than two-thirds (7122 ha) of the land required to meet the present self-sufficiency target has therefore been identified along with its water supplies.

The growing of rice on a large scale also opens up the possibility for interesting crop rotations, especially with legume crops. Soybean seems to be the most promising of the legumes as it enjoys an assured market and requires similar equipment to that of rice. Being a legume, soybean will also enhance soil fertility in rice areas. However, soybean is best suited for large scale production. On small acreages, therefore, other legumes such as the red kidney bean will need to be used in the rotation.

On the other hand, Jamaica has been growing vegetables for the North American winter market and could therefore grow them in rotation with rice and so enhance the profitability of the farms.

Local rice production as an import substitute will save foreign exchange for Jamaica. As the foreign exchange cost of growing rice locally is a fraction of what it is to purchase rice from abroad, it is advisable that Jamaica aims at increasing its local rice production.

Rice in Suriname*

220644

*M. J. Idoe***

The Republic of Suriname is situated on the northeast coast of South America between latitudes 2⁰ and 6⁰ north and longitudes 54⁰ and 58⁰ west. The climate is classified as wet equatorial with an average annual temperature of 27⁰ C and an annual rainfall which ranges between 2000 mm and 3000 mm. There are two rainy and two dry seasons.

The total area of Suriname is 163,830 square kilometres, but only a very small portion of the coastal plains in the north is populated. The total estimated population is 400,000 with very mixed ethnic origins.

Bauxite and rice are Suriname's principal export products. The Gross Domestic Product (GDP) of Suriname is mainly dependent on the bauxite industry and because of several internal and external factors the growth of GDP has nearly stopped at the moment.

Agriculture is a very important sector of the Surinamese economy even though its importance has been declining over time. In 1953 agriculture contributed 20.1 percent of the total GDP and by 1971 this contribution had dropped to a low of 7 percent. Now it ranges between 8 and 10 percent.

The GDP of the agricultural sector has increased from Sur.f.51 million[1] in 1973 to Sur.f.108 million in 1978. Agriculture is one of the most important sectors for generating employment. Although the number of people employed full time in agriculture has continuously declined since 1973, the total amount is still more than double that of mining and bauxite together.

In 1979 the agricultural sector employed 19,600 people—most of whom were rice farmers. The production of rice, shrimps, bananas, and oil palm

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* Read by E. Cuevas Pérez, Consultant, Centro Internacional de Agricultura Tropical (CIAT).

** Plant Breeder, Rice Research and Breeding Station, P.O. Box 26, Nieuw Nickerie, Suriname

1. Exchange rate: Sur.f.3.33 = US$1.00.

are oriented mainly towards the export market. The value of agricultural export at current prices and its contribution to foreign exchange earnings have increased substantially during the seventies. In 1970 agricultural exports accounted for only 4 percent (Sur.f.10.3 million or US$3.09 million) of the total exports. By 1979 its contribution rose to 17.4 percent (Sur.f.137.6 million or US$41.32 million).

General Status of the Rice Industry in Suriname

In 1982 the total rice area was about 40,000 hectares which were distributed, according to the size of holdings, as: 17,800 ha in small holdings (less than 12 ha); 2,200 ha in middle-sized farms (12 to 50 ha); and 20,000 ha in estate farming (more than 50 ha).

The Foundation for the Development of Mechanized Agriculture in Suriname (SML), a semigovernment entity, has the largest farm with an area of 10,000 ha. This entity produces nearly two crops of rice per year and in 1982 the average yield per crop was about 4.5 t/ha.

The processing facilities such as dryers, silos, and mills are not in the hands of the small farmers, but are normally in the hands of middlemen and rice exporters. The SML is the only production unit which has all the processing and exporting facilities.

Marketing. Since 1919 Suriname has been self-sufficient in rice, exporting the surplus to Europe and the Caribbean region. The total exports of the different grades of rice for the period 1977-1981 are shown in Table 1. The different uses and respective quantities of rice during 1982 are presented in Table 2.

Table 1 **Rice exports, Suriname, 1977-1981.**

Year	Quantity (t)
1977	30,768
1978	83,757
1979	69,799
1980	101,141
1981	112,929

Table 2. **Uses of rice production in Suriname, 1982.**

Use	Grades	Quantity (t)
Exports	Brown	93,388
	Milled and broken	26,989
Local consumption	Milled rice	34,200
Industry		900

Currently rice exports include brown, milled, broken, and parboiled rice grades. Exporting paddy is not permitted by the government. Per capita rice consumption is 85 kg.

The rice market is not well organized. Some millers have rice export licenses and operate within the international market independently. This situation of course is not desirable and the government is trying to coordinate the rice exports. Probably in the near future the responsibility for rice exports will be taken over by the export organization SUREXCO (Suriname Export Company). Its members will include the government, private exporters, and farmers organizations.

The most important market for Suriname's milled rice is the European Economic Community (EEC) in general and the Netherlands in particular.

Government policies. The Suriname government is planning to increase the rice production area. At the moment there are being implemented three major projects totaling an area of about 24,000 ha. Calculating by means of annual projections, in 1990 Suriname's total rice production area will be about 64.000 ha (Table 3).

The principal development project is the Multipurpose Corantijn Canal. It has long-term plans to bring under cultivation 12,500 ha of new land and shall be part of a total rice operation that will include drying and milling facilities. Its objective will be to divide the land into plots of an average size of 20 ha to be worked on a cooperative basis.

The second largest project is LOC located in the Commenwijne District and will cover 3300 ha.The Saramacca District also plans to increase its rice production acreage from 3900 ha to 8300 ha.

Financial status. Besides other problems rice production is facing the very serious problem of production costs. The dropping of export prices is also causing further declines of revenues for the rice sector. Small holders are in an especially bad position because of increasing production costs

Table 3: **Annual projection of the area and production of paddy rice in Suriname.**

Year	Area (ha)	Production (t)
1982	40,000	300,000
1983	42,250	338,800
1984	44,600	357,100
1985	47,150	376,900
1986	50,000	399,200
1987	52,850	421,400
1988	56,800	452,400
1989	60,150	478,900
1990	64,000	506,100

Table 4. **Net returns for three types of rice production units in Suriname.**

Item	Values according to farm size (Sur.f.)[a]		
	4 ha	24 ha	500 ha
Costs	900	892	831
Gross income	1140	1140	1426
Net income	240	248	595

a. Exchange rate: Sur.f.3.33 = US$1.00.

and a worsening economy at the farm level. Table 4 shows the net returns for the three types of rice farms: small farms, middle-sized farms, and estate farms.

Rice Production Systems

About 95 percent of the rice cultivation in Suriname is grown under irrigated conditions. In the interior of the country subsistence farmers produce rice under upland conditions. Most of the irrigation water used in the Nickerie District comes from the Nanni Swamp Reservoir by means of gravity. River water is also pumped up to flood the rice fields.

Varieties and seed production. There are three commercial varieties at the moment—Camponi, Diwani, and Eloni (Table 5). Genetic and basic seeds

Table 5. **Major rice varieties at the Foundation for the Development of Mechanized Agriculture (SML) in Suriname, 1982-1983.**

Variety	Release (year)	Area (ha)	Yield (t/ha)
Camponi	1974	4712	4.20
Diwani	1976	6540	4.01
Eloni	1979	5569	4.38
Total/average		16821	4.19

Source SML.

of these varieties are produced by the breeding station. The production of certified and registered seed is not well organized.

There is only one seed production station in Suriname, managed by the SML. However, there are some companies which sell rice seed, but of very poor quality because there are no quality controls. The price for this kind of seed is about Sur.f.0.50 (US$0.15)/kg which is 15 cents lower than that of the SML.

Sowing. Farmers begin to prepare their land for sowing as soon as the rains start. There are two rainy seasons in Suriname: the main one begins in mid-April and lasts until the end of August and the second one begins in December and lasts until mid-February (Figure 1). There are, however, some farmers who do not take into account the rainy seasons and plant the year round. This obviously causes all kinds of problems at harvest such as low yields, poor quality, and the underuse of facilities for harvesting, transport, and drying regardless of their capacities. Because there is a shortage of irrigation water, especially in the second season, a sowing rice schedule would be very helpful.

All commercial rice planting is done by direct sowing of pregerminated seed and flooding the fields to a depth of about 15 cm. After sowing the water is drained as soon as possible by building some channels, if necessary, from the lower parts of the fields.

Large estates use airplanes for sowing while small farmers sow manually. Normally a seed density of 120 kg/ha is used, but when seed is of poor quality a higher density is recommended.

