No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF AGRICULTURE OF THE REPUBLIC OF CUBA (MINAG)

THE STUDY
ON
SUSTAINABLE TECHNICAL DEVELOPMENT
FOR
RICE CULTIVATION IN THE CENTRAL AREA
IN
THE REPUBLIC OF CUBA

FINAL REPORT

MAIN REPORT

MARCH 2006

PACIFIC CONSULTANTS INTERNATIONAL
CUBAN COUNTERPART

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PREFACE

In response to a request from the Government of the Republic of Cuba, the Government of Japan decided to conduct a study on Sustainable Technical Development for Rice Cultivation in the Central Area in the Republic of Cuba and entrusted to the study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched a study team headed by Mr. Yutaka NOZAKI of Pacific Consultants International between October, 2003 and February, 2006.

The team held discussions with the officials concerned of the Government of the Republic of Cuba, and conducted field surveys at the study area. Upon returning to Japan, the team conducted further studies and prepared this final report.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relationship between our two countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Cuba for their close cooperation extended to the study.

March 2006

Ariyuki MATSUMOTO,
Deputy Vice President,
Japan International Cooperation Agency

Tokyo, March 2006

Mr. Ariyuki MATSUMOTO
Vice President
Japan International Cooperation Agency

Dear Mr. MATSUMOTO

Transmittal Letter

We are glad to submit the Final Report of "THE STUDY ON SUSTAINABLE TECHNICAL DEVELOPMENT FOR RICE CULTIVATION IN THE CENTRAL AREA IN THE REPUBLIC OF CUBA".

The report proposes the development plan for the sustainable techniques of rice cultivation in the study area, which has been prepared in consideration of the advices and recommendation of relevant ministries of the Government of Japan and JICA on formulation of the development plan, as well as the discussions with the Cuban counterpart on the Draft Final Report and their comments on the report.

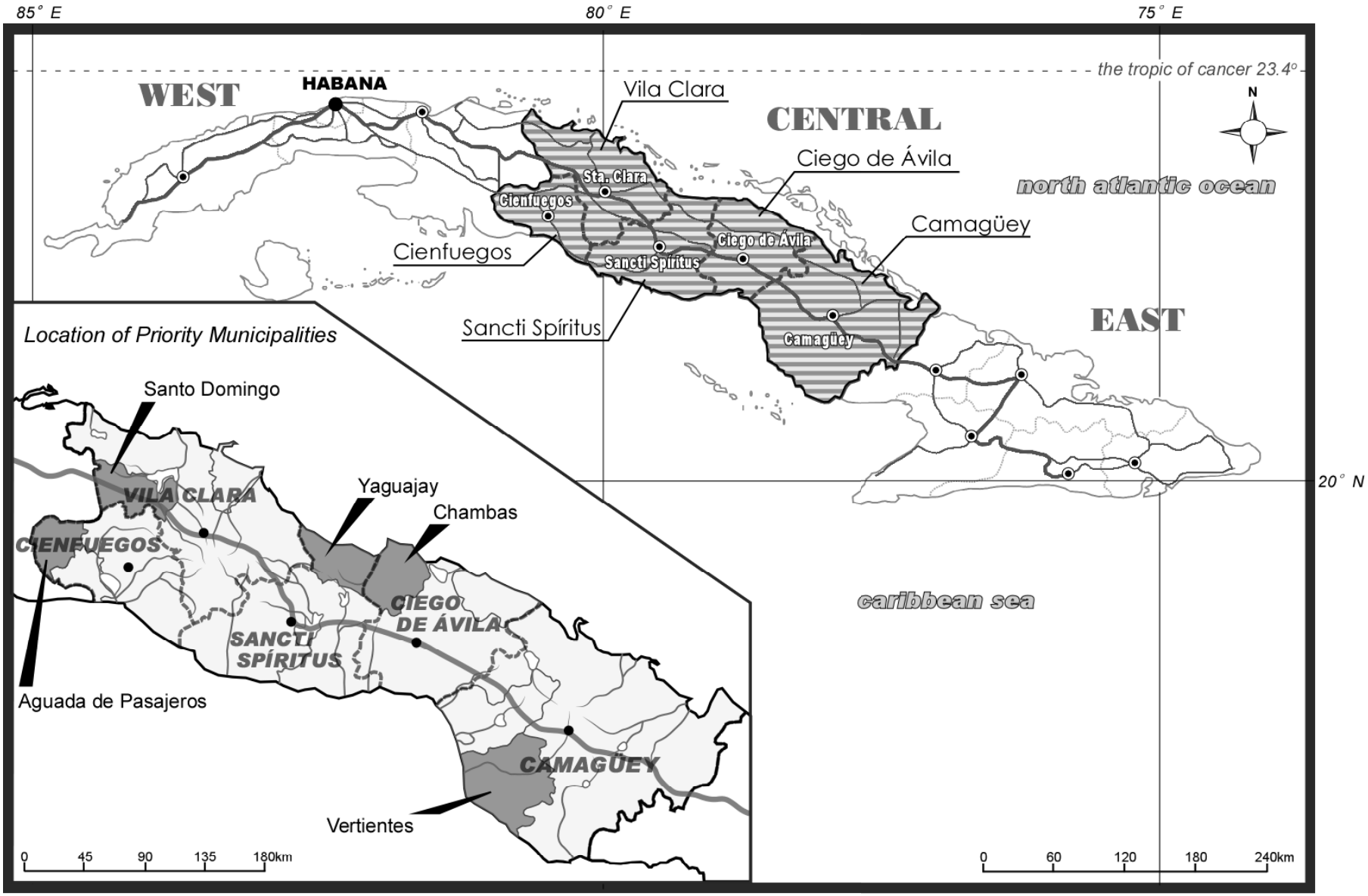
Cuba is a food importing country and its production of main grains covers only 23% of its requirements. Rice, one of the staple foods in Cuba, occupies second place among the imported cereals after wheat. Therefore, the Cuban Government considered the increase of rice production as a critical matter, and from 1996 started to promote the Program of Production of Popular Rice. The five central provinces of the country are currently producing around 45% of Popular Rice and they have the potential of increasing production through the improvement of productivity as well as through the expansion of the cultivation area. It is necessary to recognize that available capital and agricultural inputs of the small and medium scale Popular Rice producers is limited, and to improve the techniques for sustainable rice production, so that the potential would be fully utilized.

Through the implementation of the Development Plan proposed in this report, the increase of production would be achieved by the small and medium scale producers of the five provinces in the central area of Cuba by utilizing sustainable techniques. Furthermore, through the execution of the Action Plan in each municipality, that would contribute to the establishment of a sustainable technical model, which is transferable to other municipalities in the central provinces. Consequently, increase production of Popular Rice in Cuba would be expected as a knock-on effect. Taking this into account, I wish the immediate implementation of the Development Plan.

Taking this opportunity, we express our sincere gratitude to the officials of your agency, the Ministry of Foreign Affairs and the Ministry of Agriculture, Forestry and Fishery of the Government of Japan for their valuable advices and recommendations for our study. We are also grateful to the officials of the Cuban Government, the Ministry of Foreign Investment and Economic Cooperation, the Ministry of Agriculture, the five provincial governments and other public organizations involved in the Study for their devoted cooperation and support during the implementation of the Study in Cuba.

Sincerely yours,

Yutaka NOZAKI,
Team Leader,
The Study on Sustainable Technical Development
for Rice Cultivation in the Central Area
in the Republic Cuba



LOCATION MAP

Photographs of Study Area（1/4）

Rice Research Institute (IIArroz): Bird View

Rice Research Insititute is located in Bauta of Havana Province. It has 46 ha of experimental field for rice cultivation.

Popular Rice Production: Land Preparation by Manpower

Land preparation and preparation of ridge and levee by manpowere in the popular rice plot.
(Chambas Municipality)

Rice Research Institute: Research Building

Rice Research Institute consists of 5 departments under the Investigation Division. It has 3 Regional Research Stations of Paddy Rice (ETIA) as well as 2 Farms for Seed Production in Havana Province.

Popular Rice Production: Land Preparation by Animal Power

Ploughing, puddling and land leveling by animal pwer is popular in the popular rice production.
(Santo Domingo Municipality)

Rice Research Institute: Production of Basic Seed

Original Seed and Basic Seed of rice are produced in the experimental field of Rice Research Institute.

Popular Rice Production: Transplanting

Transplanting work in the plot of Parcerelos. Random planting is popular in Cuba at present.
(Chambas Municipality)

Photographs of Study Area（2/4）

Popular Rice Production: Irrigation

Pump operation using PTO of tractor. Most of irrigastion pump for popular rice use diesel.
(Santo Domingo Municipality)

Popular Rice Production: Transportation by Animal Power

Transportation by animal power is popular in Cuba. Lack of transportation measns is one of the most urgent problems in the farming activity of popular rice producers.

Popular Rice Production: Harvesting by Large-scale Combine Harvester

Rice harvesting by a large-scale combine harvester possessed by CCS. Most of machines have been deteriorated. (Chambas Municipality)

Variations of Rice Cooking in Cuba

Rice is a staple food of Cuban people. They have a large variety of rice cooking. (Rice Museum of Aguada de Pasajeros)

Popular Rice Production: Sun Drying of Paddy

Due to lack of drying machine, most of popular rice producers apply sun drying of wet paddy on roof and road. The quality of paddy is easily affected by weather condition.

Free Market for Agricultural Products

Various agriculturual products including Popular Rice are sold in the free market. Popular Rice sold in the free market has an important role of supplement supply in addition to the ration rice.　(Havana City)

Photographs of Study Area（3/4）

Verification Study: Transplanting

Regular planting using ruler string was introduced in the verification plot. (El Río Site)

Study Tour: Inspection of Regual Planting

Study Tour received participats from 5 provinces of the central area. Introduction of proposed techniques and discussion among the participants were held. (El Río Site)

Verification Study: Row Seeding

Row seeding using a drum seeder, which was assembled in Cuba based on IRRI design, was introduced in the verification plot. This equipment is easy to use even in the plot of heavy soil. (Mayajigua Site)

Study Tour: Weed Control Technology

Manual rotary weeder combined with row seeding and planting was demonstrated in the Study Tour as a weed control technology. The weeder was one of the most interested techniques for participants. (Mayajigua Site)

Verification Study: Evaluation of Harvest Loss

Harvest loss of large-scale combine harvester was evaluated in the field and the loss was compare among various harvesting method. (Mabuya Site)

Study Tour: Production of Earthwarm Manue

Inspection tour to the livestock enterprise in Venegas, Yaguajay, which produces earthwarm manure, was held in the Study Tour. Earthwarm manure was produced by popular rice producer in the Verification Study.

Photographs of Study Area（4/4）

Strengthening of IIArroz: Improvement of Infrastructure of Seed Area

Approximately 10 ha of seed area for Popural Rice were improved infrastructure such as irrigation and drainage system, so as to strengthen seed production of IIArroz.

Technical Seminar

A serious of Technical Seminar on the Study was held in Havana and in the central area. Proposed cultivation technique and Action Plan were explained in the Seminar. (Santa Clara, February 2006)

Strengthening of IIArroz: Providing Laboratory Instrument

Some testing instruments such as basic instrument for measurement, testing rice husker, testing rice mill, etc., were provided to the laboratory of IIArroz.

Technical Seminar

Extension officers and representatives of popular rice producres from 5 provinces of the central area were participated to the Technical Seminar. (Santa Clara, February 2006)

Strengthening of IIArroz: Providing Agro-machinery

Threshing test with self-propelled threasher at the field of IIArroz. Agro-machinery such as tractor, binder, rice transplanter, etc. were provided and tested in the Verification Study.

Steering Committee

Steering Comiittees at the cental level and provincaial level were organized thtough the Study, and animated discussions on the Study were held.

SUMMARY

1. INTRODUCTION

1.1 Background and Objectives of the Study

Cuba is a food-importing country; the production of main food grains covers only 23% of its requirements. The import of rice, one of the principal foods of the population, is quite large following that of wheat. In the early '90s, due to lack of imported agricultural inputs caused by the disintegration of the USSR and the socialist block, rice production suffered since it was based on application of big amounts of chemical fertilizers and pesticides, which was conducted by the specialized enterprises (CAI). Since rice production for the last 10 years has been unstable, the increasing and stabilizing of rice production is a priority issue.

Under these conditions, the Government of the Republic of Cuba requested the government of Japan to perform a development study on "Sustainable Development Program of Rice" for small-scale rice farming farmers covering the central area (5 provinces), which is a big granary in Cuba with around 40% of the rice production area of the country. In response, the Japan International Cooperation Agency (JICA) conducted "THE STUDY ON SUSTAINABLE TECHNICAL DEVELOPMENT FOR RICE CULTIVATION IN THE CENTRAL AREA IN THE REPUBLIC OF CUBA. Its objectives are: to formulate a Development plan for improvement of sustainable rice production (popular rice) in central 5 provinces, and to carry out technology transfer to the Cuban counterpart through on-the-job training in the course of the Study

1.2 The Study Area

The study area covers the 5 provinces of the central area of Cuba; the 5 priority municipalities for studying action planning were selected by the Cuban side as shown below.

5 Provinces of the central area of Cuba and the Selected 5 municipalities

Province	Cienfuegos	Villa Clara	Sancti Spíritus	Ciego de Ávila	Camagüey
Municipality	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Vertientes

2. GENERAL ASPECTS

2.1 General Aspects of Cuba and the Study Area

The Cuban archipelago consists of Cuba Island, Island of Youth and more than 4,000 small islands. They are located at the entrance of the Mexico Gulf within longitude of 74º 7' to 84º 57' and latitude of 19º 49' to 23º 16'. The area of the island of Cuba is approximately 110,861 km^2. The island is divided into 14 provinces and 169 municipalities, including the special municipality of the Island of Youth. The Cuban population was approximately 11,230,000 inhabitants in 2001 with population density around 100 inhabitants/km².

The Study Area covers the following five provinces:

The province of Cienfuegos has an area of approximately 4,178 km² and a population of about 397,630. This province has a mean temperature between 24ºC and 26ºC in the plain zones and between 17ºC and 24ºC in the mountain side. Average annual rainfall in the plain zones is about 1,200

to 1,500 mm and about 1,500 to 2,000 mm in the mountainside. Cienfuegos is divided into 8 municipalities, of which Aguada de Pasajeros, Abreus and Palmira have the highest potential for rice cultivation.

The province of Villa Clara has an area of approximately 8,662 km² and a population of about 836,300. This province has a mean temperature between 24ºC to 26ºC and the average annual rainfall is about 1,200 to 1,700 mm. Villa Clara is divided in 13 municipalities, of which Santo Domingo, Sagua La Grande and Encrucijada have the highest potential for rice cultivation. However, there are also other municipalities having high sowing levels.

The province of Sancti Spíritus has an area of approximately 6,744 km^2 and a population of about 462,789. The mean temperature is about 24ºC to 27ºC in the plain zones, while in the mountainside is about 17ºC to 24ºC. Average annual rainfall in plain zones is about 1,538 mm. Sancti Spíritus is divided into 8 municipalities, of which La Sierpe and Yaguajay have the highest potential for rice cultivation.

The province of Ciego de Ávila has an area of approximately 6,910 km² and a population of about 412,074. The mean temperature is between 24ºC to 27ºC and the average annual rainfall is about 1,200 to 1,400 mm. Ciego de Ávila is divided into 10 municipalities, of which Chambas, Baraguá and Bolivia have the highest potential for rice cultivation.

The province of Camagüey has the largest territorial area in the country, with approximately 15,990km² and a population of about 790,800. Its mean temperature is about 24ºC to 27ºC and the average annual rainfall is 1,100 to 1,500 mm. Camagüey is divided into 13 municipalities, of which Vertientes and Florida have the highest potential for rice cultivation.

2.2 National Economy in Perspective

Although Cuba, which has a population of more than 11 million inhabitants, has been identified as a famous sugarcane producing country, in the last few years, the tourism industry has become the main source of income for the country. Currently, the main export item is nickel (Cuba is the fifth largest producer worldwide). Nickel production increased approximately 6.9% and in 2005 it is expected to reach 77,000 tons. In 2004, there was a remarkable increase in the export of lobster, fruit juices, rum and honey. Among the main import products are machinery and equipment, fuel, foodstuffs and chemical products. Imports increased approximately 14.3% compared to 2003.

2.3 Rice Economic Situation in Cuba

Rice is the major staple food of the people. Its consumption has been exceeding that of wheat for several years. According to information of FAO, the average intake of calories from rice has been 18% of the total, versus 15% from wheat. Approximately 500,000 tons of rice are consumed annually as a whole. Rice production in Cuba was 217,000 tons in 2001, and imports have been filling the gap between the production and the demand. For some years, 25% broken rice has been imported mainly from Vietnam/China. In the government's self sufficiency policy, the immediate target for the rate of rice production is set at 63%.

2.4 Brief Explanation of Rice in Cuba

Rice cultivation was established in Cuba in about 1750, but it only gained economic importance in the late 20th century when some American varieties were introduced in the country, mostly from Texas.