Fields are normally plowed and harrowed in the dry season using tractors which have either wheels or tracks. If possible the fields are plowed twice before flooding and then puddled with disc harrows drawn by either

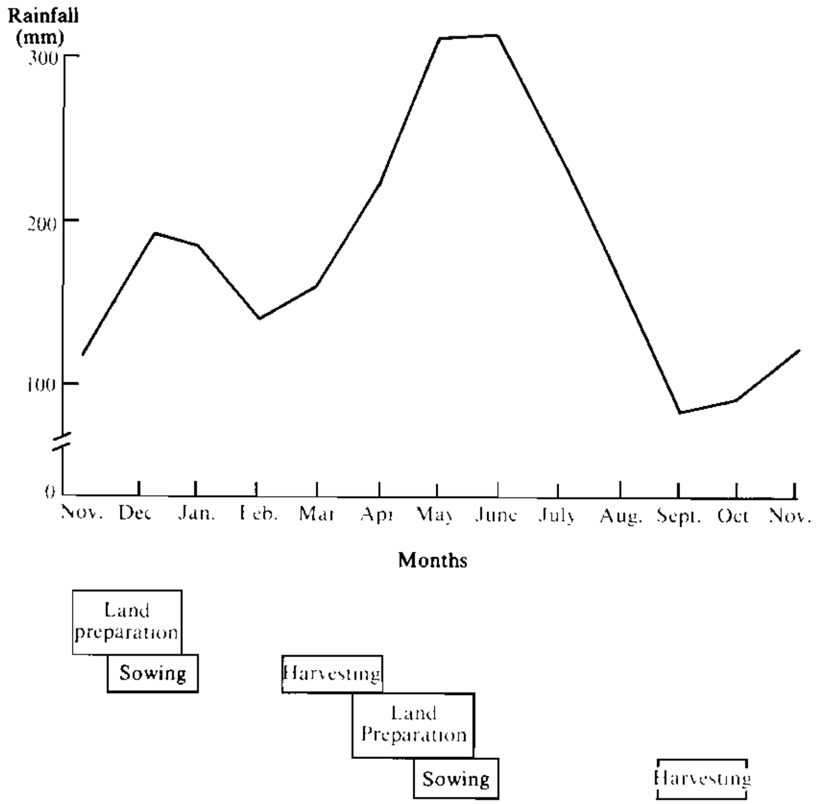

Figure 1. ***Calendar for double-cropping of rice in Suriname.***

wheeled or tracked tractors. To obtain a flat seedbed a heavy beam is drawn over the fields. If necessary, snails are controlled before sowing.

Weed control, pests, and diseases. There are some very noxious grasses which are controlled with propanil (3 to 4 litres/ha). Red rice is controlled by repeated plowing. For broad-leaved weeds and sedges 2,4-D amine (0.5 to 1.0 litre/ha) is used.

Insecticides are used for insect pests like *Spodoptera* spp., *Hydrellia* spp., *Sogatodes* spp., stem borers, and stink bugs. Spraying insecticides and herbicides is normally done by airplanes, but small farmers also use back-bomb sprayers and mist sprayers. The concentrations of the pesticides used in Suriname are tested by local research.

All fungus diseases known in Suriname have already been identified, but until now it has not been necessary to control them because the economic damage they cause is not high—the resistance of rice varieties to fungal diseases is normally stable. The "hoja blanca" disease is also present but its incidence is not significant. Bacterial diseases are not known.

Fertilization. For rice production usually nitrogen fertilizers only are used, especially urea. Experiments have indicated that there is little or no response to phosphorus and potasium applications.

A total amount of 250 to 300 kg/ha of urea is topdressed in three applications. The first application is broadcasted on drained fields. The second and the third applications are also broadcasted but under flooded conditions. The time of application and the amount to be broadcasted have been determined by long-term research. On large estates broadcasting is done by airplanes while small farmers broadcast by hand.

Harvesting, drying, and storage. Harvesting is normally done 35 days after flowering, when the grains have a moisture content of about 20 to 22 percent. With the exception of upland rice, all rice is harvested with combine harvesters. During the mechanization of rice production several brands of combine harvesters were tried out and the most suitable brands for local conditions were identified.

Two or three weeks before harvesting the fields must be drained, otherwise the harvester may slip or become stuck in the mud, resulting in heavy harvest losses. The harvested paddy is transported in jute bags or in bulk to the dryers.

There are two types of dryers—the bind dryer which is locally made and the column dryer which is imported from U.S.A. or Germany. The bind dryer works with a lower volume and requires more time than the column dryer. Diesel oil is normally used in the burners. The paddy is dried to a moisture content of 13 to 14 percent.

After drying the paddy is stored in two types of silos: one is flat and horizontal with a concrete floor and the other is vertical, consisting of a cylinder with metal or concrete walls. Storage insects are usually controlled.

Production costs. With the exception of land, labor, seed, and water all inputs are imported. Labor in Suriname is extremely expensive, consequently increasing production costs. Table 6 shows the production costs for the small farmer. The production costs for middle-sized farms are slightly lower while those for large-scale farming are the lowest.

Table 6. **Production costs per hectare for farms of about 24 ha, Suriname.**

Item	Cost (Sur.f.)[a]
Land preparation	125
Harvesting	125
Pesticides	60
Fertilizers	90
Polder maintenance	50
Seed	70
Labor	270
Land tax	15
Various	70
Interest	20
Total	895

a. Exchange rate: Sur.f 3.35 = US$1.00

Water management. Water is one of the most important factors in rice cultivation both for the physiological processes and for controlling weeds and pests. To obtain better water management the fields must be level. Timing is also very important and can be better achieved if farmers use individual pumps.

There are two major water sources—the Nanni Reservoir which distributes water by gravity and the rivers from which water is pumped up. In the near future another water supply will be available through the Multipurpose Corantijn Canal Project. Water from the Corantijn River will be pumped up and guided through a canal of 65 km toward the rice areas of Nickerie. When this project is finished 12,500 ha of rice land will be added to the present rice cultivation area.

Rice Research

Rice research used to be done on a small scale by the Agricultural Experiment Station at Paramaribo. This research, however, was often interrupted because of a lack of research workers.

With the introduction of mechanization the SML focused its research activities on mechanized rice production of a large scale. The results, however, were also applicable to medium-sized and small farming. Research is conducted in two locations—the Prins Bernhard Polder (soils and fertilizers and breeding) and Wageningen (plant protection). From 1970 research at the SML has been slightly reduced.

In 1978 the government started a research project (POR) that was primarily directed toward small farming.

At the moment there are not enough facilities available to set up a broad-based rice research program in Suriname. However, the breeding program and the research on plant protection are fully equipped. The best location for all rice research would be the Prins Bernhard Polder, where the rice research and breeding station of the SML is located. The total area of the Polder is about 800 ha and there are some facilities already available to begin a worthwhile research program.

Because rice research in Suriname takes place in different locations and by different organizations it is important to coordinate research under one single national rice research institution in order to achieve an efficient use of the available research capacity. In addition, there would be better control of the overall operations for rice, from tillage to marketing. At present a project is being developed along these lines.

There is also a project on rice seed production and its profits would cover the research costs, but no legislation has been developed yet.

One of the principal problems of establishing of a broad research program is to find qualified personnel. Such personnel in Suriname often leave the field of research because of higher salaries offered by other employers. Foreign experts normally leave Suriname after acquiring the experience they sought. The Suriname government needs to raise the salaries of researchers if it is to keep them in its employ on a permanent basis.

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Rice in Trinidad and Tobago*

*Ronald Barrow and Roop Ganpat***

Trinidad and Tobago is a country formed by two islands and is a member of the British Commonwealth with an estimated population of 1.2 million in 1983. The major ethnic groups in the population include East Indians and African descendants. The educational level of the people is very high with less than 10 percent illiteracy.

Since most rice is grown in Trinidad, this work will focus on that island. Trinidad is located between latitudes 10°05' and 10°50 north and longitudes 61°00' and 61°55' west and has an area of 1868 square miles (438,812 hectares). In 1972, 62.1 percent of the land was under forest and natural vegetation, 15.4 percent under tree crops, 12.4 percent under field crops, and 10.1 percent were built-up areas. The main tree crop was cacao (8.3 percent) while rice occupied 1.5 percent of the area.

The number of people employed in agriculture decreased from 24 percent in 1970 to 11 percent in 1980 (Figure 1), probably because of the development of the oil industry and the resulting increases in wages.

General Status of the Rice Industry in Trinidad

Rice growing in Trinidad has always been associated with small farmers (Table 1) of the East Indian ethnic group. Local production has been difficult to estimate accurately because most of the rice produced is consumed at home.

It has been estimated that 15 to 60 percent of local production is consumed by the farmer and his family and that the contribution of locally produced rice to the total consumption changed from 45 percent (1363 t) in

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* Read by Thomas W. A. Carr, Director of Research, Caroni (1975) Ltd., Trinidad and Tobago.

** Director, Central Experiment Station, Centeno; and Researcher, Cereals Division, Central Experiment Station, Centeno, respectively.

1954[1] to 22 percent (9000 t) in 1981. The decrease in production has been associated with the reduction of area planted which was approximately 8000 ha in 1951 but 4535 ha in 1981. Average yields have been estimated as ranging from 1.7 to 3.5 t/ha in 1981.

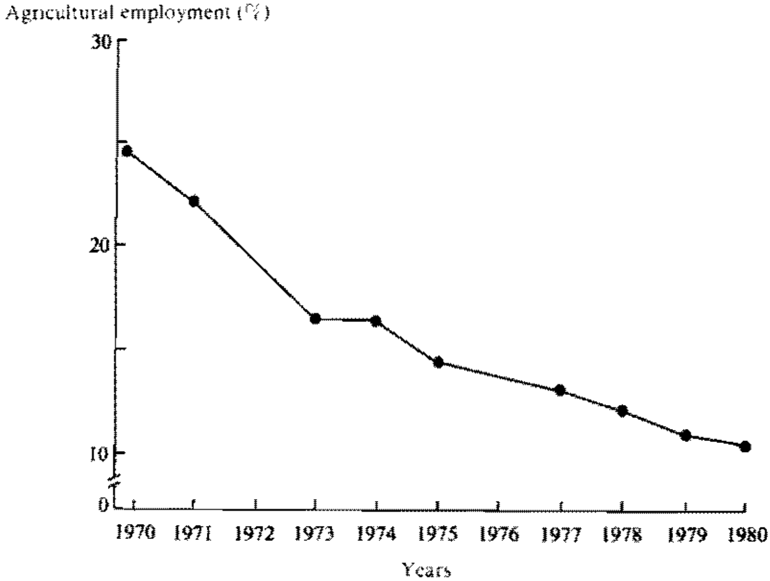

Figure 1. *Number of people employed in agriculture as a percentage of all employees, Trinidad and Tobago. 1970-1980.*

Table 1. **Distribution of rice farmers and farm sizes in Trinidad, 1981.**

County	Cultivated area (ha)	Registered farmers (no.)	Average farm size (ha)	Proportion (%)
St. Patrick	1664.5	2,496	0.65	36.7
Caroni	1352.5	2,255	0.61	29.8
Victoria	1092.6	1,933	0.57	24.1
Nariva, Mayaro	248.9	581	0.45	5.5
St George	88.6	211	0.40	2.0
St. Andrew, St. David	87.8	191	0.40	1.9
Total/average	4534.9	7667	0.51	100.0

SOURCE. Ministry of Agriculture, Lands and Food Production, Agricultural Planning Division. 1981.

1 Annual statistical digest 1955 No 5.

The main source of imported rice has been Guyana with whom Trinidad and Tobago signed, in 1962, a three-year rice importation agreement for 1963-1965. The agreement has since been extended and renegotiated at different times.

Rice imports including bulk and packaged rice for the period 1973-1981 are listed in Table 2. The value of rice imports increased from TT$27 million (US$11.25 million)[2] in 1978 to TT$37 million (US$15.42 million) in 1980 which represented 0.5 percent of total imports and ranked fourth on the list of imported food items after meat and meat products (1.4 percent), milk (0.9 percent), and wheat (0.8 percent).

Local rice production used to be sent to more than 200 small mills until 1977 when the government decided to centralize rice milling in a big rice mill in Carlsen Field near Chaguanas. This mill was bought from a Colombian smelting company and has a capacity of 4 tons per hour. In the period 1977-1980 it processed an average of 1250 t per year. A rice dryer with a capacity of 33.6 t/hr was also obtained but it has not been properly installed yet.

The physical operation of the mill is the responsibility of the Field Engineering Division of the Ministry of Agriculture. Paddy is delivered to the mill by the Central Marketing Agency (CMA) which buys it from the farmers. The CMA has several trading branches where paddy is delivered by the farmers in bags and is then transported to intermediate storage facilities in Chaguaramas.

In 1980 farmers were paid a guaranteed price of TT$1.21 (US$0.50)/kg and recently this has been increased to TT$1.96 (US$0.82). However, there are complaints that payment takes too long after delivering the paddy and that CMA receives the paddy only on availability of storage space.

Table 2. **Quantity and value of rice imported by Trinidad and Tobago, 1973-1981.**

	Year				
Item	1973	1975	1978	1980	1981
Imports (t)	29,480	32,572	27,330	33,350	46,625
Value (TT$ in thousands)[a]	29,000	29,650	27,650	37,100	52,128

a. Exchange rate: TT$2.40 = US$1.00 (Nov. 1984)

SOURCE: Overseas Trade Reports, C.S.D.

2. Exchange rate: TT$2.40 = US$1.00 (Nov. 1984)

In 1980 the Ministry of Industry and Commerce approved to grant distributors a price of TT$0.73 (US$0.30)/kg. The Ministry also authorized a price of TT$0.73 (US$0.30)/kg for imported bulk rice and TT$1.52 (US$0.63)/kg for imported packaged rice. The retail price of rice was fixed at TT$0.81 (US$0.33)/kg in 1980 and in 1982 it was increased to TT$1.30 (US$0.54)/kg.

Considering the prices quoted it can be seen that rice consumption is highly subsidized. Using the data from 1980, estimating a rice yield of 60 percent, and adding the cost of TT$0.145 (US$0.06) for handling and processing, the total subsidy to the consumer amounts to TT$1.35 (US$0.56)/kg.

The present per capita consumption of rice is approximately 45 kg, a level higher than the desired consumption levels. This is apparently due to the subsidized consumer price which results in a retail price being relatively cheaper than that for other locally grown crops intended to substitute rice as a major starch component in the local diet (Figure 2).

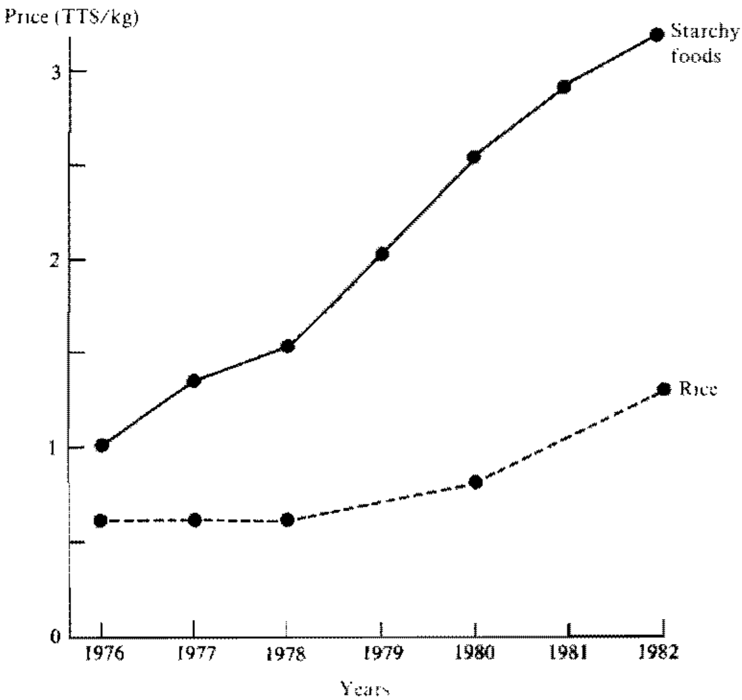

Figure 2. *Average retail prices of starchy foods (sweet potatoes, yams, plantains) and rice in Trinidad and Tobago, 1976-1982.*

The government of Trinidad and Tobago has been well aware of the importance of rice as a staple food for the people and the danger of depending on foreign supplies, particularly after the increase in price of imported rice in 1972-1973. Consequently it has been trying to increase local rice production by the following ways:

Increasing the arable land suitable for paddy production by initiating some developmental works such as repairing and constructing drainage and irrigation facilities in the Caroni, Fishing Pond, and Nariva areas;

Providing farmers with seeds of new and improved high-yielding rice varieties at the subsidized price of TT$0.62 (US$0.25)/kg;

Subsidizing land preparation costs by operating a tractor pool at El Reposo-Sangre Grande and at Rio Claro at prices of TT$20.00 per acre (US$20.58/ha) for plowing, TT$15.00 per acre (US$15.44/ha) for leveling, and TT$15.00 per acre (US$15.44/ha) for banking;

Making the CMA purchase rice at a minimum guaranteed price;

Providing funds to the Caroni Rice Pilot Project to evaluate a highly mechanized rice-cropping system;

Establishing a Rice Company of Trinidad in 1982 to promote and administer all aspects of rice production and marketing; and

Providing agricultural credit through the Agricultural Development Bank.

However, farmers' response to these measures has not met with expectations.

Rice Production Systems

Rice growing in Trinidad can be classified as rainfed lowland since planting is done during the wet season in flood-prone areas near swamps (Figure 3). Most rice is transplanted from nurseries that are established at the beginning of the rainy season (May, Figure 4) using about 113 kg/ha of seed. Seedlings are transplanted to puddled soil when they are 35-days old.

The soils are mainly classified in groups A1 (deep hydromorphic soils with restricted internal drainage) and A4 (deep alluvial soils with restricted internal drainage).