Since 1967, several semi dwarf varieties were introduced from the International Rice Research Institute (IRRI) in the Philippines and from the International Center of Tropical Agriculture (CIAT) in Colombia.

(1) Production in Specialized Enterprises

Since 1967, the Program for Rice Development took place in order to improve rice crop in Cuba. Six big rice enterprises were established at first, and further three others were founded with the addition of those in Ciego de Ávila, Holguin and Las Tunas. These enterprises are called Agro-industrial Complex (Complejos Agroindustriales: CAI), and rice production is carried out with mechanized units, using planes and land-based machines for every activity in cultivation. Chemical fertilizers and pesticides are applied to control weeds, insects and diseases caused basically by fungus.

(2) Production of Popular Rice

Although rice was brought to Cuba and farmers have cultivated popular rice spontaneously, these activities were never widely developed. Cooperative associations and other institutions not belonging to CAIs also have been producing popular rice to distribute supplemental rice to their staff. In 1996, the Ministry of the Agriculture (MINAG) decided to encourage popular rice production by means of 1) Sustainable production and low use of equipment, 2) Productions based upon the use of varieties adapted to different ecosystems with maximize use of bio-fertilizers, bio-pesticides, organic matter and use of green manure in systems of crop rotation, 3) Design of the production on a small and medium scale with wide utilization of animal power in cultivation, and 4) Capacity building of producers. Also MINAG designed the Union of CAIs (today Agro industrial Group of Cattle and Rice –GAIPA) and IIArroz to take the necessary measures for leading and organizing popular rice production.

(3) Production of Rice in Recent Years

Due to lack of agricultural inputs, the production of Specialized Rice decreased from around 104,000 tons in 1998 to 66,000 tons in 2002. On the other hand, due to self-effort by producers and the Governmental support, Popular Rice production increased from around 112,000 tons in 1996 to 226,000 tons in 2002. Yield (white rice base) increased from 1.23 tons/ha in 1998 to 1.65 tons/ha in 2002 for Specialized Rice and from 1.25 tons/ha in 1996 to 1.67 tons/ha in 2002 for Popular Rice.

3. PRESENT CONDITIONS OF POPULAR RICE

3.1 Production and Consumption of Rice

(1) Categories of Rice in Cuba

(State Rice and Popular Rice)

There are two categories of rice: State Rice and Popular Rice. State Rice is controlled by the government, and is mainly used for social and ration uses, and some quantities can be sold in the state market in order to supplement the amount of rice in the market and to stabilize the selling price in the free market. Popular Rice is produced by individual producers and organizations for mainly supplemental self-consumption. It has been produced from olden times spontaneously, until 1996 when the government started a program to develop Popular Rice production. In 2003, around

65% of total production of Popular Rice was used for self-consumption, and 35% was sold to outside in the market place.

(Import Rice and Self-production Rice)

There are two sources of rice: imported rice and self-production rice. It is estimated that Cuba imports around 65% of total consumption of rice from Vietnam and other countries.

(Form of Production Contract)

There are three contract forms for rice production: Specialized Contract, Non-Specialized Contract and Non-contract. Specialized Contract is a form of production contract made by the government through Rice CAI with the production units for the State Rice. Rice CAI supply to these producers agricultural inputs for rice production and producers sell all rice production to CAI. Non-Specialized Contract is a form of production contract that individual rice producers or non-rice production units make with Rice CAI or state institutes which supply land and agricultural inputs for Popular Rice. The producers get agricultural input of rice production from Rice CAI and they sell some amount of the production based on contract to Rice CAI or state institutes.

Non-contract is a form of Popular Rice production of individual rice producers or non-rice production units without any contract and they prepare the agricultural inputs by themselves.

(Form of Consumption)

There are several forms of consumption: Stored Rice, Social Use which is one of social systems of Cuba that the Government supplies the food in schools, hospitals, Governmental institute and the army, Ration Rice which is also one of social systems that the Government distribute to people as a minimum security of food, Seed, Self-Consumption, Sale to state organization such as Rice CAI, Acopio, other organizations (UBA MINCIN, Granjas Urbanas, Empresas Estatales), and Sale in the market.

(2) Production Units and Organizations Concerning Rice Production

(Governmental Institutions and Supporting Organization)

GAIPA (Agro-industrial Group of Cattle and Rice): Previously, the All Union of Rice Production, (now, GAIPA), had the responsibility of the technical support of the rice production. In the last few years, the responsibility for providing technical guidance has shifted to IIArroz, while GAIPA has the responsibility to check the rice production policy.

CAI (Agro-industrial Complex): There are two kinds of CAI (i.e., Rice CAI and Non-rice organization). Rice CAI have been producing specialized rice, and from 1996, started to coordinate and establish some contracts (non specialized) with popular rice producers in some provinces. Rice CAI promotes the rice production in Cuba, distributing high-quality seed, procuring agricultural inputs and fuel for rice production, post harvesting (drying, milling and marketing) and technical support to producers jointly with IIArroz. Rice CAI makes specialized contracts with rice production units such as Rice UBPC, Rice CPA, CCS and State Farms. Rice CAI also makes non-specialized contract with popular rice producers such as Non-rice UBPC, Non-rice CPA, CCS,

others institutions and individual producers.

Popular Rice Unit (Unidad de Arroz Popular): Popular Rice Units were established at the provincial level by MINAG in 2001. The main activities of Popular Rice Unit are coordination for institutes and organizations concerned with popular rice and support to popular rice production units. It also has a role as the core of promotion activities at the provincial level. Popular Rice Unit is also buying popular rice and selling it in the state market.

ACOPIO (Empresa de Acopio) is a group of enterprises belonging to MINAG, which is in charge of buying the agricultural productions from producers and selling to state market. MINCIN is the ministry in charge of the distribution of rice for ration use and for social use. ANAP (Asociacion Nacional de Agricultores Pequeños) was established for promoting the organization of CPA and CCS consisting of small and medium scaled producers who are landowners.

(Rice Production Unit)

UBPC (Basic Unit of Production Cooperative): UBPC was established as an association formed by employees of the former state enterprise. The land belongs to the state and it is surrendered for use without payment of rent. The means of production belong to UBPC. Rice UBPC: They produce Specialized Rice based on special contract with CAI and they sell the production to CAI. They succeed by using rice production technologies on a large-scale: namely, airplanes, big agricultural machines and irrigation scheme with large agricultural inputs.

CPA (Cooperatives of Agricultural Production): CPA is the voluntary association of small farmers who unite their efforts for collective agricultural production on the basis of unification of their lands and other production means. The Cooperative of Agricultural Production is an economic and social organization. Job assignment of members is generally determined by variety of crops, indicating that members assigned to rice crop continue to be in charge of rice production every year.

CCS (Cooperatives of Credit and Service): CCS is also one of the cooperatives formed by private agricultural producers, but it consists of small- and medium-scale producers (mainly more or less than 10 ha) who have their own land and manage their farmland individually. The difference from CPA is that agricultural management is carried out individually for their own land. Most of members of CCS sell their agricultural products through CCS and they also have non-specialized contract with CAI/Acopio.

GENT (State farms of New Type): GENT is a state company created in places where conditions do not exist to constitute UBPC. These state farms possess bigger autonomy than the traditional state farms.

State Company (for State self-consumption): Some companies and institutions of sectors not linked to agricultural production have used idle lands, with the objective of producing foods for self-consumption and to sell to workers.

Renter producers - Parceleros (6 cordeles): The government made the decision of giving lands (0.25 ha: 6 cordeles) to families for the production of food with the objective of family

self-consumption. These producers can sell the surpluses of their production freely.

Renter producers – Préstamos: Préstamos is one of the rental land systems for increasing popular rice production. Mainly the land from rice UBPC is lent to retired persons, self-employed, unemployed persons, etc. with a maximum 13.4 ha per person. Préstamos produce only popular rice. The land is free of charge, but Préstamos make production contract (non-specialized) with rice CAI and they sell some amount of popular rice to CAI based on the contract. Basically, the remaining amount of popular rice can be sold freely.

3.2 Rice Production Techniques of Popular Rice

(1) Rice Cultivation Techniques

Rice in Cuba is grown in upland field, rain-fed paddy field and irrigated paddy field. There are two rice growing seasons in Cuba: the rainy season (PRIMAVERA, summer season, May to October) and the dry season (FRIO, winter season November to April); it is possible to make rice double cropping with proper irrigation system. As the varieties of rice in Cuba are sensitive to temperature, the growing period in the rainy season when the temperature is high is shorter than that at dry season when the temperature is low. Compared with dry season, the yield in the rainy season is low because of less solar radiation, shorter growing period and much damage by the pests/disease than that of dry season.

Popular rice producer's willingness (production stability and high yielding) has improved when the popular rice production program was started and allowed the free sale of rice production more than self-consumption.

Popular rice production at present in Cuba is chiefly grown by transplanting cultivation and direct seeding. Also, traditional rice cultivation such as rainfed - drilling or hill sowing - direct seeding (dry seed) method has been done on frequently inundated land. The proportion of transplanting cultivation is 48% and direct seeding cultivation is 52%.

The national average yield of popular rice (paddy rice with 22% moisture content) is superior for the transplanting method (4,100 kg/ha) compared to the direct seeding (3,000 kg/ha). About 55% of the national popular rice production (530,000 tons) is produced by transplanting cultivation.

(Seed for Popular Rice)

After 1997, when the production of Popular Rice began, CAI Rice has sold small quantities of certified seeds to producers of Popular Rice through the Provincial Units of Popular Rice. In 2003, the extension officers of the Popular Rice began implementation of a new system to produce seed that consists of hiring with the producers, the production of certified seed in their properties to increase the amount that is to be given to producing reference seeds of the new or established varieties so that they can obtain seeds of quality under the supervision of seed certification specialists in the municipalities.

(2) Post-harvest Practices of Rice

(Large Scale and Small Scale)

In large-scale farming practice in Rice CAI, post-harvest practices such as harvesting, threshing, drying, husking and rice milling are mechanized. On the other hand, in small-scale rice farming by

individual farmers, practices are mainly dependent on manual/animal power, and partly on small machines.

(Mechanized and Manual/Animal Power)

Two-types of post-harvest practices can be observed: one is fully mechanized farming and another is farming practice mainly by manual/animal power and partly mechanized for some of post-harvest practices.

(Specialized Rice and Popular Rice)

For Specialized Rice, producing organizations are comparatively advanced in processing technology and mechanization, but for Popular Rice, a variety of processing activities is observed.

(Traditional Rice Growing Area and Newly Developed Area)

Transplanting, manual harvesting and threshing, sun-drying, commission milling are mainly practiced in traditional rice growing area. On the other hand, large-scale mechanization is progressing in newly developed production area, but productivity has declined due to recent shortage of materials and equipment.

(Dry Season and Rainy Season)

Basically cultivated variety is the same and there is no large difference in post-harvest practices for both crops. However, quality deterioration is observed due to difficulty of wet paddy drying.

(3) Agricultural Mechanization

At the present, the preparation of soil is carried out with machinery and also with animal traction. According to the producer's conditions, this work is carried out by three different methods: dry, dry–puddling and direct puddling. The tractors used for popular rice have low technical capacity, they are old with more than 15 years use, and the consumption of fuel, lubricant and spare parts are high. Lack of batteries, tires and engine spare parts, which are the tractor's main components, additionally increase fuel consumption. They lack implements for animal traction which are appropriate for popular rice production on small rice fields.

In the municipalities of Vertientes, Chambas and Yaguajay, they use modern combine harvesters rented to popular rice producer from the state sector, fundamentally through the rice production CAIs. There are other combines in the selected municipalities that were disposed from CAI because of their low productivity and inefficiency, and they were sold to the producers of different organizations of popular rice production and specific farmers that repaired them with their own resources and state help.

(4) Irrigation and Water Use

(Irrigation of CCS members)

In CCS, most farmers possess and use their own irrigation system or equipment. Even though collective irrigation systems are observed in some CCSs, such systems are a minor case in general. In the individual irrigation system, farmers take water from small rivers, spring water, small ponds and groundwater and sometimes farmers use small pumps for irrigation. In the case of pump irrigation, farmers own their pump in general, but shared or collective use of pumps or motors for

pumps (tractors) by several farmers is observed in some CCSs.

(Irrigation of Préstamos in CAI/UBPC)

Contrary to individual farmers in CCS who generally use their own irrigation system, Préstamos, who rent land from CAI/UBPC, can receive irrigation water from the irrigation system operated by CAI/UBPC. However, the condition of irrigation system of CAI/UBPC is generally poor due to lack of maintenance and Préstamos sometimes meet difficulty to obtain water even though the system has the capacity. Because Préstamos are not landowners and their right to occupation is not secured for multiple years, the intention of Préstamos to invest in land and facilities is difficult.

(Electrification of Irrigation)

Use of small pumps for irrigation is popular among the individual farmers including CCS members. They mainly use diesel pumps at present, even though a few cases of electric pumps were observed. In the popular rice cultivation using diesel pump irrigation, to obtain diesel fuel is one of the most serious constraints of expansion of irrigation. The cost of electricity is much lower than diesel fuel when used for irrigation. Most of farmers using diesel pumps have the desire to replace their pumps to electric ones. The electrification of irrigation pumps is considered widely as an important subject, as it is included in the action plan to promote popular rice production in the basic policy of MINAG. However, the electrification of irrigation pumps in popular rice production has not progressed much.

3.3 Popular Rice Production in the Priority Municipalities

(1) Present Situation of Popular Rice Production

In the five municipalities in the Study Area, popular rice is mostly produced in various production units such as UBPC, CPA, Parceleros, Préstamos, Empresa, GENT, and CCS. There is no Rice Production Unit in the Study Area which is producing Popular Rice for sale to market, except Préstamos in all surveyed municipalities and CPA in Vertientes.

(Aguada de Pasajeros Municipality)

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, animal husbandry (which is mainly dairy cattle), and various crops including vegetables. Annual total area of rice cultivation in 2003 was about 3,000 ha, which was ranked at 4th in the five municipalities, and rice production was about 11,700 tons in wet paddy. Average yield in wet paddy was 4 ~ 4.5 tons/ha in dry season, and 3.4 ~ 4 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was about 50%, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

PARCELEROSs and PRESTAMOSs in Aguada have no reliable water resources for irrigation, and therefore, they cannot cultivate rice in dry season and cannot introduce the double rice cropping. Rice yields in Aguada show comparatively high level with a few differences among units in rice yield. Some reasons for such high level yield of rice are introduction of rice planting method and returns of whole straw to paddy fields.

(Santo Domingo Municipality)

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, various crops including vegetables, rice, and animal husbandry (which is mainly dairy cattle). Annual total area of rice cultivation in 2003 was about 3,400 ha, which was ranked at 3rd in the five municipalities, and rice production was about 13,600 tons in wet paddy, which was ranked at 2nd in the five municipalities. Average yield was 3.3 ~ 4.6 tons/ha in dry and rainy season. Ratio of area of double rice cropping for total paddy area was about 70%, which is very high as compared with that in other surveyed municipalities, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

All rice production units in Santo Domingo have reliable water resources, and already carry out double rice cropping and rice transplanting methods in all paddy fields. With regard to rice yield, the yields in UBPCs, PRESTAMOS and EMPRESAs are lower than that in other units. The rice yields in CPAs, PARCELEROS and CCSs show comparatively high level, with a few differences among units and between cropping seasons. Some reasons for such high level yield of rice are introduction of rice planting method, returns of whole straw and fertilization with cachasa to paddy fields.

(Yaguajay Municipality)

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, animal husbandry, various crops included vegetables, and rice. Annual total area of rice cultivation in 2003 was about 3,438.2 ha, and rice production was about 12,173 tons in wet paddy, which was ranked at 4th in the five municipalities. Average yield was 4.4 tons/ha in dry season and 3.4 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 17% in CCS, which is low as compared with that in other surveyed municipalities, and the range of 60% of total paddy fields in dry season was cultivated frijol and maize with companion planting and vegetables as second planting, and the rest field was fallows.

All rice production units in Yaguajay carry out irrigation by use of river water, and have problem of shortage of irrigation water in dry season. Therefore, percentages of introduction of double rice cropping for total paddy fields in whole units are ranged from only 7% to 17%. UBPCs and EMPRESAs have not introduced the rice transplanting method yet, but other units have introduced in range of 26% to 50%. The yields of every unit show comparatively high level, and a few differences among units. Some reasons of such high level yield of rice are introduction of rice planting method, fertilization of less than 30% with necessary quantity of urea, which is supplied by appropriation of urea for sugar cane, and returns of whole straw to paddy fields.