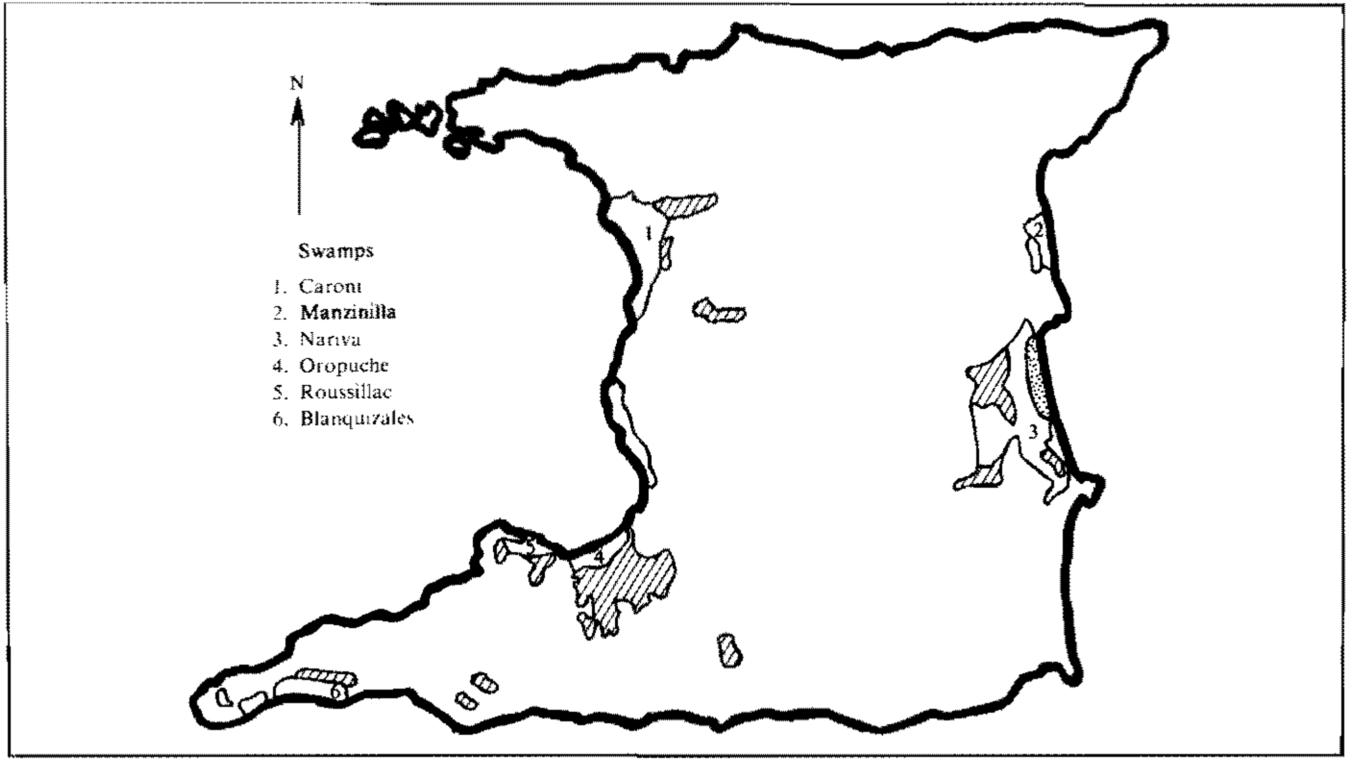

Figure 3. *Distribution of the rice crop in Trinidad, 1973.*

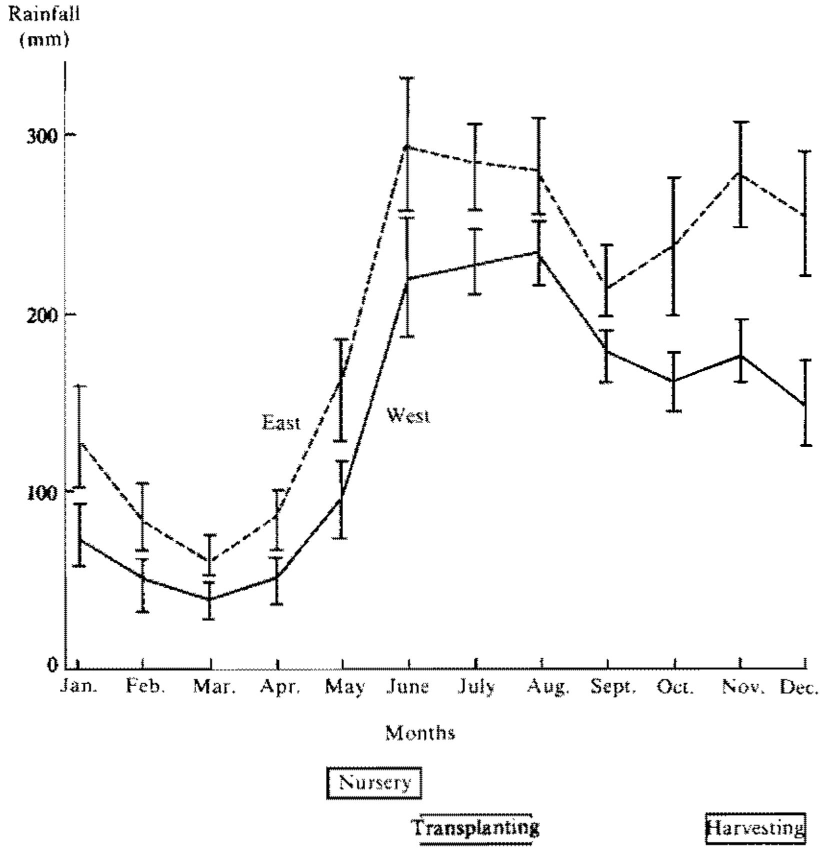

Figure 4. ***Rainfall and rice cropping system in Trinidad. (Vertical bars indicate standard error.)***

The high clay content (swamp clay, sandy clay alluvial, and silty clay alluvial) and restricted drainage brings flooding during most of the cropping season. The fields are harvested in October to December when the soil is still saturated or flooded which, together with the likelihood of rains, causes delays in threshing—even after rice has been cut—and the delivery of fairly wet paddy to the mill.

Being a traditional system of rainfed cultivation, most operations, with the exception of land preparation, require labor inputs. About 70 percent of the total cost of production is attributable to labor costs. Fertilizers and chemicals are not widely used and seeds of tested and improved cultivars and selections are at present used on about 35 percent of holdings.

The Ministry of Agriculture supplies about 10 percent of the yearly seed needs. The farmers also use seeds from their own crops. The varieties currently being distributed are IR 5, IR 22, Dima, D 110, and local selections. Tall varieties are used because of the periodic floodings. On the pilot farm at Caroni, two U.S.A.-developed varieties are being used. CICA 4, a promising high-yield variety, had been distributed but was discontinued because of its susceptibility to blast disease.

There are three main rice diseases which have appeared in all the major rice-growing areas: blast disease *Pyricularia oryzae*, leaf scald *Rhynchosporium oryzae*, and leaf smut *Entyloma oryzae*.

The two major pests are the grasshopper *Conocephalus* spp. and land crabs. Sporadic attacks from stink bugs *Oebalus* spp. can cause damage to grains in the milk stage.

During 1983 the estimated production cost was TT$7000 (US$2916.66)/ha with an average yield of 3925 kg/ha.

Research and Development

During the past three decades the Ministry of Agriculture's Crop Research Division has supported an ongoing program which was and is constantly revised to meet current trends in rice production. The research programs and efforts are cooperative, involving different disciplines in the Division, extension services, and, to some extent, farmers.

Research policy has, as its main objective, the well-being of rice farmers which, in practical terms, means that research programs serve to improve the farmers' level of income and consequently their standard of living. Efforts are being directed mainly toward the small rice farmer of swampy lands.

Current research is, therefore, by nature, applied and concentrates on two areas: the increase of production on small farms and the feasibility of large-scale fully-mechanized production.

The primary objective of research for small farms is to effect a change from traditional cultivation systems to modern systems wherever they can be adopted locally. These changes involve: the substitution of traditional varieties by introduced and tested varieties and selections; the application of improved planting methods including planting densities; the use of fertilizers; the use of chemicals for weed, pest, and disease control; the introduction of small-scale equipment for harvesting and subsequent operations; and, most important, the introduction of a double-cropping system.

The feasibility studies on large-scale production resulted in the implementation of the sugar rationalization plan in which approximately 6500 acres (2630 ha) were released for conversion to flooded land for paddy production. It is envisaged that the farm sizes will be relatively large (2000 acres or 809 ha) and will use a fully mechanized production system. The existing agency, Caroni 1975 Ltd., is currently evaluating a pilot project of 150 acres (60 ha), fully mechanized, to determine the feasibility of this system and its possible application to much larger units.

Proposals and Plans for Action

The demand for commodities such as cereals and grains is expected to increase substantially at current consumption levels by the year 1990 (Table 3). It is generally accepted that it will not be possible to meet the projected increases through local production with the present land availability and suitability. Accordingly, a target of 38 percent of the expected demand for cereals and grains in 1990 is envisaged[3]. Several government agencies and two public companies (Caroni 1975 Ltd. and Rice Company of Trinidad and Tobago Ltd.) are charged with the responsibility of meeting the projected demands[4].

Because the capital investment needed to reclaim or convert lands for irrigated rice production increases over time studies have started on the feasibility of upland rice production for both small and medium-sized farms of up to 10 ha.

Table 3. **Projected demand for selected food groups in 1990, Trinidad and Tobago.**

Commodity	Demand by year (t)		Increase over demand (%)
	1976	1990	
Cereals and	155,790	174,032	
grains	155,790	174,032	12
Fats and starches	35,256	86,352	145

SOURCE White Paper on Agriculture. Appendix XIV A

3. White Paper on Agriculture
4. Rice Company of Trinidad and Tobago Ltd. Memorandum of Association

A possible alternative for promoting upland rice production with a minimum of capital investment is the rationalization of the use of existing sugar cane lands or abandoned tree crop farms. This is not to forgo the reclamation of former swamp land but would increase acreage faster with fewer capital resources.

Active consideration is being given to the reluctance on the part of former rice growers to revive production and to the disinclination of younger farmers to enter rice production because of the lower levels of profit compared with other food crops and other forms of production. Moreover, it appears that this may be attributable to a socioeconomic problem which was and still is a major factor in the stagnation of local food crop production.

To alleviate this problem it is envisaged that a coooperative effort between research and extension activities will be developed to include the sociological aspects of food crop production.

Constraints to Increased Rice Production and Research Approaches

The main constraint to increased rice production is that farmers are drifting away from their land. This has resulted in a significant decrease of acreages of rice and other food crops cultivation. Among the different actions suggested by several reports to reverse this trend are the improvement of drainage and irrigation systems, the organization of land tenure, improving CMA's efficiency, and finishing work on the rice mill.

Most reports agree that if rice growing is to continue, mechanization is a must. However, farm size seems to indicate that only with small machinery will the problem of depending on scarce and expensive labor be solved. The government has therefore initiated work on hand threshers and although they reduce approximately one-third of the labor required for harvesting, labor is still required for cutting and transporting the paddy under adverse working conditions.

The Caroni 1975 Ltd. Rice Pilot Project is working on a highly mechanized operation which includes direct sowing and combining. However, this requires more research and trained personnel in the short term. In flood-prone areas to mechanize harvesting would require the development of a timetable that allows harvesting during the drier months. The possibility of planting improved photoperiod-sensitive varieties is being evaluated.

Double-cropping in the areas which can be irrigated and the evaluation of the feasibility of a ratoon crop may require further variety testing because the germplasm available to farmers does not include recently developed high-yielding varieties.

The training of both research and extension personnel has to be encouraged because the work required for increased production will demand much more technical expertise than is presently available.

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Rice Cultivation in the Caribbean Countries: Summary

*Federico Cuevas Pérez**

The Caribbean region includes the group of islands scattered in the Caribbean Sea which extends from the southern coast of the State of Florida to the northern coast of South America. There are three continental countries which, for historical reasons, are also considered as part of the Caribbean: Suriname and Guyana on the north coast of South America and Belize in Central America.

Language barriers have traditionally restricted collaboration among the different countries of the region. The English-speaking countries have considerable experience in mutual collaborative activities whereas Dutch-, French-, and Spanish-speaking territories normally relate with countries outside the region.

Economic activity is dominated by mining and agriculture with the tourism sector representing an important source of foreign currency in some countries. The agricultural sector has been dominated by the sugar cane crop, particularly in the larger islands.

Although not all the Caribbean countries are traditional rice-growing areas, most do consume rice as a staple food. This report describes the general characteristics of those rice-growing areas which include Belize, Cuba, Dominican Republic, Guyana, Haiti, Jamaica, Suriname, and Trinidad and Tobago. It summarizes the principal constraints to increased productivity in the region.

Rice Production and Marketing

The area planted with rice varies considerably between different countries, ranging from a maximum of 146,000 hectares in Cuba to a minimum of 450

* Consultant, Centro Internacional de Agricultura Tropical (CIAT), and Subdirector of Research, Instituto Superior de Agricultura (ISA), Santiago, Dominican Republic. Now Coordinator for International Rice-Testing Program (IRTP) for Latin America, CIAT, Cali, Colombia.

ha in Jamaica (Table 1). Most rice is irrigated although the 13,000 ha in Belize and Trinidad and Tobago are under upland and favorable rainfed systems. Large farms of over 100 ha are common only in Cuba and Suriname. In the rest of the countries rice is grown on small farms of 6 ha or less.

Differences in yield are also large, reflecting differences in ecosystems and experiences with rice growing. Cuba, Dominican Republic, Guyana, Haiti, and Suriname have been involved in rice cultivation since the 1930's. The case of Haiti is special because the projects to develop infrastructure for rice cultivation are recent—which partly explains the low yield of 1.9 t/ha.

Although three of the Caribbean countries (Belize, Guyana, and Suriname) are rice exporters, the region as a whole is a net importer. During the period 1979-1982 the total consumption of rice in the region was 1.08 million tons of which 135,000 were net imports (Table 2). However, the quantity of rice entering the region was much higher, because the largest exporter, Suriname, sold most of its rice to Europe.

In general rice farming is profitable (Table 3) although in some cases the cost and availability of machinery and inputs result in high production costs. The cases of Belize (average farmer breaks even) and Trinidad and Tobago (average farmer loses money) should indicate the direction of any

Table 1. **Ecosystems, area, production, and yield of rice in the Caribbean countries, 1979-1982.**

Country	Ecosystem[a]	Area harvested (ha in thousands)	Production[b] (t in thousands)	Yield (t/ha)
Belize	Upl, I	3.00	8.0	2.6
Cuba	I	146.00	454.0	3.1
Guyana	I, RF	97.00	267.0	2.7
Haiti	I, Upl	50.00	95.0	1.9
Dominican Rep	I, Upl	107.00	408.0	3.7
Jamaica[c]	I	0.45	1.4	3.1
Suriname	I	61.00	247.0	4.0
Trinidad and Tobago	RF, I	10.00	20.0	2.0
Total/average		474.45	1500.4	3.2

a Upl = Upland, I = Irrigated. RF = Rainfed

b. Paddy.

c. Data for 1983

SOURCES: Department of Agriculture (Belize) Annual Report, 1982.
Casas, J. 1984. CIAT EPR Mission in Cuba.
Departamento de Fomento Arrocero (Dominican Republic).
USDA. 1982. Foreign Agriculture Circular, FG-22-82

Table 2. **Population and movement of white rice in the Caribbean countries, 1979-1982.**

Country	Population (million)	External trade[a] (t in thousands)	Consumption Total (t in thousands)	Consumption Per capita (kg)
Belize[b]	0.15	0.14	3.40	22.66
Cuba	10.00	(190.25)	488.00	48.80
Dominican Rep.	5.60	(0.46)	277.20	49.50
Guyana	0.75	73.75	96.25	128.33
Haiti[c]	5.30	(14.50)	72.25	14.20
Jamaica	2.20	(47.50)	53.50	24.32
Suriname[d]	0.40	81.75	34.20	85.50
Trinidad and Tobago	1.20	(38.25)	51.75	43.12
Total/average	25.60	(135.32)	1076.55	42.17

a. Parentheses indicate imports.
b. Data for 1983 only.
c. Imports vary from year to year depending on water availability.
d. Data for consumption 1982 only.

SOURCES: USDA. 1982. Foreign Agriculture Circular, FG-22-82.
Departamento de Fomento Arrocero (Dominican Rep.).
Department of Agriculture (Belize). Annual Report, 1982.

Table 3. **Cost and selling prices per kilogram of paddy in the Caribbean countries. Averages for 1983.**

Country	Cost[a] (US$/kg)	Minimum price (US$/kg)
Belize	0.15	0.15[b]
Cuba	0.17	0.23
Dominican Rep.	0.22	0.27
Guyana	0.10	0.14[c]
Haiti	0.34	0.37
Jamaica	0.17	0.18
Suriname	0.12	0.14[d]
Trinidad and Tobago	1.27	0.83

a. Calculated, assuming average yield, as in Table 1. Does not include land rent or financial costs.
b. Minimum price for paddy with 18 percent moisture.
c. Price for grade B.
d. Price for first quality.

regional research, that is, agronomic research should have a strong socioeconomic component. Marketing problems and high costs of machinery and labor should be investigated to provide a base for agronomic research planning. The high production costs for Haiti are partly responsible for the low per capita consumption (Table 2) which suggest that cheaper rice would probably increase the demand.

With the exception of Haiti, Caribbean rice farmers sell their paddy through channels which guarantee a minimum price. In general, and because of the political sensitivity of the rice market, most countries have one or two agencies to buy and/or sell rice. In Belize the Marketing Board is the only agency authorized to market rice locally and because it buys paddy only at a maximum of 18 percent of moisture there are harvesting delays and a reduction of grain quality.

Rice Production

Both transplanting and direct seeding are found in the Caribbean (Table 4). Most farmers prepare the land dry and then puddle the soil. Belize and Cuba sow dry seed in dry soil—by broadcasting in Belize and with machinery in Cuba. Belize and Trinidad and Tobago have several irrigated rice projects where herbicides and fertilizers are used, but most farmers in these countries do not use chemical inputs.

On the whole, two crops per year is the goal, but problems of water, machinery availability, and weather normally limit production to three crops every two years (Figure 1). Only Guyana and Suriname obtain two crops per year and start their first crop in November and harvest their second crop in September to October (Figure 1, A). Most problems associated which the first crop are due to lack of water at planting and/or to wet weather during harvesting. A delay in planting to as late as early February would result in harvesting during the rainy season (end of May).

Cuba starts its first crop in mid-December (Figure 1, B) because earlier plantings normally suffer low temperature damages. In Cuba and Dominican Republic, if the first crop cannot be planted because of water shortage, planting begins in March to April.

Belize (upland rice) and Trinidad and Tobago (lowland rainfed rice) depend on rainfall for planting. Crops are established at the onset of the rainy season and harvested when the rains start decreasing (Figure 1, C).