(Chambas Municipality)

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, tobacco, animal husbandry and various crops including vegetables. Annual total area of rice cultivation in 2003 was about 2,400 ha, which was ranked at 5th in the five municipalities, and rice production was about 10,000 tons in wet paddy, which was ranked at 5th in the five municipalities. Average yield was 4.4 tons/ha in dry season and 3.6 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 45%, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

CCSs in Chambas irrigate rice from spring or river. Other units use water of dam as source of irrigation water. Irrigation water from river in dry season is often short due to shortage of fuel for pumping up from river, but the problem will be resolved by electrification of pumps. In Chambas, CCSs and PARCELEROS are introducing double rice cropping (15 - 17%) and rice transplanting method (45 – 50%), but other units have not introduced them yet. The yields of these two units show comparatively high level due to introduction of rice transplanting method, 4.8 tons/ha in dry season. The rice yields of all units in the rainy season ranged from 3.2 to 4 tons/ha, and showed a few differences among units. Some reasons of such high level yield of rice are introduction of rice planting method in CCSs and PARCELEROS, and active fertilization with organic matter, such as straw, mixture of straw and half-dry excrement, cachasa, dried excrement, etc.

(Vertientes Municipality)

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, animal husbandry, various crops including vegetables. Annual total area of rice cultivation in 2003 was about 6,300 ha, which was ranked at 1st in the five municipalities, and rice production was about 21,000 tons in wet paddy, which was ranked at first in the five municipalities. Average yield was 3.4 tons/ha in dry season and 3.1 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 9% in Préstamos, which is very low as compared with that in other surveyed municipalities, and almost all paddy field is fallowed after rice cultivation in dry season or in rainy season, except fields of double rice cropping.

PARCELEROSs in Vertientes have no reliable water resources for irrigation, and therefore, irrigation water is in shortage and unstable. In general, the large-scale farming size in Vertientes restricts the introduction of double rice cropping and rice planting method due to shortage of labor. Rice yield is lower than that of other municipalities. Especially, the yields of UBPCs and CPAs are low, 1.0 to 1.7 tons/ha. The yields of other units range from 2 to 3 tons/ha. Some reasons of such low level yield of rice are difficulty to introduce new rice planting method, and no returns of rice straw and no fertilization with other organic matter to paddy fields.

(2) Problems of Popular Rice Production in the 5 Municipalities

Common problems in the surveyed five municipalities are as follows:

1) Shortage of farm materials, such as chemical fertilizer, chemicals, certified seeds, etc.
2) Shortage of fuel for pumping up of well and river water, and difficulty of electrification.
3) Broken-down machinery, shortage of machinery and lack of machinery for post harvest.
4) Lack of irrigation-drainage system and large loss of irrigation water in old canals.
5) Low utilization of the rotation crop with rice.
6) Low utilization of the residual crop for soil improvement.
7) Deficient drying process.
8) Deficient milling process.
9) Insufficient training of producers

3.4 Rice Marketing

(1) Government organizations for rice distribution

The two government organizations closely in charge of rice distribution are: MINAG is the responsible ministry for production of domestic rice, and MINCEX is responsible for importing rice from other countries. MINCIN is administratively in charge of the rice distribution all over the country for both domestic and imported rice. INRE is the competent agency for food reserve.

(2) Marketing channel

Rice marketing in Cuba is basically controlled by the government and divided into that for state rice and Popular Rice. The state rice is sourced from imported rice and Specialized Rice produced based on the specialized contract. It is used for ration rice and social use. It is reported to be sold partly through the state market in order to stabilize the rice market price for consumers. On the other hand, individual farmers and rice producing units produce Popular Rice and it is more than half used for self-consumption, but some of it is sold to the government institutions or in the markets using any means.

(3) Market for agricultural products

There are three types of agricultural markets: Free Market run by MINCIN, State Market (exactly, Parallel Market or Placitas de Acopio) founded under MINAG, and Integrated vegetable farm in which state divisions and cooperatives sell vegetable at the place of production. In state markets, the government sets ceiling price (top price) and Popular Rice is sold though CAI and Acopio. In the free market, Popular Rice is sold freely but the price is affected by the state market price and basically the marketing price is stabilized. Even so, the price in the free market is around 10-20% higher.

3.5 Extension System for Rice Production

(1) Extension System

Province and municipality have one officer each on rice production in their MINAG delegation. An officer at the level of province occupies the position to control and manage rice production in a whole province, while extension officers at municipal level are in charge of technical assistance to producers at field level along with management of rice production in their own municipalities. Extension activities adopt several modes in order to offer technical support (such as lecture on occasion of producer meetings, showing video and others).

The fact that there is only one extension officer in each municipal indicates the physical limitation for them to cover the whole municipal area. Therefore, most extension activities of extension officer direct to producers are limited to a part of producers who have enthusiasm.

(2) Current Conditions of Extension Activities by IIArroz

From the beginning of the Program of Rice Development in 1967, the Institute of Investigations of the Rice has been in charge of designing and applying the System of Agricultural Extension in the cultivation of rice. This system was directed to specialized rice production. One of main difficulties of the extension system was that the training generally stayed on the level of the directors and technicians of Rice CAI and it went to the producers very infrequently.

In 1996, the Ministry of Agriculture designated IIArroz to implement the training and extension systems for the Popular Rice producers. This task motivated a change of mentality in researchers because it was not possible to use the established system since the specialized rice and Popular Rice cultivation takes place in very different ecosystems from that of specialized rice; furthermore, the extension activities were directed to every form of production. As part of the actions, an extension system was settled on for the cultivation of rice, which includes both specialized rice and popular rice. In this system, the Experimental Stations and the Universities have a main role, as well as the extension officer of every municipality.

3.7 Organization of Rice Research Institute (IIArroz)

IIArroz belongs to MINAG and was established in 1968. It has three experimental stations located in the provinces of Sancti Spíritus, Camagüey and Granma. Also, there is a rice mill and two Farms for Seed Production in the Havana province, which belong to the institute. These farms are engaged in seed production (registered and certified I)

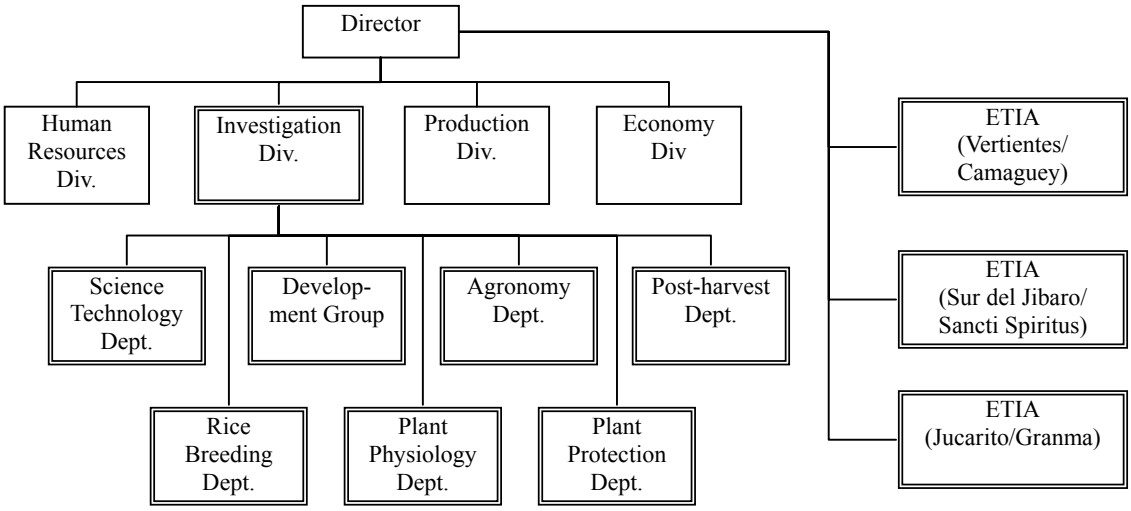


Fig. 3.7.1 Organization of IIArroz

4. DEVELOPMENT POTENTIALS AND CONSTRAINTS

4.1 Development Potentials for Increasing of Popular Rice Production

When the development target is set as increasing of popular rice production, the following potentials can be considered:

- Popular rice has been produced naturally from olden times for self consumption and producers have experience of popular rice production.
- The government started the program for increasing popular rice production from 1996 and several measures have been tried to increase popular rice production.
- Research and supporting systems on rice production technique have been developed for national rice and these systems can be applied for popular rice.
- Rental land system for increasing popular rice was started from 2002.
- There are unused lands (including pasture lands) suitable for popular rice production.

- The technical level of popular rice producers is high.

4.2 Justification of Sustainable Technical Development for Popular Rice Production

The issues shown below are recognized as the major constraints to be solved for increasing popular rice production and its productivity:

1) Inadequate rice cultivation technique (materials and inputs, extension, mechanization, irrigation and drainage).
2) Insufficient expansion of rice cultivation area.
3) Inadequate post harvest technology, marketing system, etc.

Also, common problems of popular rice production are:

1) Shortage of farm materials, such as chemical fertilizer, chemicals, certified seeds, etc.
2) Shortage of fuel for pumping up of well and river water, and difficulty of electrification.
3) Broken-down machinery, shortage of machinery and lack of machinery for post harvest.
4) Lack of irrigation-drainage system and large loss of irrigation water in old canals.
5) Low utilization of the rotation crop with rice.
6) Low utilization of the residual crop and other organic manure for soil improvement

5. ANALYSIS OF TECHNOLOGY FOR POPULAR RICE PRODUCTION

5.1 Priority and Direction of Technical Development of Popular Rice Production

In consideration of the position and direction of popular rice production, it is concluded that the development of technology suitable for popular rice production is important and has high priority to increase popular rice production. It includes the following:

1) Sustainable production and low use of machinery.
2) Production, mainly ecological, based upon the use of varieties adapted to different ecosystems.
3) Maximize use of bio-fertilizers, bio-pesticides organic matter and use of green manure in systems of crop rotation.
4) Design of the production on a small and medium scale; wide utilization of animal power in cultivation.
5) Capacity building for producers.

In order to increase agricultural production, it is necessary to increase agricultural inputs. For the production to be sustainable, the consumption of agro-inputs must also be sustainable. For the popular rice production, the production requires increasing of agricultural inputs, and improving the management of the limited agricultural inputs used at present. Increasing popular rice production is based on the improvement of productivity and extension of sowing area.

1) Improvement of productivity by increasing of yield and effective use of agricultural inputs
2) Extension of sowing area by utilizing the non-used land and promoting diversification from other crops, and by increase producers for popular rice
3) Improvement of production environment by promotion of investment for popular rice production and strengthening of agricultural supporting system

5.2 Suggested Technical Measures

(1) Basic Consideration

Because of the strict limitation of available resources, (namely, agricultural input, irrigation, machinery, technical support, etc.), their accessibility is considered as a key issue for the promotion of the popular rice production. Thus, the following issues are considered in examining technical measures.

(Agricultural Inputs)

Considering the limitation and difficulty of obtaining agricultural inputs such as chemicals, fertilizer, herbicide, etc. in popular rice production, alternative measures of improving farming practice are examined. In consideration with the actual situation, it is assumed that the use of agricultural inputs difficult to obtain such as fertilizer, chemicals, herbicide, etc. will be maintained at the present level. With regard to high quality seed, it is necessary to examine the measures to increase certified seed by development of suitable variety and strengthen the production and distribution system of certified seed.

(Fuel)

It is possible to purchase fuel for agricultural machinery, irrigation pumps, etc. in the market, but it is much more expensive than that obtained as assignment for crops, and producers face difficulty to purchase it due to its price. Producers can purchase the necessary fuel, but they have difficulty in obtaining low priced fuel. Thus, the promotion of popular rice shall be examined with the condition that the level of fuel consumption will be kept at the current level without significant increase.

(Agricultural Mechanization)

Improving the efficiency of machinery and effective use of fuel will be examined for mechanization in popular rice production as well as considering possible alternative measures.

(Irrigation Use)

It is considered to be unfeasible to develop new water resources and large-scale irrigation systems for popular rice. Thus it is important to use the existing water resources and facilities appropriately and effectively. Since pump irrigation is indispensable in the area using groundwater or small rivers as water resources, it is necessary to examine ways to promote irrigation positively through improving water use efficiency, saving fuel, introducing alternative power sources, etc.

(Labor)

The possibility of securing labor will be examined from the viewpoints of family labor of producers, providing labor from cooperatives, and employment of labor from outside of cooperatives.

(Adoptability of Proposed Farming Practice by Producers)

Popular rice is produced by the producer’s own decision under the limitation of accessible resources. Thus, it is most important in the promotion of popular rice production that the proposed technology and farming practice will be spontaneously adopted by producers.

(2) Suggested Technical Measures

Technical measures for improving popular rice production consists of improvement of farming practice, improvement of post-harvest, improvement of agro-mechanization, improvement of irrigation and drainage, improvement of extension activities, and improvement of supporting system. Those technical measures are grouped into two levels; technical improvement in the field/producer level and development of circumstance of popular rice production.

Technical Measures for Increasing Popular Rice Production

	Technical Improvement in the Field/Producer Level	Development of Circumstance of Popular Rice Production
Improvement of Farming Practice	・ The control of weeds by the agronomic management ・ Incorporation of organic matter into the paddy field ・ The improvement of germination and seedling growth by selection of seeds and the use of certificated seeds ・ Introduction of direct seeding in drill and transplant in drill system ・ The use of biological insecticide	・ Establishment of supply system of earthworm manure and fermented animal excrement from animal husbandry units to rice cultivation units ・ Establishment of social supply system of trained laborers for rice transplanting
Improvement of post harvest and marketing	Reaping ・ Appropriate timing for reaping ・ Upgrading working efficiency at lower cost. Threshing ・ Adequate scale and type of threshing machine Drying and cleaning ・ Introduction of field drying ・ construction of improved drying yard ・ Alternative fuel for mechanical dryer ・ Improvement of cleaning process Rice milling ・ to separate husking and milling. ・ Introduction of an improved prototype of Engelberg	・ Improvement of marketing at the field level ・ From individual to centralized collection/ processing
Improvement of Agro-mechanization	・ Introduction of row seeding and transplanting ・ Promoting the use of manual and animal power machines ・ Introduction of small machines	・ Establishing of inventory system for mechanization ・ Improvement of the operation and maintenance system of agricultural mechanization ・ Securing of necessary machines ・ Securing of fuel
Improvement of Irrigation and Drainage	Improvement of water management in the field level ・ Water management for improving farming practice ・ Water management practice in the field ・ Water management for improving efficiency of water use	Improvement of irrigation and drainage in the system level ・ Effective use of existing water resources ・ Increase of efficiency of the existing irrigation system ・ Electrification of pump ・ Increase of operation and maintenance capacity by strengthening water users organization ・ Others (addressing problems of salt damage, drainage problem)
Improvement of extension activities		・ Improvement number of laborers ・ Improvement of conditions of lack of transportation ・ Improvement of extension concerning individual producers ・ Improvement concerning the text for popular rice production techniques ・ Sharing of information

		・ Others (Demonstration farm, Encourage of leader for popular rice producers, Coordination of extension activities and institutes concerned)
Improvement of supporting system		・ Strengthening of seed supply system ・ Supporting system for fertilizers (chemicals, organics, biological) ・ Strengthening of IIArroz and branches ・ Strengthening of popular rice unit ・ Others (improvement of governmental service concerned, improvement of post harvesting and marketing system, land rental system, etc.)

(3) Integrated improvement model of rice cultivation (Cultivation type)

Even though there is a very wide variety of conditions of farm management of rice cultivation, aspects of water use, management scale and available labor force, and possibility of introducing economic crop as a secondary crop, are considered to set up an integrated improvement model of rice cultivation as major issues.

Outline of Integrated Improvement Model of Rice Cultivation

Cultivation Type	Major issues of farm management			Proposed integrated improvement model of rice cultivation (Cultivation type)
	Water use: Irrigation water is available in dry season.	**Management scale and labor force:** Labor force and funds for transplanting are possible to be secured.	**Economic crop:** Economic crop as a secondary crop is expected to be introduced.	
1	O	O	O	Rice in rainy season – Transplanting – Economic crop
2	O	O	---	Double rice cropping – Transplanting
3	O	X	---	Double rice cropping – Direct sowing
4	X	O	X	Rice in rainy season – Transplanting – Soil maintaining crop
5	X	X	X	Rice in rainy season – Direct sowing – Soil maintaining crop

The outline of each improvement model of rice cultivation is described below:

Cultivation Type 1 Rice in rainy season – Transplanting – Economic crop:
This type is a high profit model which aims high profitability by double cropping of the combination of rice in the rainy season and economic crop in the dry season.

Cultivation Type 2 Double rice cropping – Transplanting:
This type is a high yield model of rice cultivation with double cropping of rice, which aims to obtain high yield by transplanting technology and double cropping of rice in the field even under the limited inputs.

Cultivation Type 3 Double rice cropping – Direct sowing
This type is a low input double cropping model of rice cultivation. Direct sowing using drum seeder is introduced as to reduce labor force in seeding process as well as double cropping of rice is proposed to make high production.

Cultivation Type 4 Rice in rainy season – Transplanting – Soil maintaining crop:
This type is a labor saving rice cultivation model, where the main production is rice in the rainy season. It is proposed to cultivate crops for green manure or which will contribute to maintaining soil fertility and structure by returning crop residue in order to realize sustainable crop cultivation under the condition of limited inputs.

Cultivation Type 5 Rice in rainy season – Direct sowing – Soil maintaining crop:
This type is a sustainable and labor saving rice cultivation model, where the main production is rice in the rainy season. It is proposed to cultivate crops for green manure or which will contribute to maintaining soil fertility and structure by returning crop residue in order to realize sustainable crop cultivation under the condition of limited inputs..

6.1 Development Plan

6.1 Importance of the Development Plan for Sustainable Technologies in the Rice Production

In order to achieve improvement on the sustainable production of Popular Rice in the five districts in the central area of Cuba, activities related to production should be carried out. Furthermore, in order to support the increase of national rice production, effective execution over an extensive area is necessary. However, taking into consideration that the capital and inputs are limited for production, this should be carried out gradually.

First, it is necessary to elaborate a development plan for the sustainable production of Popular Rice in the selected areas. This plan is a combination of the actual production plan for Popular Rice and the activity plan from related organizations supporting these activities. The knowledge obtained through the verification study can be used effectively for the preparation of the development plan. Presently, the Cuban government is carrying out several policies to improve the percentage of self-sufficiency in basic grains and to reduce the amount of imported rice. Therefore, it is expected that the preparation of the development plan will support the national policies.

6.2 Goal and Basic Policies for the Development Plan

(1) Goal of Development Plan

GAIPA has been verifying the production plan for Popular Rice, as well as the production goal for the districts, keeping land productivity in mind. A new plan was prepared in December 2004. Hence, the obtained data refers to the required certified seeds for the production of Popular Rice. The demand for certified seeds in 2015 was calculated as approximately 25,500 tons for a total of 330,000 ha, of which 250,000 ha function as the cultivation area for Popular Rice and 80,000 ha are for specialized rice.

Because a 10-year target is appropriate, 2015 has been set as the long term target year, and 2010 has been set as the medium target year, since 5 years are appropriate to carry out concrete independent activities.

The area object of the Development Plan covers the 5 central provinces in the Republic of Cuba; one municipality has been selected in each of these provinces for the implementation of the Development Plan. The following are the provinces and municipalities: Cienfuegos (Aguada de Pasajeros), Villa Clara (Santo Domingo), Sancti Spíritus (Yaguajay), Ciego de Ávila (Chambas) and Camagüey (Vertientes).

The main target of the Development Plan will be the small and medium scale popular rice producers, mainly members of CCS, préstamos and parceleros, as well as the persons interested in and organizations related to promoting popular rice production.

(2) Basic Policy for the Development Plan

In order to overcome the current restricting factors for the production of Popular Rice, it is necessary to combine improvement of the existing techniques as well as introduction of more effective ones. One single rice production technique or a combination of them (and definitively the latter) can produce effective results. In other words, when a combination or package of techniques is applied at the productive level (field) and at the related organizational levels (production support), it is then possible to increase the production of Popular Rice.

Based on this, the following items have been established as the basic policies for the development plan.

Basic Policy 1: Improvement of the Producer Techniques
Basic Policy 2: Improvement of the Production Environment
Basic Policy 3: Improving the Extension Activities
Basic Policy 4: Strengthening of Related Organizations

6.3 Strategy to Implement Basic Policies for the Development Plan

The development plan will be executed by farming activities at district level for Basic Policy 1: Improvement of the Producer's Techniques, Basic Policy 2: Improvement of the Production Environment, and Basic Policy 3: Improving the Extension Activities. The activities for Basic Policy 4: Strengthening of Related Organizations will be carried out by the related organizations at the national level.

6.4 Contents of the Development Plan

The concrete activities to carry out the basic policies of the Development Plan must be implemented by adapting them to the characteristics of the selected municipalities, including environmental, social and economical aspects. Hence, not only the independent countermeasures will be important, but also the supplemental countermeasures to assure the implementation of the independent measures. Therefore, municipalities must be analyzed from the viewpoint of the constraints and potentials for the improvement of popular rice, as well as the revision of the improved techniques and the setting of the development plans. It is necessary to include the requests and comments of the local people in the action plans. The action plan of the concerned organizations supporting the action plans at municipal level will be established.

For that reason, it has been decided that the development plan will be carried out jointly with the action plan at municipal level and the action plan of the related organizations at the national level.

7. Action Plan

7.1 Global Consideration for the Development Plan and the Action Plan

In order to carry out the sustainable production of popular rice, action plans at municipality level will be carried out in each site together with established improved techniques. In the action plans at municipality level, the practical improvement of the existing techniques will be carried out, as well as

for new techniques without imposing any large expenditure. Through the monitoring of cultivation techniques and production activities related to popular rice in the selected municipalities, it is possible to consider an efficient and complete implementation of the Development Plan in the future. Furthermore, the effect of the demonstration will be expected with the implementation of the Verification Study and interest from local producers is expected to increase.

On the other hand, for the implementation of the action plan at the municipality level, it is necessary to carry out the action plan for the organizations that are supporting cultivation and post-harvest activities of popular rice producers. Also, regarding techniques which are basically related to production, efficiency could be increased at municipality level by prioritizing the action plan of the organizations.

Although the action plan at the municipality level and the action plan of the organizations will be implemented by different bodies, it is expected that IIA and GAIPA of MINAG will be in charge of the overall arrangements. It is also important that the activities of the organizations and the necessary arrangements are considered when the Action Plans and the sources of input are implemented.

7.2 Action Plan at Municipality Level

(1) Cultivation Type and Improvement of Rice Cultivation Techniques

Cultivation types shall be achieved by introducing combination of improvement of cultivation techniques, which is so called a technical package, not by individual techniques. The cultivation types proposed in the Development Plan consist of combination of techniques (technical packages) shown below.

Cultivation Type and Technical Package

Proposed Technique	Rice in rainy season – Transplanting – Economic crop	Double rice cropping – Transplanting	Double rice cropping – Direct sowing	Rice in rainy season – Transplanting – Soil maintaining crop	Rice in rainy season – Direct sowing – Soil maintaining crop
Weed control by the agronomic management	O	O	O	O	O
Leveling of the paddy field by animal			O		O
Use of the Certificated seed	O	O	O	O	O
Seed selection by specific gravity	O	O	O	O	O
Planting pattern	Regular planting	Regular planting	Row seeding	Regular planting	Row seeding
Manual rotary weeder	Furrow and inter hill space	Furrow and inter hill space	Furrow space	Furrow and inter hill space	Furrow space
Hand weeding			O		
Weed control by maintenance of the flooding condition of the paddy field	O	O		O	
Application of the earthworm manure	O	O	O	O	O
The use of a biocide	O	O	O	O	O
Midseason drainage at maximum tiller number stage	O	O	O	O	O
Improvement of soil physics and chemistry and weed control by combination of secondary crop	O			O	O
Incorporation of the rice straw	O	O	O	O	O

(2) Components of the Action Plan at Municipality Level and Expression of the Effects

The type of cultivation is part of the package for technical improvement, and it is selected according to the characteristics of the region and the conditions for agricultural improvement. In order to guarantee the introduction and determination of the type of cultivation in the field, the "Program for the Improvement of Sustainable Techniques for the Production of Rice" is being promoted at municipality level (to the producer/field level) as a total package of activities that include post-harvest and extension activities. The organizations, under the initiative of MINAGR, should fulfill several projects when they carry out this program. Although the types of cultivation to be recommended in each municipality are different; the projects to be fulfilled are similar. Also, if sustainability of the type of cultivation is taken into consideration, the projects become important by the training activities that allow people to develop, rather than by the amount of material inputs.

The effect of the type of cultivation will cause an increase in the amount of Popular Rice production. The first 5 years, up to 2010, will give priority to the introduction and determination of the type of cultivation in the existing cultivation area. The following 5 years, up to 2015, will have a knock-on effect attributable to the promotion of the "Program for the Improvement of Sustainable Techniques for the Production of Rice", and an approximate expansion of 30% of the existing cultivation surface of Popular Rice (2003) is presumed. Also, the rate of diffusion of transplanting technique in the future is predicted by GAIPA at approximately 60%.

(3) Project Profiles

Improvement of Cultivation Techniques

1. Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities
2. Project to Support Production of Biological Pesticides in CREE of each Municipality
3. Project for the Production of Small Machinery and Validation of Demonstration Areas for Popular Rice Producers
4. Project for the Improvement of Water Management at Field Level
5. Project for the Strengthening of Water User's Organization

Improvement of Post-harvest Techniques

1. Pilot Project for the Interoperation of Agricultural Machinery and Facilities by the Group of Popular Rice Producers
2. Project for the Improvement of Paddy Drying System for Popular Rice Producers

Improvement of Extension Activities

1. Project for Capacity Building of Leaders among Producers and Extension Officers
2. Project of Study Tours as an Extension Method

(4) Action Plan for each Municipality (Recommended cultivation type)

Municipality of Aguada de Pasajeros

Cultivation type 2: Double cropping - Transplant
Cultivation type 4: Rice for spring season - Transplant - Crop for soil maintenance

Municipality of Santo Domingo

Cultivation type 2: Double cropping - Transplant
Cultivation type 1: Rice for spring season - Transplant -Cash crop

Municipality of Yaguajay

Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance
Cultivation type 4: Rice for spring season -Transplant - Crop for soil maintenance
Cultivation type 3: Double cropping - Drilling
Cultivation type 2: Double cropping - Transplant

Municipality of Chambas

Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance
Cultivation type 4: Rice for spring season - Transplant - Crop for soil maintenance
Cultivation type 3: Double cropping - Drilling
Cultivation type 2: Double cropping - Transplant

Municipality of Vertientes

Cultivation type 3: Double cropping - Drilling
Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance

7.3 Action Plan for Related Organizations

(1) Program for the Improvement of the Extension System and Capacity Building.

Objective of the program

The objective of the program is to strengthen the extension system and capacity building for popular rice.

Content of activities

1. Training of extension officers, both at provincial and municipal levels.
2. Strengthening the structures of popular rice units at provincial and municipal levels.
3. Establishing the most convenient ways to train individual producers who are not organized at present (parceleros in some municipalities and prestamos in other cases, etc.).

(2) Program for Strengthening Production and Distribution of Certified Seeds for Popular Rice

Objective of the program

The objective is to establish a production and distribution system of certified seeds for popular rice producers.

Contents of the activities

1. To strengthen the capacity for producing original and basic seed in the research centers in charge of this activity.
2. To strengthen the production capacity of farms producing registered seeds.
3. To establish farms for certified seed production based on the characteristics of each municipality.
4. To modify technical regulations and quality specifications for certified seed production for popular rice.

(3) Program for the Improvement of Research and Development Activities

Objective of the program

The objective is to strengthen the activities of research and development on the technologies for popular rice.

Content of the activities

1. To provide the necessary equipment for research centers in order to produce new varieties and technologies adapted to the different conditions of popular rice cultivation.
2. To strengthen the capacity of the research centers for the preparation, editing and distribution of understandable texts and technical brochures for popular rice producers.

7.4 Contents of the Action Plan

Many activities are necessary to find out in detail the type of rice cultivation applied in each municipality. The effect of the cultivation techniques involving activities in the field will depend on the characteristics of each region. On the other hand, the post-harvest techniques that involve activities outside of the field have little difference among the regions. Also, the activities that make up the Action Plan are composed of two parts: productive activities of rice including cultivation techniques and post-harvest activities where producers (farmers) and groups of producers will become the nucleus, and support activities where the central, provincial or municipal governments will be the nucleus.

Contents of Action Plan

Action Plan at Municipality Level	Action Plan for Related Organizations
Program for the Improvement of Sustainable Techniques for Rice Production Improvement on Cultivation Techniques 1. Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities. 2. Project for the Support of Biological Pesticides Production at CREE in the Municipalities 3. Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers. 4. Project for the Improvement of Water Management at Field Level. 5. Project for Strengthening Water User's Organization Improvement of Post-harvest Techniques 1. Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers. Project for Strengthening Water User's Organization Improvement on Extension Activities 1. Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers. 2. Project for Study Tours as an Extension Method	1. Program for the Improvement of the Extension System and Capacity Building 2. Program for the Strengthening of Production and Distribution of Certified Seeds for Popular Rice 3. Program for the Improvement of Research and Development Activities

The center for the Action Plan is the "Program for the Improvement of Sustainable Techniques for Rice Production" which will directly contribute to increase the production and productivity of popular rice. Furthermore, "Improvement of Cultivation Techniques" which directly correlate with increase in production among the productive activities will form the nucleus of the Action Plan. In consequence, production sustainability of popular rice will be possible, and this will contribute to increase the self-sufficient proportion of rice in Cuba as a result of the knock-on effect.

7.5 Implementation Plan for the Actions

(1) Adequate Implementation

Implementation of the Development Plan and the Action Plan for the 5 selected municipalities as models should be completed. For early execution in the 5 selected municipalities, the plan could be expanded to the neighboring municipalities through a model project, monitoring the organization for the implementation and making it possible to completely and efficiently consider a new development plan. Furthermore, the execution of the Action Plan in the selected municipalities completes the demonstrative effect and it is possible that this will improve the participation and interest of people, with their participation in the continuation of the Verification Study, collaborating in the execution of a future plan of similar development. On the other hand, if there is possibility of financial benefit, the Development Plan can be enlarged further to include it, based on the acquired experiences.

(2) Implementation Plan for the Programs

The Action Plan has 12 components with the objective of being implemented during 10 years from 2006 to 2015. The component Programs should be executed systematically based on the objectives, importance and urgency. The projects will be completed corresponding to their period of execution in two stages (medium and long term). During the first five years, the implementation of the nucleus project and the preparation period for the long term plan will be carried out, as well as the support system and necessary training for the improvement of cultivation techniques. After that, the activities will be promoted and the improvement of the cultivation technique will be established as a long term plan.

(3) Inputs for the Plan

The programs /projects that integrate the Development Plan assume that the inputs for the new projects will not involve a heavy financial burden. The majority of the costs in the Plan are expenses for personnel and supply materials that take into consideration the priority of what products can be obtained within the country. As for the part of foreign expense, it should cover necessary expenditures for fuel, agricultural machinery, etc. The related organizations are aware of the shortage of supply materials and budget (lack of foreign currency, fuel shortage, lack of equipment, materials and research equipment and the wear and tear of agricultural machinery), and so execution of the project is expected with few inputs. The effective use of all the resources including human resources is very important.

7.6 Organization of the Plan Implementation

Each project type has different characteristics so the organization will depend mostly on the scope of the project and financing sources. IIArroz will be in charge of follow-up tasks for all the projects in execution and will inform GAIPA on the status of each one of them. The organization of the implementation, the organization of the executioner (execution nucleus) and the organization related to the program/project of the Action Plan are as follows:

Organization for Implementation of Action Plan

Project / Program	Implementing Organization	Selection Nucleus	Related Organization
Program for the Improvement of Sustainable Techniques for Rice Production	MINAG, GAIPA, IIArroz	GAIPA, IIArroz	ANAP
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities	CCS or CPA	Popular Rice Producers	Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in Municipalities
Project for the Support of Biological Pesticides Production at CREE in the Municipalities	National Directorate of Crop Protection	CREE in municipalities	INISAV, Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in municipalities
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers	CCS or CCS-F	IIM、IIArroz	Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in Municipalities
Project for the Improvement of Water Management at Field Level	Provincial Delegation of Agriculture	Municipal Extension Officer, Leaders among Producers and interested persons	INRH, IIRD
Project for Strengthening Water User's Organization	Provincial Delegation of Agriculture, local INRH	CCS and its members, Municipal Extension Officer, local INRH	IIRD, ANAP
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers	MINAG, IIArroz	GAIPA, Group of Producers (CCS)	ANAP
Project for the Improvement of Paddy Drying System for Popular Rice Producers	MINAG	IIArroz	GAIPA
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers	IIArroz, GAIPA	Municipal Extension Officer, ETIA	CCS, ANAP
Project for Study Tours as an Extension Method	IIArroz	IIArroz, ETIA, Municipal Extension Officer	GAIPA, ANAP
Program for the Improvement of the Extension System and Capacity Building	GAIPA	IIArroz	National Group of Popular Rice, Popular Rice Unit in Municipalities and Provinces, ANAP
Program for the Strengthening of Production and Distribution of Certified Seeds for Popular Rice	IIArroz	IIArroz, ETIA, Rice Experimental Station at Los Palacios	SICS, GAIPA, Popular Rice Unit in Municipalities and Provinces, CAI
Program for the Improvement of Research and Development Activities	IIArroz	IIArroz, ETIA, Rice Experimental Station at Los Palacios	IIMA, INISAV, IIS

7.7 Procurement of Financing

The programs/projects included in the Action Plan are divided into production activities (economy) for producers and public investments from the financial point of view. Since it is difficult to cover all the project costs from the budget of MINAG and there is also a limit on public investment, the introduction of financing from outside sources should be revised. The main organizations that could provide financing are the following:

1) Direct financing from the Ministry of Agriculture (MINAG)
2) Financing through Projects of Technological Innovation (National, branch and territorial)
3) Collective financing from producers of CCS and CCSF

4) Financing from international cooperation (international organizations, donating countries, NGOs, etc.)