Most varieties used are semidwarfs which are either locally developed or selected from germplasm available from international research centers

Table 4. **Common agronomic practices for rice in the Caribbean countries.**

Practice	Belize	Cuba	Dominican Republic	Guyana	Haiti	Jamaica	Suriname	Trinidad and Tobago
Land preparation								
Mechanical, dry	X	X	X	X		X	X	
Mechanical, wet		X	X	X		X	X	X
Hand			X		X			
Planting								
Transplanting			X		X	X		X
Dry seed	X	X						
Pregerminated seed		X	X	X		X	X	
Weed control								
Herbicide	X	X	X	X		X	X	
Hand			X		X	X	X	X
Fertilization								
Complete		X	X	X	X	X		
Nitrogen	X	X	X	X	X	X	X	
Harvesting								
Combine		X	X	X		X	X	
Hand	X		X		X	X		X

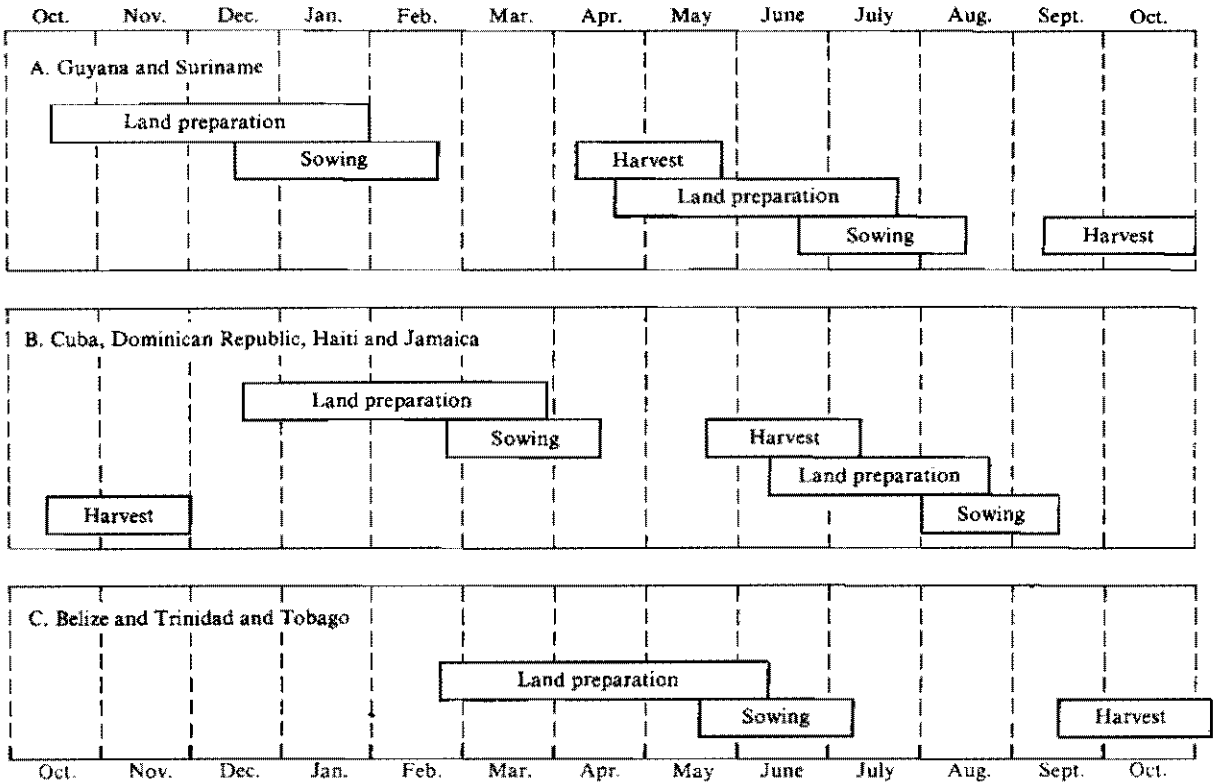

Figure 1. *Rice cultivation systems in the Caribbean countries.*

[CIAT or IRRI (International Rice Research Institute)] (Table 5). It should be pointed out that the varieties developed in the Caribbean countries are normally used by the countries where they were developed. The only exception is Diwani, released in Suriname and also used by Guyana.

Seed multiplication is not very well organized in the region and, with the exception of Cuba and the Dominican Republic, legal regulations for seed

Table 5. **Major rice varieties planted in the Caribbean countries.**

Variety	Type[a]	Country of origin	Planted by
Bluebonnet	IT	U.S.A.	Belize
Camponi	SD	Suriname	Suriname
Caribe 1	SD	Thailand	Cuba
CICA 8	SD	Colombia	Belize, Jamaica, Dominican Republic
Dawn	IT	U.S.A.	Haiti
Diwani	SD	Suriname	Suriname, Guyana
Eloni	SD	Suriname	Suriname
IR 5	SD	Philippines	Trinidad and Tobago
IR 880	SD	Philippines	Cuba
J-104	SD	Peru	Cuba
Juma 57	SD	Dominican Republic	Dominican Republic
Juma 58	SD	Dominican Republic	Dominican Republic
MCI-3	SD	Taiwan	Haiti
Mingolo	TT	Dominican Republic	Dominican Republic
N	SD	Guyana	Guyana
Naylamp	SD	Peru	Cuba
Quisqueya	SD	Haiti	Haiti
Rustic	SD	Guyana	Guyana
Starbonnet	IT	U.S.A.	Guyana, Haiti
Tanioka	SD	Dominican Republic	Dominican Republic

a. IT = Improved tall; SD = Semidwarf; TT = Traditional tall.

certification are either lacking or not well defined. This intensifies red rice problems in Belize, Suriname, and Trinidad and Tobago.

Rice Research and Extension

There are two basic models for rice research and extension: in one model these activities are under the responsibility of a semigovernment organization engaged in rice production and/or marketing; and in the other model a rice technical group is formed within the Ministry of Agriculture and includes development, research, and extension workers.

The first model is followed by Guyana, Haiti, Jamaica, and Suriname. The organizations responsible are, respectively, Guyana Rice Board (GRB), Organization for the Development of Artibonite Valley (ODVA), Black River Upper Morass Development Corporation (BRUMDEC), and the Foundation for Mechanized Agriculture (SML). Guyana and Suriname are trying to reorganize their research program by, in the case of Guyana, establishing a national research institute which would include rice within its activities and, in the case of Suriname, organizing a national rice institute.

The second model is followed by Cuba and the Dominican Republic. Although rice research is specifically carried out by Estación Central de Investigación Arrocera (ECIA) in Cuba and Centro de Investigaciones Arroceras (CEDIA) in the Dominican Republic, the organization within the Ministry of Agriculture permits constant interaction among all rice workers by either having the station under the Dirección de Arroz (Cuba) or concentrating all rice workers in the same place (Dominican Republic).

Belize and Trinidad and Tobago do not have a rice research group as such. Belize has the British-run Toledo Research and Development Project (TRDP) which is engaged in rice research but its future is not very clear. In the past Big Falls Ranch (a private company) carried out rice research, but financial difficulties have severely reduced its contributions.

Agricultural research in Trinidad and Tobago is very well organized but rice has not been a priority research area. Rice research has been carried out by the Cereal Division of the Central Station with very little personnel and resources.

As far as research capability and experience are concerned, the Caribbean countries can be divided into two groups: those having an organized rice improvement program for more than ten years (Cuba, Dominican Republic, Guyana, and Suriname) and those beginning to develop their research programs (Belize, Haiti, Jamaica, and Trinidad and Tobago). Within the first group Guyana is having problems maintaining its program, largely because of staff changes and lack of resources. Indeed, Guyana can be considered a special case as far as staff improvement is concerned.

Regional Constraints to Increased Production and Possible Solutions

Agricultural production depends on several components which interact to bring higher crop output and farm profit. The impact of improved varieties depends on the other components of production. Research must therefore generate technologies suitable for present and projected infrastructures and consistent with farmers' experience.

Many of the constraints for rice production in the Caribbean are infrastructural which cannot be overcome through research only. The major constraints of the region are related to the availability of water and machinery and to marketing policies. Some of these problems are country specific and should be dealt with as such. However, regional collaboration could contribute to increased rice yields by concentrating on the following activities:

Seed production. Few countries of the Caribbean have functional seed legislation and trained personnel to ensure availability and good quality. Most of the red rice problems have resulted from low seed quality standards. Regional cooperation and training, technical advice on seed multiplication and red rice control methods can contribute to increased yields and quality without causing major changes in current agronomic practices.

Agronomic research. Economic changes in the Caribbean are increasing the costs of rice production which therefore will require cheaper agronomic packages. Research on land preparation, weed control methods, fertilization, and harvesting equipment would reduce costs and increase yields per unit of land.

Another area of agronomic research for increased yield per unit of land and time is the increase of cropping intensity. Cuba, Dominican Republic, and Trinidad and Tobago have tried to increase the number of crops per year by reducing the variety cycle and by ratooning. The Dominican Republic has considerable experience with ratooning that should be shared with the other countries.

Germplasm evaluation. Although most varieties used in the region are of the improved type, it is possible to improve yield potential by selecting varieties with characteristics appropiate for each country with regard to cycle, quality, and tolerance to soil problems. For example, early-maturing cultivars would be of use to Cuba, Dominican Republic, and Jamaica. Improved photoperiod-sensitive varieties would be useful to Trinidad and Tobago and probably to Belize. Currently some countries harvest their rice under unfavorable conditions because of the use of late-maturing cultivars and/or delayed planting.

Delayed harvesting or unfavorable conditions, differences in marketing preferences, and export requirements demand rice varieties with good milling yields even when harvested with very low moisture content. The cases of Suriname and Guyana should be cited since their extra long grain varieties normally result in low milling yields. With the countries' expected area expansion and marketable surplus, they should make use of improved varieties having better milling quality.