7.8 Evaluation of the Plan

The execution of the Action Plan is based on the Development Plan as a result of technical improvement by the producers, improvement of production conditions, improvement of extension activities and reinforcement of the related organizations. Increase in production and improvement of productivity of Popular Rice is foreseen in the target areas of the Development Plan and in the neighboring municipalities. The implementation of the Plan will be a big stimulus for production activity, and an increase on production is expected to contribute to the stability and sustainability of Popular Rice production in the target areas. Consequently, as a knock-on effect, it will contribute to the national economy due to the expansion of the self-sufficient percentage for rice.

From the above, it can be said that the implementation of the Development Plan is appropriate due to the results of the economic analysis that was calculated by the tangible benefit that is obtained from the cultivation type, that is, the improvement of rice. Additionally, the socio-economic effects that were analyzed as intangible benefits are also expected. Moreover, no problems are expected from the environmental and social points of view; therefore the immediate implementation of the Development Plan is recommended.

8. Conclusions and Recommendations

8.1 Conclusions

The goals of the Development Plan called “Sustainable Development for Rice Cultivation in the Central Area in the Republic of Cuba” will be accomplished through the extension of the Action Plans in each one of the selected municipalities from the five central provinces in the Study Area. At the same time, in order to achieve the proposed goal in the Development Plan the related organizations should be strengthened, as well as the rest of the supporting activities for rice production.

Through the implementation of the Development Plan, small and medium scale producers in the five provinces in the central area of Cuba will achieve an increase of production by utilizing sustainable techniques. Furthermore, through the execution of the Action Plan in each one of the municipalities, a knock-on effect will take place in order to establish this type of production as a sustainable technical model, which will be transferable to other municipalities in the central provinces. This will contribute to increase production of Popular Rice in Cuba. Taking this into account, the immediate implementation of the Development Plan is very important.

8.2 Recommendations

(1) Immediate Implementation of the Development Plan

In order to implement the Development Plan, the Action Plan of each one of the selected municipalities should be executed first. To be able to achieve the expected effect on production increase and productivity improvement of Popular Rice through the implementation of the Development Plan, the institutions executing the project such as the Ministry of Agriculture (MINAG), the Institute of Rice Research (IIArroz) and other organizations should actively work in the selection and execution of the projects. This Development Plan shall be the model for the cultivation of Popular Rice for small and medium scale producers utilizing sustainable methods and

shall serve as a model for the neighboring municipalities, gradually being adopted by them in the future.

(2) Strengthening of the Executing Institutions of the Project

The Ministry of Agriculture (MINAG), especially through the Agro-industrial Group of Cattle and Rice (GAIPA) and the Rice Research Institute (IIArroz), which is the institution in charge of the immediate and effective implementation of the Development Plan, shall make the necessary arrangements with the rest of the institutions at the central, provincial and municipal levels. Similarly, the implementation of the Development Plan and the execution of the pilot projects will require the active participation of the following essential institutes and institutions: Institute of Investigation of Agriculture and Stockbreeding Mechanization (IIMA), Institute of Investigation of Irrigation and Drainage (IIRD), Institute of Investigation of Soil and Fertilizers (IIS), Institute of Investigation of Vegetable Sanitation (INISAV), Reproductive Centers for Entomophagus and Entomopathogens (CREE), National Enterprise of Agriculture and Stockbreeding (ENPA), System of Inspection and Certification Seeds (SICS), National Association of Small Farmers (ANAP), Agro-industrial Complex for Rice, (CAI Arroceros), Cooperatives of Credit and Service (CCS and CCS-F), etc. The organizations (institutes and institutions) related to the improvement of the people's capacity in charge of the management and implementation of the projects, should guarantee their training readiness and preparation of the necessary materials.

(3) Promoting Change towards New Ways of Agricultural Management

The proposed technologies imply a change in the manner of thinking of the individual producers which have little dependency on inputs (mainly agrochemicals) for the cultivation of rice. Agricultural management is mainly based on the use of the producer's own resources.

(4) Promotion of Extension Activities

An increase in the number of extension officers in each of the municipalities (between 4 and 7 in the selected municipalities), has been planned by the Agro-industrial Group of Cattle and Rice (GAIPA) and identification and training of the leading producers has also been considered. The activities of the extension officers are essential for the diffusion of the cultivation techniques of Popular Rice; therefore it is important that the increase in personnel dedicated to this activity is carried out as soon as possible by the Ministry of Agriculture (MINAG).

(5) Use of the Trainees from the Training Courses in Japan

Since 2003, Japan International Cooperation Agency (JICA) has been holding a Special Course in Japan for Cubans called "Techniques for Small Scale Rice Cultivation" and approximately 30 Cuban technicians have already participated in this training course. After returning to their country, the scholarship holders have continued working in research, extension activities and administration. The techniques on rice cultivation and the extension methods learned in Japan can also be applied to the increase and stability of the production of Popular Rice in Cuba. The training that was received to carry out diffusion activities of new technologies and for the training of extension officers and leaders among the producers should be taken advantage of to the fullest extent possible.

(6) Improvement of the System for the Inspection and Certification of Seeds for Popular Rice

Presently, the System for the Inspection and Certification of Seeds (SICS) has been established and it is working for Specialized Rice. However, the production of certified seeds from the Seed Farms belonging to the Rice CAI is insufficient to supply the demand from the producers of Popular Rice. Therefore the promotion of production of certified seeds by the producers of Popular Rice has started. The main problem that has been encountered is related to charging the producers for sample analysis. Changes should be made since both the management and the volume of production are completely different from Specialized Rice to Popular Rice.

(7) Construction of Manual Equipment for Cultivation

Presently, the import of agricultural machinery is very difficult and therefore the development of light machinery that can be manufactured in Cuba and that can be modified to the required conditions for the cultivation of Popular Rice is very important. During the Verification Study some equipment was built at the Institute of Investigations of Agricultural and Stockbreeding Mechanization (IIMA) at a very low cost. An example is the construction of the manual row seeder, based on a design from the International Rice Research Institute (IRRI) in Philippines. The IRRI seeder had better characteristics than the Vietnamese manual seeder which was tested by IIArroz before. In so far as the economic resources, the Ministry of Agriculture should facilitate the construction of some equipment such as the manual row seeder and the manual weeding machine.

(8) Continuing Research and Technical Development Activities for Popular Rice

The program for the production of Popular Rice is relatively new and different from the production of Specialized Rice and the most adequate techniques for its management have not yet been established; therefore, it is very important that the research and development activities, as well as technology transfer activities are continued. It is indispensable to establish and promote the most adequate techniques pertaining to the cultivation area and the type of agricultural development. The following items are especially important: a sustainable production system with a small amount of inputs, environmental considerations with the application of organic fertilizers and biological control of pests, use of animal traction in small and medium scale cultivation, establishment of a training system, transplanting technique, introduction and establishment of two cultivation seasons per year, crop rotation systems, the use of short cycle varieties, and the establishment of a production and distribution system for certified seeds.

The Verification Studies carried out had the expected demonstration effect and therefore they can be used as models for the technological development of rice production with sustainable methods. It is necessary to promote verification studies in different municipalities as well as promoting the techniques applied for the improvement of productivity, extension activities, etc.

(9) Possibility of International Technical Cooperation

Support for the execution of the projects can be requested from international organizations, donating countries and NGO's through the Ministry of Foreign Investment and Economic Cooperation (MINVEC) and the Ministry of Agriculture (MINAG). It is extremely important to have the possibility of visits from experts from countries with experience on these topics, and it is also important to train the people involved in management, implementation and monitoring of the projects.

(10) Project Financing

The Ministry of Agriculture (MINAG) shall adjust the budget for the execution of the Development Plan and shall revise the content of the project for the prioritized activities to be executed immediately. For the execution of the project, financial support from the provinces and municipalities is also expected, as well as from farmer organizations (CCS, CCS-F) and if possible, the cooperation of international aid as well.

THE STUDY ON SUSTAINABLE TECHNICAL DEVELOPMENT FOR RICE CULTIVATION IN THE CENTRAL AREA IN THE REPUBLIC OF CUBA

Final Report

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ABBREVIATIONS

A	ANAP	Asociación Nacional de Agricultores Pequeños	National Association of Small Farmers
C	CIF	Costo de seguros y flete	Cost, insurance and freight
	CAI	Complejo Agro-industrial	Agro-industrial Complex
	CDR	Comité Defensa de la Revolución	Defense Committee of Revolution
	CCS(F)	Cooperativas de Créditos y Servicios (Fortalecidas)	Cooperatives of Credit and Service
	CIAT	Centro Internacional de Agricultura Tropical	International Tropical Agriculture Center
	CIGB	Centro de Ingeniería Genética y Biotecnología	Genetic Engineering and Biotechnology Center
	CITMA	Ministerio de Ciencia, Tecnología y Medio Ambiente	Ministry of Science, Technology and Environment
	CPA	Cooperativas de Producción Agropecuaria	Cooperatives of Agricultural Production
	CREE	Centros Reproductores de Entomófagos y Entomopatogenos	Reproductive Centers of Entomófagos and Entomopatogenos
E	EAH	Empresa de la Provisión Hidráulica	Hydraulic Provision Enterprise
	EIA	Evaluación de Impacto Ambiental	Environmental Impact Assessment
	EJT	Ejército Juvenil del Trabajo	Work Youth Army
	ENPA	Empresa Nacional de Proyectos Agropecuarios	National Enterprise of Agriculture and Stockbreeding
	ETIA	Estación Territorial de Investigaciones del Arroz	Regional Research Station of Paddy Rice
F	FAR	Fuerzas Armadas Revolucionarios	Revolutionary Armed Forces
	FAO	Organización de las Naciones Unidas para la Agricultura y la Alimentación	Food and Agriculture Organization of the United Nation
	FEU	Federación de Estudiantes Universitarios	University Students Federation
	FMC	Federación de Mujeres Cubanas	Cuban woman's Federation
G	GAIPA	Grupo Agroindustrial Pecuario Arrocero	Agro-Industrial Group of Cattle and Rice
	GENT	Granja Estatal de Nuevo Tipo	New Type State Farm
	GRC	Gobierno de la República de Cuba	Government of the Republic of Cuba
I	IEE	Evaluación Inicial del Medioambiente	Initial Environmental Evaluation
	IIArroz	Instituto de Investigaciones del Arroz	Rice Research Institute
	IIMA	Instituto de Investigaciones de la Mecanización Agropecuaria	Institute of Investigation of Agriculture and Stockbreeding Mechanization
	IIRD	Instituto de Investigaciones de Riego y Drenaje	Institute of Investigation of Irrigation and Drainage
	IIS	Instituto de Investigaciones de Suelos y Fertilizantes	Institute of Investigations of Soils and Fertilizers
	INISAV	Instituto de Investigaciones de Sanidad Vegetal	Institute of Investigation of Vegetable Sanitation

	INRE	Instituto Nacional de la Reserva Estatal	National institute of State Reservation
	INRH	Instituto Nacional de Recursos Hidráulicos	National institute of Hydrological Resources
	IPF	Instituto de Planificación Física	Institute of Physical Planning
	IRRI	Instituto Internacional de Investigaciones del Arroz	International Rice Research Institute
J	JICA	Agencia de Cooperación Internacional de Japón	Japan International Cooperation Agency
M	MINAL	Ministerio de la Industria Alimenticia	Ministry of Food Industry
	MINAG	Ministerio de la Agricultura	Ministry of Agriculture
	MINAZ	Ministerio de Azúcar	Ministry of Sugar
	MINCEX	Ministerio de Comercio Exterior	Ministry of External Commence
	MINCIN	Ministerio de Comercio Interior	Ministry of Internal Commence
	MININT	Ministerio del Interior	Ministry of Internal Affairs
	MINVEC	Ministerio para la Inversión Extranjera y la Colaboración Económica	Ministry of Foreign Investment and Economic Cooperation
	MPA	Mercado de Productos Agrícolas	Market for Agricultural Product
P	PTO	Árbol toma de fuerza	Power take off
S	SICS	Sistema de Inspección y Certificación de Semilla	System of Inspection and Certification Seeds
	SEA	Sistema de Extensión Agrícola	Agricultural Extension System
	S/W	Alcance de Trabajo	Scope of Work
T	TRD	Tiendas Recaudadoras de Divisas	Foreign Currency Collecting Shop
U	UBPC	Unidades Básicas de Producción Cooperativa	Basic Unit of Production Cooperative
	UJC	Unión de Jóvenes Comunistas	Young Communist Union
	UNDP	Programa de las Naciones Unidas para el Desarrollo	United Nations Development Program
	URSS	Unión de Repúblicas Socialistas Soviéticas	Union of Soviet Socialist Republics

UNIT, UNIDAD

cab.	Caballería: 1cab.=13.42ha =324cordeles
cordel	1 cordel =414.2m^2, 1ha = 24cordeles
q	Quintal: 1quintal =100libras =46kg
Lb	Libra: 1libra=0.46kg

CHAPTER 1 INTRODUCTION

CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Monoculture represented by sugarcane production has been one of the main characteristics of agriculture in the Republic of Cuba (hereinafter referred to as "Cuba") for many years and sugarcane cultivation occupied approximately 50% of the total cultivated area. This situation has changed remarkably in the recent years due to the reduction of the areas for sugarcane cultivation, and these areas have been used in agricultural diversification. Cuba is a food-importing country and the production of main food grains covers only 23% of the requirements. The import of amount of rice, one of the principal foods of the population, is quite large following that of wheat (FAO 2001). In the early '90s, Cuba lost more than 80% of its trade due to the disintegration of the USSR and the socialist block, which had negative repercussions on the economy and consequently on rice production of the specialized enterprises (CAI). These enterprises have a technology based application of big amount of chemical fertilizers and pesticides, generally applied by airplanes. Considering that the rice production for the last 10 years has been under an unstable situation, the increasing and stabilizing of rice production is a priority issue.

The Ministry of Agriculture of Cuba (hereinafter referred to as "MINAG") is promoting food production. As a part of this policy of the Ministry of Agriculture, small and medium scaled production began to be encouraged in 1996, known as the Popular Rice Program. This program is based on low chemical fertilizers, the use of green and organic manures, and the introduction of the transplanting method, as well as animal power.

Under these situations, the Japan International Cooperation Agency (hereinafter referred to as "JICA") dispatched the Project Formulation Mission in June 2001 and a series of discussions on development projects were held between the Government of the Republic of Cuba (hereinafter referred to as "GRC") and the Mission. According to the results of the discussions, GRC requested the government of Japan to perform a development study on "Sustainable Development Program of Rice" for small-scale rice farming farmers covering the central area (5 provinces), which is a big granary in Cuba with around 40% of rice production area of the country. In response, JICA dispatched the Preparatory Study Team in February 2003 and, based on the result of discussions between GRC and the Team, the study was decided to be conducted and the Scope of Works (S/W) for "THE STUDY ON SUSTAINABLE TECHNICAL DEVELOPMENT FOR RICE CULTIVATION IN THE CENTRAL AREA IN THE REPUBLIC OF CUBA (hereinafter referred to as "The Study")" was signed by both parties. In accordance with the S/W, JICA dispatched a Study Team to the Republic of Cuba and the Study has been conducted since October 2003. The results of the Study are elaborated in this report.

1.2 Objectives of the Study

The objectives of the Study are:

1) To formulate a Development plan for improvement of sustainable rice production (popular rice) in central 5 provinces (the Study will include verification study), and
2) To carry out technology transfer to the Cuban counterpart through on-the-job training in the course of the Study.

1.3 The Study Area

The study area covers the central area (5 provinces; Cienfuegos, Villa Clara, Sancti Spíritus, Ciego de Ávila, Camagüey) in Cuba. The 5 municipalities for studying action plan as a priority municipality were selected by the Cuban side as shown below.

Selected 5 municipalities

Province	Cienfuegos	Villa Clara	Sancti Spíritus	Ciego de Ávila	Camagüey
Municipality	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Vertientes

1.4 Methodology of the Study

The following scopes were conducted in order to achieve the objectives of the Study.

a. Basic study (Study on present conditions and problems)
b. Formulation of Verification Study Plan
c. Implementation of Verification Study
d. Analysis of result of Verification Study
e. Formulation of Development Plan
f. Analysis of characteristics of priority municipalities
g. Formulation of Action Plan

1.5 Member of Study Team and Cuban Counterparts

The members participated in the Study as a team member and a counterpart are listed below:

Assignment	Study Team	Counterpart
Team Leader	Yutaka NOZAKI / Yujiro ITAKURA	Enrique Suárez
Rice Cultivation 1	Harunobu INOUE	Francisco Cruz Yudel García
Rice Cultivation 2	Hiroshi IKEDA	
Agricultural Economy 1	Fumiakira ONODA	Magali Amador
Agricultural Economy 2 / Post Harvest	Isamu YAMAZAKI	Maikel O. Arrastía
Agricultural Machinery	Hironori HONMA	Idaibel Navarro
Irrigation and Drainage	Kazuhiro TSUCHIDA	Aymara García / Reynaldo Cun
Rural Society	Jun TOTSUKAWA	Irene Moreno Mariela Chaviano
Interpreter	Hideharu SUGAWARA	Giraldo Rodríguez

CHAPTER 2 GENERAL BACKGROUND

CHAPTER 2: GENERAL BACKGROUND

2.1 General Aspects

2.1.1 Location and Population in Cuba

The Cuban archipelago consists of Cuba Island, Island of Youth and more than 4,000 small islands. They are located at the entrance of the Mexico Gulf within longitude of 74° 7' to 84° 57' and latitude of 19° 49' to 23° 16'.

The area of the island of Cuba is approximately 110,861 km^2. The distance of the widest part north to south, is around 191 km between Tararaco beach to the north and Punta de Camaron Grande to the south of Granma. The narrowest part is around 31 km between Mariel Bay and Ensenada de Majana in the province of Havana. Since 1976, the island was divided into 14 provinces and 169 municipalities, including the special municipality of the Island of Youth. The Cuban population had approximately 11,230,000 inhabitants in 2001 and the population density is around 100 inhabitants/km². The provinces with higher population densities are Havana City, Santiago de Cuba and La Habana; the lower population densities are found in Camagüey, Ciego de Ávila, Sancti Spíritus, Pinar del Río and the Island of Youth.

2.1.2 Provinces in the Study Area

The Study Area covers the five provinces of Cienfuegos, Villa Clara, Sancti Spíritus, Ciego de Ávila, and Camagüey. Table 2.1.1 shows data related to the area and population of the Study Area.

Table 2.1.1 National and provincial area and population in the Study Area

	National	Cienfuegos	Villa Clara	Sancti Spíritus	Ciego de Ávila	Camagüey
Area (km^2)	110, 861	4,178	8,662	6,744	6,910	15,990
Population 1981. Census	9,723,605	326,383	765,823	400,026	321,015	667,539
Population 1992.	10,831,070	374,641	819,142	439,201	380,293	758,746
% Increase	0.99	1.26	0.61	0.85	1.55	1.17
Population 2001.	11,230,229	397,630	836,336	462,789	412,074	790,849
% Increase.	0.40	0.66	0.23	0.58	0.90	0.46
Density. Inhab./km^2	101.3	95.2	96.5	68.6	59.6	49.5

Sources: Annual Statistics in Cuba 2001

(1) Cienfuegos

The province of Cienfuegos has an area of approximately 4,178 km² and a population of about 397,630. This province has mean temperature between 24 °C and 26 °C in the plain zones and between 17°C and 24°C in the mountain side. Average annual rainfall in the plain zones is about 1,200 to 1,500 mm and about 1,500 to 2,000 mm in the mountainside. Cienfuegos is divided into 8 municipalities, of which Aguada de Pasajeros, Abreus and Palmira have the highest potential for rice cultivation.

Aguada de Pasajeros is the selected municipality in this province. The National Highway passes through the northern part of the municipality. Aguada de Pasajeros consists of 7 Consejos Populares. The municipality has a long tradition in rice cultivation in Cuba, which is reflected in its coat of arms showing some ripe rice panicles. There are two Sugar Agro-industrial Complexes in Aguada de Pasajeros (Antonio Sánchez and Primero de Mayo). At this moment, CAI Antonio Sánchez is under restructuring.

(2) Villa Clara

The province of Villa Clara has an area of approximately 8,662 km² and a population of about 836,300. This province has mean temperature between 24 °C to 26°C and the average annual rainfall is about 1,200 to 1,700 mm. Villa Clara is divided in 13 municipalities, of which Santo Domingo, Sagua La Grande and Encrucijada have the highest potential for rice cultivation. However, there are also other municipalities having high sowing levels.

Located at the western part, Santo Domingo is the selected municipality in the province of Villa Clara. The Central Road crosses the municipality in the southern part. The municipality consists of 11 Consejos Populares. The main rice producing areas are located in Cascajal, although they are also distributed over the whole municipality. There are three Sugar Agro-industrial Complexes in the municipality (George Washington, Carlos Baliño and Veintiséis de Julio). The Sugar CAI Veintiséis de Julio is under restructuring.

(3) Sancti Spíritus

The province of Sancti Spíritus has an area of approximately 6,744 km^2 and a population of about 462,789. The mean temperature is about 24 °C to 27°C in the plain zones, while in the mountainside is about 17°C to 24°C. Average annual rainfall in plain zones is about 1,538 mm. Sancti Spíritus is divided into 8 municipalities, of which La Sierpe and Yaguajay have the highest potential for rice cultivation.

The Agro-industrial Complex “Sur del Jibaro” is located in this province, with the Experimental Station of Rice that is in charge of the provinces of Ciego de Ávila, Villa Clara and Cienfuegos.

As in the case of Yaguajay, both the railway connecting Santa Clara with Morón and Circuito Norte pass by its territory. The municipality consists of 16 Consejos Populares. The main rice producing areas are located in the Consejos Populares of Mayajigua and El Río, although there are other areas. In Yaguajay, there are three Sugar Agro-industrial Complexes (Obdulio Morales, Simón Bolivar and Aracelio Iglesias). Both the Sugar Agro-industrial Complexes Obdulio Morales and Simón Bolivar are under restructuring, while Aracelio Iglesias is still working.

(4) Ciego de Ávila

The province of Ciego de Ávila has an area of approximately 6,910 km² and a population of about 412,074. The mean temperature is between 24 °C to 27°C and the average annual rainfall is about 1,200 to 1,400 mm. Ciego de Ávila is divided into 10 municipalities, of which Chambas, Baraguá and Bolivia have the highest potential for rice cultivation.

Located at the northeastern part, Chambas is the selected municipality for the Development Study in this province. Both the railway connecting Santa Clara with Morón and Circuito Norte pass through this territory. There are 8 Consejos Populares in the municipality and rice is cultivated in seven of them but still sugarcane is the main crop in this province. There is one Sugar Agro-industrial Complex in the municipality (Enrique J. Varona) and one Agricultural and Livestock Company (before it was a Sugar Agro-Industrial Complex Máximo Gómez). Until 2002, there was a Rice Agro-industrial Complex in the municipality, but these areas were experiencing increasing salinity. For this reason, at present these areas were assigned to other purposes, such as livestock, etc.

(5) Camagüey

The province of Camagüey has the largest territorial area in the country, with approximately 15,990km² and a population of about 790,800. Its mean temperature is about 24 °C to 27 °C and the average annual rainfall is 1,100 to 1,500 mm. Camagüey is divided into 13 municipalities, of which Vertientes and Florida have the highest potential for rice cultivation. The province has a high potential to apply scientific techniques, with the Camagüey University in the front line.

Being located at the central and southern part, Vertientes is the selected municipality in this province. The municipality consists of 9 Consejos Populares. The railway connecting Florida with the port in Santa Cruz del Sur passes by Vertientes. The rice areas are located in the southern part of the municipality, mainly in the Consejo Popular Ruta Invasora. The Rice Agro-industrial Complex "Ruta Invasora" and the Rice Experimental Station are located in Vertientes. There are two Sugar Agro-industrial Complexes (Batalla de las Guasimas and Panama), and therefore, sugar cane production has more importance here than rice production.

2.1.3 National Economy in Perspective

The islands being located in the sub-tropical region just south of the Tropic of Cancer, as a downside of its geographical location, they are destined to be under the mercy of hurricanes, which makes the forecast of economic activity difficult.

Although Cuba, which has a population of more than 11 million inhabitants, has been identified as a famous sugarcane producing country, in the last few years the tourism industry has become the main source of income for the country.

Fortunately, the service industry import substitution policy has been able to make use of the upside of Cuba's geographical position. During recent years, the tourism industry has improved remarkably. In 2004, the amount of incoming tourists per year exceeded 2 million (approximately an increment of 7.6% compared to the one in 2003) and in 2005 it is expected to reach 2.3 million[1].

The two most important contributors to the economy are the gross revenues from the tourism industry and the direct foreign investments. Another source of income has been the remittance from Cuban immigrants in other countries. Recently, the USA government has proposed new measures to reduce the amount of transfers sent to Cuba by the Cuban immigrants in that country.

Currently, the main export item is nickel (Cuba is the fifth producer worldwide). Nickel production increased approximately 6.9% and in 2005 it is expected to reach 77,000 tons. In 2004, there was a remarkable increase in the export of lobster, fruit juices, rum and honey.

Sugar production (which used to be the main export item) grew approximately 14.4% compared to 2003, but the perspective for 2005 is lower due to the intense drought and revising the ordinances of the areas.

Among the main import products are machinery and equipment, fuel, foodstuffs and chemical products. Imports increased approximately 14.3% compared to 2003.

As far as petroleum extraction, the production has been able to increase and several transformations have taken place in the electricity generating stations which use the Cuban crude for generating

[1] Source: *Informe de los resultados económicos del 2004 y el Plan Económico Social para el 2005*, presented by José Luis Rodríguez Minister of Economy and Planning. Granma Newspaper, December 27, 2004.

electrical power. In 2004, the generation of electricity decreased 1.4% (mainly due to breakdowns in the stations) and the generation of electricity with national oil was 81.7% making it necessary to increase the import of fuel oil at high prices.

In 2004, there were important changes in the monetary policy of the country as a response to the challenge from the USA government to prevent the deposit of dollars abroad. Since November 15, 2004 the US dollar stopped circulating in Cuba, imposing a 10% tax to the cash transactions in dollars. Presently, the official exchange rate of the Cuban Peso (MN), against the Cuban convertible Peso (CUC) is 1 CUC = 24 MN and the exchange rate for the US dollar (USD) against the Cuban convertible peso (CUC) is 1 CUC = 1.08 USD.

2.1.4 Rice Economic Situation in Cuba

(1) Balance of demand and supply

Eleven million plus people are living on the 111,000 km^2 span of the Cuban archipelago. Rice is the major staple food of the people. Its consumption has been exceeding that of wheat for some years. According to information of FAO, the average intake of calories from rice has been 18% of the total, versus 15% from wheat. Approximately 500,000 tons of rice are consumed annually as a whole. Imports have been filling the gap between the production and the demand. Imports have also helped fill storage facilities. Import has increased dramatically since 1995, reaching more than 400,000 tons in 2001, about 80% of the total annual consumption. Recent demand and supply balances are shown in the following table.

Table 2.1.2 Demand and Supply of Rice (unit 1,000 tons)

Year	1995	1996	1997	1998	1999	2000	2001	2001*
Production	149	246	279	187	246	204	217	340
Import	345	347	298	318	461	403	496	168
Stock increase (-)	0	-31	-21	10	-103	-72	-205	0
Total	494	562	556	515	604	535	508	508
Food	457	514	507	477	554	493	461	461
Seed	7	7	6	5	5	5	5	5
Livestock Feed	7	12	14	9	12	10	11	11
Waste	22	29	30	24	33	28	31	31
Total	493	562	557	515	604	536	508	508
Unit consumption (kg/cap)**	41.7	46.7	45.8	42.9	49.7	44.0	41.0	
Population (million)	10.96	11.02	11.07	11.12	11.16	11.20	11.24	
% Self-sufficiency	31%	45%	51%	37%	42%	39%	44%	63.0%

Source: FAO Note:* estimation by Study team for 67% of self-sufficiency, ** Calculated based on total consumption and population

In the government's self sufficiency policy, the immediate target for the rate of rice production is set at 63%.

The goal is to be attained not only by improving cultivation techniques but also by increasing area with irrigation facilities. In this sense, some areas of the Ministry of Sugar (MINAZ) can play an important role since before they cultivated sugarcane and presently are being reorganized for the production of other crops.

The policy of the MINAZ is to use 820,000 ha for sugar cane cultivation, which is enough to achieve the sugar production plan, and to use 1,300,000 ha for other productions such as viands, vegetables, fruits, forestry, grains, livestock, etc. Until November 25th, 2003, 594,103 ha have been

transferred from sugar cane to food production for the population[2]

Regarding the total land exploitation, 1,700,000 ha currently being used for sugarcane will have to be reduced, from the viewpoint of the physical conditions, amounting to 820,000 ha according to the last study on land use. The sugarcane land that does not have the conditions for this crop are fundamentally being dedicated to citric fruits and other fruits, forests, livestock and other crops, such as rice. 32,000 ha have been turned into citric crops.

The potential of rice production as an import substitute is calculated by the dollars which could be saved by reducing rice imports from 291,000 tons (=496,000 imports -205,000 storage) to 195,000 tons, namely, the difference of 96,000 tons in 2001. The total savings would be USD17.5 million in 2002 price.

> [=182.5 (CIF price/ton in 2002 price of rice from Vietnam/China at La Habana port: see section 4) x 123,000]

The size in terms of gross saving would be a little less than the earnings of the citrus exports. At the same time, CIF price at La Habana should be regarded as a benchmark price of the domestically produced rice.

(2) Consumption

In 2001, total consumption reached 461,000 tons. If roughly 20% went to the category of the social consumption, some 92,000 tons were consumed by individuals. (Used in Tourism: hotels and restaurants: approx. 8,500 tons for 19 million-day of foreign and domestic tourists in 2001.)

Ration system delivered 318,000 tons to the maximum, so, the rest (51,000 tons) were sold to the limited free market.

[461,000 = 92,000 (social use) + 318,000 (ration) +51,000]

(3) Production

Paddy production has been carried out for some time by different types of producers in terms of size and land holdings. According to the official statistics, all the large scale farms are state-operated enterprises on state land, which include GENT. There are three types of production cooperatives: namely, CPA CCS, and UBPC. In CPA the right of holding farmland is collective, whereas CCS is an individual landowners cooperative. UBPC possess state lands in free usufruct. There are three types of private producers: namely, '*parcelero*' (known as 6 cordeles), the upper limit of the holding is a quarter ha (0.25 ha), the usufruct is using the lands of the state enterprises as a permanent usufruct, and 'préstamo' is the tenant of the state land for rice production, up to 13.4 ha (1 cab).

(4) Imports

For some years, 25% broken rice has been imported mainly from Vietnam/China. Its CIF price at La Habana port was about USD182.5/ton in 2002.

Logistics: Milled 25% broken rice from USA costs $217.5/ton (CIF at La Habana) in 2002, whereas paddy rice cost $167.5/ton (CIF at La Havana). To switch to importing paddy may have

[2] Source: Interview with Ulises Rosales del Toro, Minister of Sugar. Granma Newspaper. Monday, January 12th, 2004.

some impact on rice industry as a whole. It would fill rice mill latent excess capacity to begin with, although conditions of rice mills are badly deteriorated. Then it would increase chaff and bran for the piggery industry. Compared with transporting milled rice, weight would increase by 50%, but unit freight cost would be half. Additional benefit in logistics is one tenth of transit days compared to the rice from Southeast Asia with a quarter size lots that could reach local ports, saving local transport cost. At present, paddy rice is not being imported from the USA because the price has increased over USD235/ton.

International Policy: Since approximately 4 years ago, commercial activity with the USA was started, mainly for the purchase of foodstuff, especially cereals for human consumption and also for the preparation of feed for livestock and for poultry. There are a many restrictions in commerce since Cuba cannot sell any of its products to the USA and the purchases have to be paid by cash without credits.

(5) Some aspects of the production costs

Manpower

The average requirement of manpower in cultivation of paddy fields is estimated at 0.4 ha/head at the present rate with the machinery and manpower in Santo Domingo municipality where the highest productivity is found.

Energy: fuel, electricity for motors

Regarding energy input, one of the government restructuring policies on agriculture, especially on paddy cultivation, is to switch from diesel fuel to electricity (i.e., internal combustion engines to electric motors as the energy sources of irrigation pumps).

The actual background of energy production and import is shown in the following table.

Table 2.1.3 Background of Energy Production and Imports in Cuba

energy	Crude		1000 ton	%	gas prod	import		electricity*	derivative
	production	import	Total	domestic	million m³	diesel oil	fuel oil	Gwh	1000 ton
1994	1,299	1,386	2,685	48%	19.8			11,964	1,546
1995	1,471	1,199	2,669	55%	17.3	1,564	3,143	12,459	1,595
1996	1,476	1,636	3,112	47%	19.3	1,530	2,912	13,237	1,963
1997	1,462	1,094	2,555	57%	37.2	1,745	3,662	14,146	1,493
1998	1,678	899	2,577	65%	124.2	1,440	3,449	14,149	1,259
1999	2,136	801	2,937	73%	460.0	1,541	2,946	14,492	1,138
2000	2,695	1,648	4,344	62%	574.1	1,346	2,416	15,032	2,285
2001	2,886	1,715	4,601	63%	594.6	1,154	1,982	15,301	2,431

Source:Oficina Nacional de Estadistica 2001, *Nivel de electrificación: 2001=94.79%, CIA country fact book, 2003

Fertilizer and Chemicals:

The conditions of consumption of chemical fertilizers and pesticides are shown below::

Table 2.1.4 Consumption of chemical fertilizers and pesticides.