There are two major soil problems in the Caribbean—salinity and organic soils. The germplasm available to Cuba, Dominican Republic, and Haiti should include materials tolerant to salinity, and germplasm destined for Jamaica should tolerate peat soils.

For some countries regional activities could include specific crossing and collaboration in the screening of segregated populations. Countries like Belize, Cuba, Guyana, Haiti, and Trinidad and Tobago could make use of these regional crosses.

Training. With the probable exception of Cuba and Dominican Republic, most countries lack trained rice researchers. Training researchers would ensure dynamic national programs and the capacity to carry out country-specific experiments.

Researchers from Belize, Haiti, and Jamaica can be trained in courses organized by CIAT either in Colombia or in the Dominican Republic and Suriname. Researchers from Trinidad and Tobago can benefit more from training at IRRI where they can study rainfed lowland ecosystems.

Training efforts for Cuba, Dominican Republic, and Suriname should concentrate on area-specific short-term training courses, particularly in the areas of breeding and weed control. Belize, Jamaica, and Trinidad and Tobago which are currently developing their rice industries, need additional training efforts including onfarm training.

Belizean rice workers would benefit from interchanges of experiences with Central American farmers. Jamaicans and Trinidadians should interact with Guyanese farmers and with Colombian and Dominican farmers if language barriers can be overcome. Intercountry sharing of agronomic experiences should be encouraged, particularly in machinery use and development. Regional meetings would help stimulate such interchange.

Conclusions and Recommendations of the First Workshop on the Caribbean Cooperative Rice Research Network

After careful discussion of the country reports, the summary, and the consequent proposals, the participants of this First Workshop on the Caribbean Cooperative Rice Research Network concluded that a significant and well-coordinated regional effort is needed in rice research in order to achieve national goals in rice production. Several countries in the region have both germplasm and technology to offer to other countries in the region and yet interaction is not occurring because of insufficient communication and lack of incentive.

The workshop on agricultural research policies held in Port-of-Spain, Trinidad and Tobago, in September 1983, recommended that collaboration among the countries of the region and with programs of international centers be developed by the creation of a cooperative Caribbean rice research network. The participants of this workshop fully endorsed such a recommendation and concluded that the network should be fully established as early as possible.

Objectives of the Caribbean Cooperative Rice Research Network

The primary objectives of the network should be:

To strengthen national rice research programs;

To stimulate cooperative research on common rice production problems;

To facilitate the horizontal transfer of production and seed technology generated by participating institutions;

To facilitate more effective cooperation and support from CIAT and IRRI (International Rice Research Institute) to national programs in the region; and

To facilitate technical cooperation between Caribbean countries as a means of promoting rice production.

The above objectives will contribute to the development of components for new rice-production and seed technologies suitable for the ecological and economic conditions existing in each production zone and rice-production system in the Caribbean.

Strategy

The central strategy is not to replace but to augment national research programs and to improve their effectiveness through a cooperative effort. Each country is expected to conduct its own research according to national priorities and to contribute to research of regional interest. Network activities should be designed to provide technical support for national efforts, not to replace them.

Activities

It is recommended that the network's activities include:

Coordination of rice research on common problems aiming, where appropriate, at a division of responsibilities among the participating programs;

Germplasm testing through a series of coordinated trials designed for overcoming specific production constraints relevant to the Caribbean regions;

Reinforcement of national research and extension programs by courses and inservice training on specific disciplines and techniques. These are to be conducted in the region as well as at the international centers;

Training in seed technology;

Regional workshops and monitoring tours designed to improve communication and cooperation by addressing problems in rice production common to the Caribbean region; and

Exchange of documentation and information among participating countries.

A recommended work plan for the network for the period 1985-1989 is presented in Tables 1, 2, and 3 which cover, respectively, the activities of

Table 1. **Areas for field research recommended for the Caribbean Cooperative Rice Research Network and proposed schedule of activities, 1985-1989.**

Activities	Year				
	1985	1986	1987	1988	1989
Regional trials					
Germplasm evaluation[a]					
Observational nurseries[b]	X	X	X	X	X
Special nurseries[c]	X	X	X	X	X
Agronomic trials					
Weed control		X	X	X	X
Nitrogen efficiency[d]		X	X	X	X
Small-machinery testing		X	X	X	X

a. Nurseries should be arranged according to each country's needs, and should include milling quality tests.
b. Includes early-maturing varieties.
c. Includes nurseries for salinity.
d. With support from the International Fertilizer Development Center (IFDC), U.S.A.

Table 2. **Recommended training activities for the Caribbean Cooperative Rice Research Network, 1985-1989.**

Activities and country	Participants per year[a]				
	1985	1986	1987	1988	1989
1. Incountry courses[b]					
Guyana (in English)	10(4)				
Haiti (in English)			10(4)		
Jamaica (in English)					10(4)
Dominican Republic[c] (in Spanish)		10(4)			
Cuba (in Spanish)				10(4)	
2. Inservice training					
CIAT Rice Program					
Plant breeding	2	2	2	2	2
Agronomy	3	3	3	3	3
Pathology and entomology	1	1	1	1	1
IRRI		1	1	1	1
Project headquarters	1	2	2	2	2
CIAT Seed Unit[d] (in English)	4		3		
CIAT Seed Unit (in Spanish)	1	2	1	2	1
3. Thesis research					
CIAT and IRRI	1	1	2	2	2

a. The number preceding the parentheses indicates the number of participants from host country; the number expressed within the parentheses refers to participants from other countries.
b. A minimum of 10 participants from the host country should attend.
c. Regular country courses.
d. Including monitoring tour.

Table 3. **Workshop and monitoring tours recommended for the Caribbean Rice Research Network, 1985-1989.**

Activity	Host country	Country to be visited	Year				
			1985	1986	1987	1988	1989
Workshop and monitoring tour	Trinidad and Tobago	Guyana, Suriname		X			
	Dominican Republic	Haiti, Jamaica				X	
IRTP[a]-Latin America Worksnop			X		X		X
Monitoring tour		Panama, Cuba, Belize		X			

a. IRTP: International Rice-Testing Program, Philippines.

field research (nurseries and experiments in areas of germplasm testing, agronomic studies[1], and small-machinery testing), training (short-term technical training, postgraduate training), and workshops and monitoring tours. The work plan is based on the diagnosis of rice-production problems in the region as described by the country reports and the summary, and should be regarded as a guideline, subject to modifications as needs arise.

Organization

In order to facilitate the organization and implementation of the network the workshop recommended the creation of a network technical advisory committee and the appointment of a regional rice scientist to act as network coordinator.

Technical Advisory Committee (TAC). It is recommended that the committee consists of one representative from each participating country (with an alternate member) and one representative from each sponsoring agency. Its functions should include:

Definition of priorities for regional rice research and training;

Evaluation of and recommendations for the annual work plan for the network. Both activities should be developed by the regional rice scientist in consultation with the participants of the network; and

1. Workshop participants acknowledge and welcome the IFDC (International Fertilizer Development Center) representative's pledge to contribute and support, through the network, nitrogen-efficiency trials in the countries of the region.

Definition of cooperation between countries in rice research and development, and definition of support between countries at the political level for regional rice research activities.

This committee will meet once a year, during regional workshops, to carry out its functions and, in particular, to analyze the research programs and specific proposals for regional cooperation and to provide support for the network's activities.

The Caribbean Regional Rice Scientist (CRRS). He should have full-time dedication to the network, should be bilingual, internationally recruited, and appointed as international staff in order to have the required freedom of movement within the region, and undertake the following duties:

To organize meetings for the TAC and provide the support for its activities;

To coordinate those experiments of regional interest supported by the network;

To organize germplasm interchange among participating countries and from international centers and other institutions outside the region;

To conduct research in support of national programs;

To organize training courses, regional workshops, monitoring tours, and other supportive activities including socioeconomic studies; and

To serve as liaison with rice programs outside the region, particularly with those of the international centers.

Network Headquarters

It is recommended that the regional rice scientist be based at the Centro de Investigaciones Arroceras (CEDIA) of the Dominican Republic. This recommendation is based on: the central geographical location of the Dominican Republic; CEDIA's ongoing rice research program and the integration between its research, training, development, and seed production activities; the diversity of environments and rice-cropping patterns found in the Dominican Republic; the infrastructure and scientific backup available at CEDIA; and the generous offer made by CEDIA to host the regional rice scientist and provide the required logistical support within its possibilities.

Regional Research

In order for the regional rice scientist to carry out research of regional interest in collaboration with the host country institution, it is recommended that he be assisted by two graduate research assistants (one of whom may eventually be located in another country) and by the necessary labor and secretarial support.

Financing

In order to carry out the proposed network activities it is recommended that the sponsoring agencies UNECLAC (United Nations Economic Commission for latin America and the Caribbean, subregional headquarters for the Caribbean), CIAT, and IRRI develop a special project proposal to be presented to potential funding agencies, with CIAT acting as the executive agency. It is recommended that the project be developed for a minimum period of five years in order to cope with the nature of the present rice-production problems and national objectives.