Insumo	Unit	1995	1996	1997	1998	1999	2000	2001
Amonia nitrates	1000 ton	123.7	121.7	50.0	23.1	20.4	37.4	22.0
Complete Fertilizers	1000 ton	217.6	241.5	183.5	156.7	138.3	118.2	92.7
Mixed insecticides	Ton	3,428.5	2,967.6	2,666.7	2,286.4	2,978.8	1,948.0	4,165.6
Herbicides and defoliants	Ton	109.8	327.5	1,480.5	3,679.0	3,965.2	4,948.0	4,933.1

Source: Oficina Nacional de Estadistica 2001

2.2 Brief Explanation of Rice in Cuba

2.2.1 Rice in Cuba

Rice cultivation was established in Cuba in about 1750, but it gained economic importance in the late 20th century when some American varieties were introduced in the country, mostly from Texas. Most of them came originally from Asia, like the *Honduras* variety, introduced in the United States at the end of the 19th century from India, known in Cuba as *Zayas Bazan*. Also, the *Nira* and *Rexoro* varieties (known in Cuba as *Rexora*), were brought to the United States from the Philippines during 1911 and 1916, and the *Fortuna* variety, selected from a variety coming from Taiwan. These varieties, considered as leaders in genetic improvement in the United States, had as a main characteristic, an excellent quality of the grain, mainly *Rexoro*, as well as a tolerance to drought. Nevertheless, these were very susceptible to lodging and some of them as *Fortuna* and *Honduras* are sensitive to photoperiod. Later, other varieties were brought during the 1950's and the early 1960's, such *as Blue Bonnet 50* and *Century Patna 231*. Since 1967, several semi dwarf varieties were introduced from the International Rice Research Institute (IRRI) in the Philippines and from the International Center of Tropical Agriculture (CIAT) in Colombia.

2.2.2 Production in Specialized Enterprises

Since 1967, the Program for Rice Development took place in order to improve rice crop in Cuba. Among the main activities carried out for this program are:

- Creation of the productive infrastructure (civil works, irrigation systems, machinery, etc.) inside the enterprises of specialized rice.
- Creation of stations for rice research in the country.
- Creation of the bank of rice germ plasma.
- Establishment of the structure of production and certification of seeds.
- Establishment of the variety policy for rice cultivation.
- Establishment of the plant protection policy.
- Establishment of the agrochemical service

Six big rice enterprises were established at first and further three others were founded with the addition of those in Ciego de Ávila, Holguin and Las Tunas. The average of sowing area during 1980 and 1990 was about 130,000 ha. This number went down dramatically during 1990 and 2000 because of the economic crisis that affected the country when the Soviet Union and the socialist block collapsed, loosing the market for main Cuban products.

These enterprises are called Agro-industrial Complex (Complejos Agroindustriales: CAI). Besides rice cultivation taking care of the whole post harvest process, they carry out other complementary productions, basically having to do with livestock for soil rotation.

Production in these CAI is technologically carried out with mechanized units, using planes and land-based machines for every activity in cultivation. Chemical fertilizers and pesticides are applied to control weeds, insects and diseases caused basically by fungus. Biological products have also been used for insect control.

2.2.3 Production of Popular Rice

Although rice was brought to Cuba and farmers have cultivated popular rice spontaneously, these

activities were never widely developed. Cooperative associations and other institutions not belonging to CAIs also have been producing popular rice to distribute supplemental rice to their staff.

In 1996, the Ministry of the Agriculture (MINAG) decided to encourage popular rice production. Also MINAG designed the Union of CAIs (today Agro industrial Group of Cattle and Rice –GAIPA) and IIArroz to take the necessary measures for leading and organizing popular rice production.

The main goals of Popular Rice production are the following:

- Sustainable production and low use of equipment.
- Productions, mainly ecological, based upon the use of varieties adapted to different ecosystems. maximize use of bio-fertilizers, bio-pesticides, organic matter and use of green manure in systems of crop rotation.
- Design of the production on a small and medium scale; wide utilization of animal power in cultivation.
- Capacity building of producers.

Popular rice production grew from 111,800 tons of white rice in 1996 to 225,700 tons in 2002. The prices of Popular Rice in the markets decreased about 60% in the same period.

Taking into account of the need of decreasing rice importation, a group of technical activities have been conceived in order to reach production of 500,000 tons [3] of white rice in medium term, among which are:

- To develop sowing techniques with transplanting technology, sowing twice a year and using sprout cultivation.
- To increase the use of varieties of early rice (less than 130 days), to guarantee two crops per year, and to use less equipment in cultivation.
- To establish and guarantee the production of certified seeds.
- To identify and present in maps of the lands which are potentially suitable for rice cultivation in the provinces and municipalities.

2.2.4 Rice Research Institute

The Rice Research Institute (IIArroz) belongs to MINAG; its headquarters are located in Bauta municipality, in La Habana province. This headquarters is the principal in all the researches related to rice cultivation in Cuba, and for this purpose it has three experimental stations located in the provinces of Sancti Spíritus, Camagüey and Granma. In addition, there are other centers in Cuba that carry out researches on cultivation, such as the Experimental Station of Rice in Los Palacios, Pinar del Río province. This Experimental Station is working in the obtaining of new varieties, water management etc. , and have achieved good results.

The headquarters of IIArroz has the Bank of Rice Germplasm of Cuba, where more than 2,300 foreign and national varieties are found, among which are the varieties used traditionally by farmers during many years.

One of the main works of IIArroz is genetic improvement, which has had an important impact on rice

[3] This amount is more or less equivalent as 63 % self-supply for total consumption.

cultivation in the country. It should be pointed out that the improvement program was basically conceived for state production. During the last few years, a great effort has been made in obtaining varieties for low water and fertilizers conditions and good results have been attained. Today, in the improvement program, some projects have been implemented, such as the molecular and morphological characterization of a group of traditional varieties. The improvement program is in charge of the production of basic and original seeds. The registered seeds and the certified seeds of the first generation are produced in other areas of the institute.

IIArroz is also working in researches related to crop protection, mainly in the control of weeds, insects and diseases. Another line of work is related to fertilization, both chemical and organic, the use of bio-regulators and green manure. Researches are also carried out on post-harvest technologies and the determination of the technologies for exploiting the new varieties. The institute also has specialists in agronomy, physiology and mathematics that are taking part in different research projects.

Since the program of Popular Rice began to be developed, IIArroz and its stations system have been leading this program. The Experimental Station of Rice in Jucarito (Granma) is in charge of the eastern provinces: Granma, Holguin, Las Tunas, Guantanamo and Santiago de Cuba. The Experimental Station of Rice in Vertientes (Camagüey) is in charge of the provinces of Camagüey and Ciego de Ávila. The Experimental Station of Rice in Sur del Jibaro (Sancti Spíritus) is in charge of the provinces of Sancti Spíritus, Villa Clara and Cienfuegos. The headquarters of the institute is in charge of the provinces of Matanzas, La Habana and Havana City, as well as the methodological direction of every station. The Experimental Station of Los Palacios is in charge of the province of Pinar del Río.

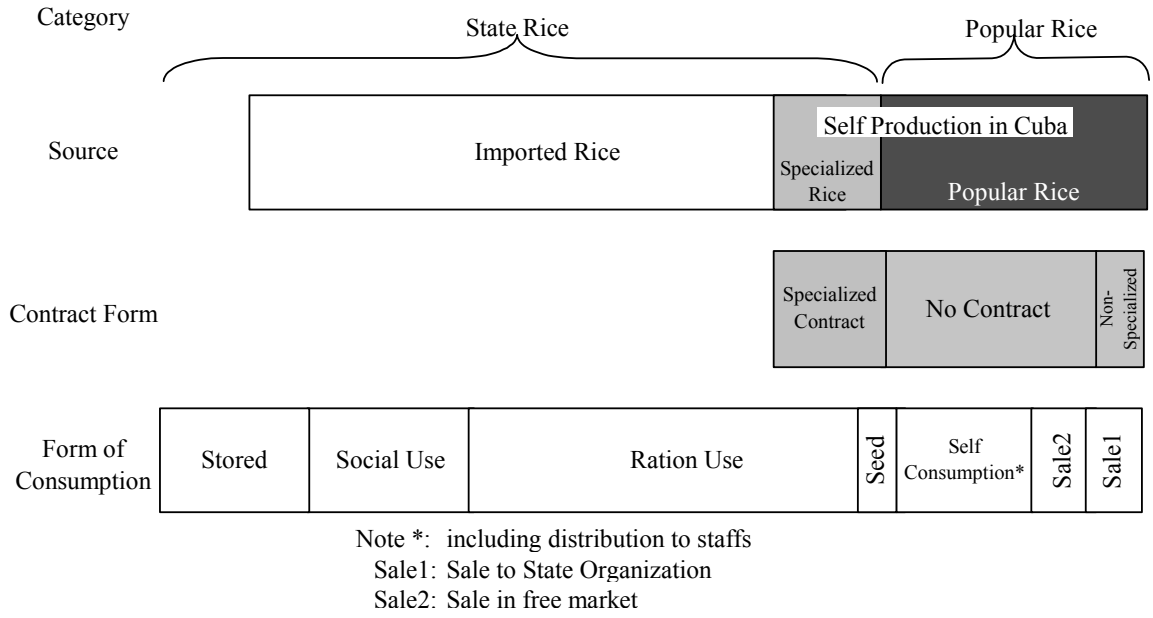
CHAPTER 3 PRESENT CONDITIONS OF POPULAR RICE

CHAPTER 3: PRESENT CONDITIONS OF POPULAR RICE

3.1 Production and Consumption of Rice

3.1.1 Popular Rice and Specialized Rice

The characteristics of rice in Cuba are outlined in Fig. 3.1.1.



Note *: including distribution to staffs
Sale1: Sale to State Organization
Sale2: Sale in free market

Fig. 3.1.1 Classification of Rice in Cuba

(1) Categories of rice

There are two categories of rice: State Rice and Popular Rice.

- State Rice consists of imported rice (the main source actually) and Specialized Rice and both are controlled by the government. Mainly, the State Rice is used for social and ration uses, but some quantities can be sold in the state market (through MINCIN) in order to supplement the amount of rice in the market and to stabilize the selling price of the free market. (The government selling prices in the state market at present are 3.5 pesos/Lb for Vietnamese rice and 3.5 to 4.0 pesos/Lb for rice imported from USA)
- Popular Rice is produced by individual producers and organizations for mainly supplemental self-consumption. It has been produced from olden times spontaneously, until 1996 when the government started a program to develop Popular Rice production. In 2003, according to GAIPA, around 65% of total production of Popular Rice was used for self-consumption (including distribution to staff and seed), and 35% was sold to outside. Based on non-Specialized contract (Non-especializado), a small portion of Popular Rice should be sold to Rice CAI or other governmental institutes, but basically the Popular Rice can be sold freely in any market. In 2003, around 60% of total amount was sold to different organizations (Complejos Agroindustriales Arroceros (CAI), Empresa de Acopio, Granja Urbana y Unidad Básica Alimenticia (UBA) and the remaining 40% was sold to the state/free market.

(2) Sources

There are two sources of rice: imported rice and self-production rice.

- It is estimated that Cuba imports around 65% of total consumption of rice from Vietnam and other countries. (Rice imports from USA started in 2002.)
- Cuba's rice production was approximately 292,000 tons in 2002 and this self production is divided into two categories: one is Specialized Rice (approximately 66,000 tons in 2002) which is produced based on a specialized contract between CAI and rice production units (described later) and mainly use for rationing and social use.

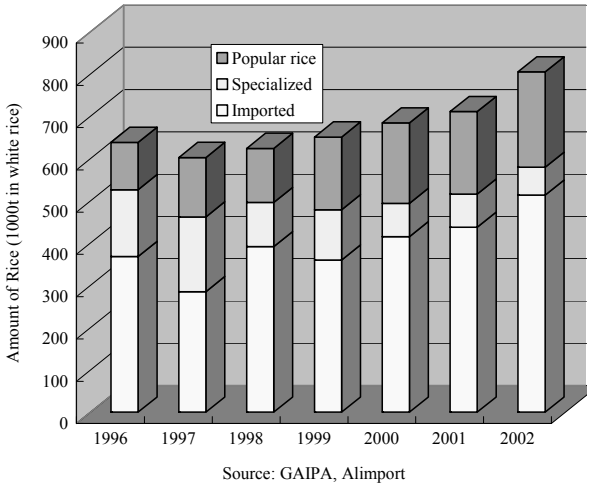


Fig. 3.1.2 Amount of Rice Supply in Cuba

- Another is Popular Rice (approximately 226,000 tons in 2002), which is produced by individual rice producers or non-rice production units for mainly self-consumption.

(3) Production contract form

There are three contract forms for rice production:

- Specialized Contract: The Cuban Government makes a production contract through Rice CAI with the production units for the State Rice. Rice CAI supply to these producers agricultural inputs for rice production such as seed, agro-chemical, fertilizer, fuels for agricultural machines including irrigation pump and they sell all rice production to CAI at the price of 0.15 pesos/Lb. (The price of Ration Rice is 0.25 pesos/Lb, and the government also sells the State Rice at the same price as that of State market.)
- Non-Specialized Contract: Individual rice producers or non-rice production units make production contract with Rice CAI or state institutes which supply land and agricultural inputs for Popular Rice. The producers get agricultural input of rice production from Rice CAI and they sell some amount of the production based on contract to Rice CAI or state institutes at the price of more or less 0.75 pesos/Lb (paddy). Rice CAI mainly sells this rice in the state market (for 2.7 to 3.5 pesos/Lb in white rice) for stabilizing the market price of rice. The state institutes use this rice for self-consumption.
- Non-contract: Individual rice producers or non-rice production units produce the Popular Rice without any contract and they prepare the agricultural inputs by themselves. The Popular Rice is mainly used for self-consumption including distribution to their staff, and surplus amount is sold to Rice CAI, other institutes, enterprises and state/free markets. In case of Rice CAI, they buy this surplus rice at the price of around 2.5 pesos/Lb and also sell it in the state market for stabilizing market price of rice. For the individual rice producers who do not have any processing facilities or marketing channel, they sell this surplus rice to Rice CAI.

(4) Form of consumption

Based on the Population and estimated consumption rate by the Study Team (60 kg/inhabitant/year), the total consumption of rice can be estimated roughly as around 675,000 tons in 2002. There are several forms of consumption as follows:

- Stored Rice: According to information of FAO, the Cuban government stored rice of around 200,000[1] tons in 2001.
- Social Use: In the social system of Cuba, the Government supplies the food in schools, hospitals, Governmental institute and the army and it is estimated that approximately 20% of total rice consumption amount is consumed for Social Use. State Rice is used for this purpose. According to data of ALIMEC, about 10,000 tons each month are distributed for social use.
- Ration Rice: In the social system of Cuba, the Government must distribute ration rice to people (6 Lb/month for an inhabitant in Havana City and Santiago de Cuba, and 5 Lb/month for an inhabitant in other provinces) and it is estimated that the amount of rice for ration use is approximately 315,000 tons (47% of total consumption). According to data of ALIMEC, each month about 28,000 tons are distributed for ration use. The State Rice is also used for ration use.
- Seed: Some amount of the production must be kept as seed for next year. The amount of seed is expected to be around 5% of the production amount and it may be equivalent to 30,000 tons on white rice base.
- Self-Consumption: Around 50% (approximately 140,000 tons is estimated in 2003) of Popular Rice production is used for self-consumption of Popular rice producers. This includes supplying food and distributing to their staffs. Most of Popular Rice producers also consume ration rice.
- Sale to state organization: Around 20% of Popular Rice (approximately 55,000 tons in 2003) is sold to state organizations such Rice CAI, Acopio, other organizations (UBA MINCIN, Granjas Urbanas, Empresas Estatales). CAI/Acopio buys most of the rice (46,000 tons) and sells it in the state market. Other organizations use it mainly for their self-consumption.
- Sale in the market: Around 15% of Popular Rice (approximately 41,000 tons in 2003) is sold in state/free market. According to interview investigation, farm gate price is more ore less 0.7 to 0.9 pesos/Lb for wet paddy rice and 2.5 pesos/Lb for white rice. But in some cases, a middleman comes to the farm and buys the rice at a price more attractive to the farmers. Also according to random investigation on the state/free market, not only CAI/Acopio but also individual production units and individual producers sell popular rice. The market price is mainly 3.0 to 3.5 pesos/Lb, but it was found that the price is more than 5.0 pesos/Lb with high quality rice.

3.1.2 Production Units and Organizations Concerning Rice Production

There are several organizations concerning rice production in Cuba as described below.

(1) Governmental institutions and supporting organization

a. GAIPA (Agro-industrial Group of Cattle and Rice)

Previously, the All Union of Rice Production, (now, GAIPA), had the responsibility of the

[1] In white rice

technical support of the rice production because they had staff working for different sectors in agronomy, plant protection, irrigation and drainage, seed production, mechanization, etc. In the last few years, the responsibility for providing technical guidance has come to IIArroz, while GAIPA has the responsibility to check the rice production policy.

b. CAI (Agro-industrial Complex).