Directory of Participants

Desiderio AMARANTE
Centro de Investigaciones Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Michel Andre ARRAUDEAU
International Rice Research Institute (IRRI)
Manila, PHILIPPINES
Tel. 88-48-59
Telex: 7425365 ITT
Cable: RICEFOUND, Manila

Elpidio AVILES ROJAS
Centro de Investigaciones Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Ronald BARROW
Ministry of Agriculture
TRINIDAD AND TOBAGO
Tel. 664-5158
664-4335-6-7

Alexis BAUTISTA
Centro de Investigaciones Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Leovigildo BELLO
Subsecretaría Investigación, Extensión Capacitación
Secretaría de Estado de Agricultura
Centro de los Héroes
Santo Domingo
DOMINICAN REPUBLIC
Tel. (809) 532-3221

Víctor BETANCES
Departamento de Fomento Arrocero
Juma, Bonao
DOMINICAN REPUBLIC

Jean Rene BOSSA
Head Research Service
ODVA/DARNDR
HAITI

Thomas W. A. CARR
Director of Research
Caroni (1975) Ltd.
TRINIDAD AND TOBAGO
Tel. 665-8072, 665-8073

Eligio Antonio CRUZ
Centro de Investigaciones Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Federico CUEVAS*
Instituto Superior de Agricultura
Apartado 166
Santiago
DOMINICAN REPUBLIC
Tel. (809) 582-6621

Frans DOORMAN
Universidad Agrícola Wageningen
NETHERLANDS
Centro Norte Desarrollo
Agropecuario (CENDA)
Apartado 900
Santiago
DOMINICAN REPUBLIC
Tel. (809) 582-1511, 582-8011

Pedro José FEDERO ROSARIO
Centro Nacional de Capacitación
Arrocera
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Ming-Ping FENG
Misión Técnica Agrícola China
CHINA
Centro de Investigaciones
Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Brenda J. FORDE
Ministry of Agriculture
GUYANA
Tel. 020-2881-3, 020-2249

Eulalio GARCIA
Ministry of Natural Resources
BELIZE
Tel. 08-2241, 08-2332

Dennis Philip GARRITY
International Rice Research
Institute (IRRI)
P.O. Box 933
Manila
PHILIPPINES

Guillermina GERONIMO
DE ORTIZ
Centro de Investigaciones Arroceras
(CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Owen W. GILPIN
Ministry of Agriculture
Porto Bello, Montego Bay
JAMAICA
Tel. (809) 952-1686

Alfredo GUTIERREZ YANIS
Director
Instituto de Investigación
de Arroz
Apartado No. 1 Bauta
Havana
CUBA
Telf. 0852619

Wen Li HUNG
Misión Técnica Agrícola China
CHINA
Centro de Investigaciones
Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-3078

* Now, CIAT (Centro Internacional de Agricultura Tropical)
Apartado Aéreo 6713, Cali, Colombia
Tel 57. 3-675050
Télex: 5769 CIAT CO.
Cables: CINATROP, Cali.

James V. HYDE
Ministry of Natural Resources
BELIZE
Tel. 08-2330

Charles Percy KENNARD
Caroni (1975) Ltd.
TRINIDAD AND TOBAGO
Tel. 636-2311, 636-2371
Cable: TRINCARONI

Julio César LOPEZ GARCIA
Departamento de Fomento Arrocero
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-3325

Emilio MARTINEZ
Oficina de Desarrollo Agrícola y Rural
Agencia para el Desarrollo
Internacional (AID)
Apartado 867
Santo Domingo
DOMINICAN REPUBLIC
Tel. (809) 682-2171

José F. MARTINEZ GRILLO
Ministerio de Agricultura
Dirección Nacional de Arroz
Havana
CUBA
Tel. 7-7177

Carl A. McDOWELL
Ministry of Agriculture
JAMAICA
Tel. 092-79831

Gustavo A. NORES
Centro Internacional de
Agricultura Tropical (CIAT)
Cali, COLOMBIA
Tel. 57: 3-675050
Telex: 5769 CIAT CO
Cable: CINATROP, Cali

Gustavo E. PEÑA CALDERON
Centro de Investigaciones
Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Winston J. PHILLIPS
Caricom Secretariat
GUYANA
Tel. 02-69281-9
Telex: CARISEC 2263
Cable: CARIBSEC

Norberto A. QUEZADA
Director
Instituto Superior de Agricultura
Apartado 166
Santiago
DOMINICAN REPUBLIC
Tel. (809) 582-6621

Petronila QUEZADA
DE AVILES
Centro de Investigaciones
Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Manuel J. ROSERO MORAN*
IRRI/CIAT
Cali
COLOMBIA
Tel. 57: 3-675050
Telex: 05769 CIAT CO
Cable: CINATROP, Cali

* Now: Coordinator Rice Research Network, Centro de Investigaciones Arroceras (CEDIA), Apartado 711, Juma, Bonao, DOMINICAN REPUBLIC.

Luis Manuel SANCHEZ UREÑA
Departamento de Fomento Arrocero
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Lomas K. TULSIERAM
Ministry of Agriculture
GUYANA
Tel. 02-58607, 02-71345

Carle WALTER
UNECLAC
TRINIDAD AND TOBAGO
Tel. 62-35428

C. H. WANG
IRI Research Institute, Inc.
GUYANA
Tel. 02-58618

En-Sheng YEN
Misión Técnica Agricola China
CHINA
Centro de Investigaciones Arroceras (CEDIA)
Juma, Bonao
DOMINICAN REPUBLIC
Tel. (809) 525-2336

Leif J. YOUNGDAHL
International Fertilizer Development Center (IFDC)
U.S.A.
Tel. (205) 381-6600
Telex: TWX 810-731-3970 IFDC

Rice Researchers in the Caribbean Region

Country, research area, and number of rice researchers in the Caribbean countries.

Country	Research area					Total
	Breeding	Agronomy	Soils	Plant protection	Others	
Belize[a]	1	1	1	1		4
Cuba	12	7	15	12	5	51
Dominican Republic[b]	5	2	3	4	10	24
Guyana[c]	2	3	1	2	2	10
Haiti	1	1	1		2	5
Jamaica	1	1			2	4
Trinidad and Tobago[d]	1	1			3	5
Suriname	1	1	1		1	4

a. Includes Toledo Rural Development Project (TRDP) and Caricom Farms. Only one from Ministry of Natural Resources
b. Includes the five members of a permanent Chinese mission.
c. Includes two foreign consultants.
d. Those included in "Others" are part-time researchers of Caroni (1975) Limited.

Academic degrees of rice researchers in the Caribbean countries.

Country[a]	Ph.D.[b]	M.Sc.	B.Sc.	Total
Cuba	9	0	42	51
Dominican Republic	5	2	17	24
Guyana	2	5	3	10
Haiti	0	1	4	5
Jamaica	0	0	4	4

a. Information on the academic degrees of researchers from Belize, Trinidad and Tobago, and Suriname was not available.
b. With the exception of one Ph.D. from Cuba, the other Ph.Ds. work either part time or as consultants.

List of Acronyms of Entities and Projects Involved in Rice Research and the Rice Industry of the Caribbean Region

Regional Institutions

Acronym	Institution	Country
ADC	Agricultural Development Corporation	Jamaica
BFR	Big Falls Ranch	Belize
BRUMDEC	Black River Upper Morass Development Corporation	Jamaica
CARIRI	Caribbean Industrial Research Institute	Trinidad and Tobago
CCST	Caribbean Council for Science and Technology	
CDCC	Caribbean Development and Cooperation Committee	Trinidad and Tobago
CEDIA	Centro de Investigaciones Arroceras	Dominican Republic
CENACA	Centro Nacional de Capacitación Arrocera	Dominican Republic
CES	Central Experiment Station, Centeno	Trinidad and Tobago
CMA	Agricultural Machinery Centre (transl. from French)	Haiti
CMA	Central Marketing Agency	Trinidad and Tobago
CRDA	Centre de Recherche et Documentation de l'Agriculture	Haiti
DARNDR	Département de l'Agriculture de Ressources Naturelles et de Développement Rural	Haiti
DFA	Departamento de Fomento Arrocero	Dominican Republic
ECIA	Estación Central de Investigación Arrocera	Cuba

FAMV	La Faculté de l'Agronomie et de Médecine Vetérinaire, Université d'Etat d'Haiti	Haiti
GRB	Guyana Rice Board	Guyana
GUYSTAC	Guyana State Corporation	Guyana
IAD	Instituto Agrario Dominicano	Dominican Republic
INESPRE	Instituto de Estabilización de Precios	Dominican Republic
ISA	Instituto Superior de Agricultura	Dominican Republic
MMA/ADA	Mahacia-Mahaicony-Abary Agricultural Development Authority	Guyana
MTA	Misión Técnica Agrícola China	Dominican Republic
ODVA	Organisme de Développement de la Vallée d' Artibonite	Haiti
POR	Applied Rice Research (transl. from Dutch)	Suriname
PROSEDOCA	Productora de Semillas Dominicanas C. por A.	Dominican Republic
SML	Foundation for the Development of Mechanized Agriculture (transl. from Dutch)	Suriname
SUREXCO	Suriname Rice Exports Company	Suriname
TRDP	Toledo Rural Development Project	Belize

Extraregional Institutions

AID	Agency for International Development	U.S.A.
CIAT	Centro Internacional de Agricultura Tropical	Colombia
FAO	Food and Agriculture Organization of the United Nations	Italy
IFDC	International Fertilizer Development Center	U.S.A.
IICA	Instituto Interamericano de Cooperación para la Agricultura	Costa Rica
IRI	International Research Institute	U.S.A.
IRRI	International Rice Research Institute	Philippines
IRTP	International Rice Testing Program	Philippines
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean	Chile