During many years, the agricultural production and the industrial processes were separated for important crops such as rice and sugarcane. In case of rice, the Ministry of Agriculture produced rice and sold the paddy rice to the Ministry of Food Industry (Ministerio de la Industria Alimenticia). The dryers and the millers belonged to this ministry. The creation of the Agro-industrial Complex permitted to joint the industry and the agriculture.

In 1967, the government began to develop the rice production and organized rice production in six enterprises located in the following provinces: Pinar del Río, La Habana, Matanzas, Las Villas (actually CAI of Sancti Spíritus), Camagüey and Oriente (actually CAIs of Granma, Holguín and Las Tunas). Later, eight CAIs Rice were created and over time reduced to six.

- **Rice CAI:** The role and responsibilities of Rice CAIs (established about 1994) is not only the rice production but also seeds production, post harvest processing and production of meat and milk. They have been producing specialized rice, and from 1996, started to coordinate and establish some contracts (non specialized) with popular rice producers in some provinces. Rice CAI promotes the rice production in Cuba, distributing high-quality seed, procuring agricultural input and fuels for rice production, post harvesting (drying, milling and marketing) and technical support to producers jointly with IIArroz. Rice CAI makes specialized contracts with rice production units such as Rice UBPC, Rice CPA, CCS and State Farms. This production is for social and ration uses. Rice CAI also makes non-specialized contract with popular rice producers such as Non-rice UBPC, Non-rice CPA, CCS, others institutions and individual producers. This production is sold in the state market in order to stabilize the market price of rice.
- **Non-rice organizations:** There are different organizations producing non-specialized rice in order to supply more rice to their members. Among them are enterprises belonging to MINAG and others from MINAZ. The producers included in this category can sell the surplus directly in the state market or sell the rice to any state enterprises with permission to buy and sell rice (Rice CAIs, Acopio, Unidad Básica Alimenticia and Granja Urbana). MINAZ has a high potential because it is expecting to actually change some areas from sugar cane to others crops including rice.

c. Popular Rice Unit (Unidad de Arroz Popular)

Since 1996, when popular rice promotion program was started, MINAG decided to nominate a Head of Popular Rice in each province. Five years latter, in 2001, the Popular Rice Units were established. The Popular Rice Units are placed under Rice CAI administratively and are very closely related to GAIPA[2]. The main activities of Popular Rice Unit are coordination for institutes and organizations concerned with popular rice and support to popular rice production units. It also has a role as the core of promotion activities at the provincial level. Popular Rice

[2] Presently, financial source of popular rice unit is changed to municipality in some provinces.

Unit is also buying popular rice and selling it in the state market. Although the process of establishment and organization form of popular rice units are slightly different among the Provinces, basically, its staff consist of a chief, several experts (such as engineer, economist, administrator), minimum one extension officer for each municipality, and some local staff (laborers, driver, etc). For the strengthening of Popular Rice unit activities, it is also planned to increase the number of extension officers in July 2004.

Table 3.1.1 Summary of Popular Rice Units in Central 5 Provinces

Provinces	Financial source	Number of Staff*	Proposed extension officers
Cienfuegos	CAI Sur de Calimete in Matanzas. (they expect to change to Aguada municipality in July 2004)	Chief/experts: 8 Extension officer: 8 Other Staff: 12	22
Villa Clara	CAI Sur del Jibaro in Sancti Spíritus	Chief/experts: 5 Extension officer: 13 Other Staff: 4	24
Sancti Spíritus	CAI Sur de Jibaro in Sancti Spíritus	Chief/experts: 2 Extension officer: 8 Other Staff: 3 (Chief is sub director of province)	27
Ciego de Ávila	Empresa Agroindustrial Integral en Chambas	Chief/experts: 3 Extension officer: 11 Other Staff: 1	15
Camagüey	CAI Ruta Invasora in Camagüey	Chief/experts: 4 Extension officer: 13 Other Staff: 6	22

*numbers of staff as of June 2004 Source: GAIPA.

d. Empresa de Acopio

It is a group of enterprises belonging to MINAG, which is in charge of buying the agricultural productions from producers and selling to state market.

e. MINCIN

It is the ministry in charge of the distribution of rice for ration use and for social use. A small portion of imported rice can be sold by this ministry in the shops at the price of 3.50 pesos for Vietnamese rice.

f. ANAP (Asociacion Nacional de Agricultores Pequeños)

In 1961, ANAP was established for promoting the organization of CPA and CCS consisting of small and medium scaled producers who are landowners. Since 2002, ANAP started to promote the organization of parceleros (6 cordeles) in new CCS.

(2) Rice production unit

The agricultural production unit in Cuba is classified into several categories as shown below.

Table 3.1.2 Summary of Agricultural Production Unit in Cuba

STATE SECTOR		State enterprise, New Type of State Farms (GENT), Agricultural farms of the Army (FAR), including the Work Youth Army (EJT) and the MININT
		State entities and workers consumption
NON STATE SECTOR	Collective production	UBPC- Rent
		CPA- Cooperative
	Individual production	CCS- Private
		Parceleros, Préstamos (individual and relatives)
MIXED SECTOR		Mixed enterprise- State

Source: TRANSFORMANDO EL CAMPO CUBANO. AVANCES DE LA AGRICULTURA SOSTENIBLE. 2001. ASOCIACIÓN CUBANA DE TÉCNICOS AGRÍCOLAS Y FORESTALES. ISBN: 959-246-032-9. LA HABANA, CUBA

Their land holdings are summarized as shown below.

Table 3.1.3 Structures of Land Holding

Structure	Origin	Land and input	Economical beneficiaries
CPA	Lands owners	Voluntary delivery and association	Direct according to personal participation
CCS	Holders, agricultural workers, owners, associates, adherents	Private and renting lands	Bank credits, personal benefit in utilities
UBPC	Ex workers of state enterprises	Collective renting lands. Buying equipment, animals, etc.	Benefit according to participation
Rented lands, rural sector (usufructo)	State areas, coffee, cacao and tobacco cultivation (Rice)	State renting lands	Sell the main crop to the State, free self-consumption and sell the rest of other crops
Rented land Urban agriculture (Parceleros 6 cordeles)	On the roof, court, balcony, urban and quasi urban plots	Private or renting lands. Using organic means. Renting 0.25 ha.	Self-consumption, sell to the neighboring, mainly vegetables, flowers, seasonings, animals.
New Type Farms (GENT)	State farms without conditions to become part of UBPC	State lands, means and tools. Larger management autonomy than State enterprises	According to the work done and the productive results.
State enterprises	Lands belonging to the Cuban State	Every item belongs to the State.	Supplying to the population and for export; salary workers

Source: TRANSFORMANDO EL CAMPO CUBANO. AVANCES DE LA AGRICULTURA SOSTENIBLE. 2001. ASOCIACIÓN CUBANA DE TÉCNICOS AGRÍCOLAS Y FORESTALES. ISBN: 959-246-032-9. LA HABANA, CUBA.

a. UBPC (Basic Unit of Production Cooperative)

UBPC was established in September 1993 as an association which was formed by employee of the former state enterprise. The land belongs to the state and it is surrendered without payment of rent. The production means belong to UBPC. They maintain commercial relationships with the state companies from which they arose, and with which they negotiate their production plans and price of the products. The Ministry of the Agriculture has organized UBPC for several crops like citric and fruit-bearing crops, coffee and cocoa, tobacco and rice. The management of UBPC is on a self-paying basis and the benefit of production is distributed among their members.

- Rice UBPC: They are producing Specialized Rice based on special contract with CAI and they sell the production to CAI. They succeed by using rice production technologies on a large-scale: namely, airplanes, big agricultural machines and irrigation scheme with large agricultural inputs.
- Non-rice UBPC: They are mainly producing agricultural production other than rice, and they produce Popular Rice using small-scale land. Most of them have Non-special contract with CAI/Acopio for getting agricultural inputs for rice production. Mainly, the purpose of popular rice production is for their self-consumption including distribution to their staff; however, recently, they have been starting to sell their surplus Popular Rice in the market. According to GAIPA, they produced around 27,000 tons of Popular Rice (about 10% of total Popular Rice production) and sold around 6,000 tons (about 22% of their production) to state organization in 2003.

b. CPA (Cooperatives of Agricultural Production)

CPA is the voluntary association of small farmers to unite their efforts for collective agricultural production on the basis of unification of their lands and other production means. The

Cooperative of Agricultural Production is an economic and social organization and in its administration it has autonomy regarding the state, since CPA is a juridical entity. It develops its activity inside the general interests of the society and according to the democracy and the common work of its members. CPAs were established in 1977. There are also two types of CPA (CPA specialized in rice and Non-specialized in rice). Some of non-specialized rice CPAs have a place in state/free market and they handle sale of Popular Rice by themselves as well as other main products. According to GAIPA, non-specialized rice CPAs produced around 26,000 tons of Popular Rice in 2003 (about 10% of total Popular Rice production) and sold around 7,000 tons (about 25% of their production) to state organization in 2003.

When CPA was formed, individual producers contributed their own land to CPA through a system as land substitution with governmental land. However, it is important to note that on establishment of its process, that there were two types of concerned parties: persons who became members with actual contribution of their own land, and also ones who did without land contribution. Persons who do not contribute land have been allowed to become members still now (actually, more than before).

Land contributors, many of whom already retired from CPA, have no obligation to work in the field, although they maintain the privilege to purchase produce of CPA at a cheaper price.

The following chart shows general organization structure of CPA.

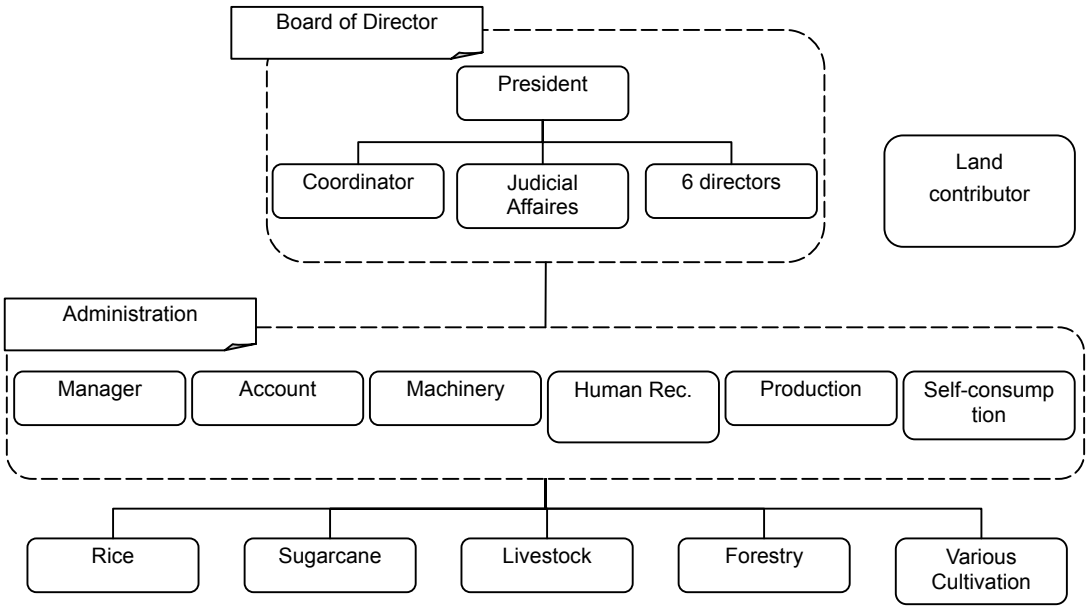


Fig.3.1.3 CPA Organization chart

Job assignment of members is generally determined by variety of crops, indicating that members assigned to rice crop continue to be in charge of rice production every year. Although degree of job categorization by crops depends on scale of CPA, most CPAs have specified persons in charge of rice production only.

Members of CPA receive salary every two weeks (15 days) and an yearly bonus in accordance with the profit of CPA and every one effort at the end of year. It is considered as a way to promote member motivation.

c. CCS (Cooperatives of Credit and Service)

CCS is also one of the cooperatives formed by private agricultural producers but it consists of small- and medium-scale producers (mainly more or less than 10 ha) who have their own land and manage their farmland individually. The difference from CPA is that the agricultural management is carried out individually for their own land. Most of members of CCS sell their agricultural products through CCS and they also have non-specialized contract with CAI/Acopio. Some CCS members are mainly producing popular rice and also have rice-processing machines. Some CCS members have a place in state/free market and they sell Popular Rice by themselves, as well as other main products. According to GAIPA, they produced around 88,000 tons of the Popular Rice in 2003 (about 30% of total Popular Rice production) and sold around 39,000 tons (about 44% of their production) to state organizations in 2003.

CCS, group of individual producers, formed its original body in the era of land reform in early 1960's. At present CCS is separated into two types: CCS and CCSF (F: fortalecido; reinforced). CCSF is a new form launched in 1997, and many CCS members have transferred into CCSF by this time.

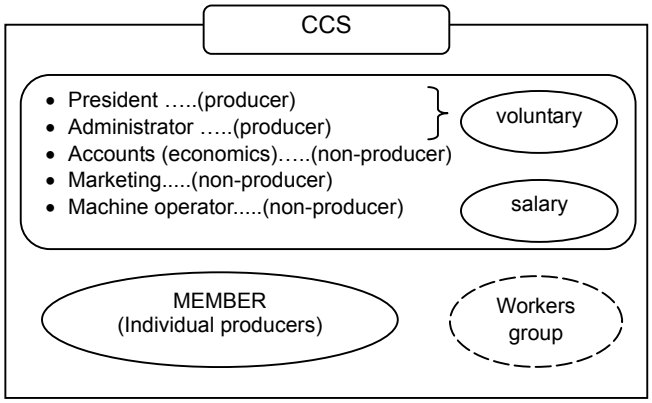


Fig.3.1.4 CCS Organization Chart

The essential difference between CCS and CCSF is as follows. CCSF: 1) the board of directors consists of persons in charge of marketing, accounts, etc., on a salary basis; and 2) machinery belongs to CCSF for communal use. On the other hand, CCS has only a president and an administrator, and also no communal machinery. In general CCSF is a larger organization than CCS pointing terms of production and members[3].

CCS (meaning CCSF from now on) is composed of individual producers themselves with board of directors mainly consisting of president, administrator, accountant, marketing, and production. Although the name of positions and their numbers differ from CCS to CCS, at least president, administrator, accountant, and marketing in-charge are found in all CCS. Both president and administrator, individual producers as well, engage in the positions on a voluntary basis, while accountant and marketing in-charge are employed by CCS for their own professional training.

Incentives for the CCS members are as follows: 1) They can receive credit from bank more easily than individual, 2) They can make sales contract through/with CCS, 3) They can acquire diesel fuel, fertilizer, etc., 4) They can utilize machinery, and 5) They can sell produce in weekend market (Feria). These positive factors encourage producers to become members of CCS. On the other hand, negative factors include that producers feel uneasy unless participating in some group.

Members of CCS have obligation to contribute annual member fee to CCS in accordance with

[3] Among the targeted municipalities only Santo Domingo and Yaguajay have CCS (Santo Domingo:CCS:9; CCSF:8), Yaguajay:CCS:21; CCSF:8). All the CCS in three other municipalities had already converted into CCSF (Aguada de Pasajeros:9, Vertientez:13, Chambas:9).

results of their own sales, which fall around 100 pesos a year. Moreover, 2% of their sales are transferred to "Social culture fund" of CCS, whose major purposes are to sustain general activity budget of CCS and to help out during sickness members as a kind of insurance.

CCS in general accepts members who have their own farmland as precondition to become members. However, only CCS in Santo Domingo had admitted Parcelero as members, even though Parcelero has no farmland of their own.

d. GENT (State farms of New Type)

They are state companies created in places where conditions do not exist to constitute UBPC. These state farms possess bigger autonomy than the traditional state farms. According to GAIPA, they produced approximately 5,000 tons of the Popular Rice in 2003 (about 2% of total Popular Rice production) and sold around 1,400 tons (about 28% of their production) to state organizations in 2003.

e. State company: State self-consumption

Some companies and institutions of sectors not linked to agricultural production have used idle lands, with the objective of producing foods for self-consumption and to sell to workers. These productions are generally carried out with low inputs and in a sustainable way. Although they also have non-specialized contract with CAI for obtaining the agricultural inputs of rice production and selling a small amount of it to CAI, they do not sell Popular Rice in the market by themselves so far. According to GAIPA, they produced around 30,000 tons of the Popular Rice in 2003 (about 10% of total Popular Rice production) and sold around 8,600 tons (about 29% of their production) to state organizations in 2003.

f. Renter producers

i) Usufructo

The Usufruct is one of the systems of rented land for increasing agricultural production in Cuba, according to Resolution No.223-95. The land is free of charge but the Usufructo must sell some part of their production to the organizations that have lent the land. The rest of the production is used for self-consumption and the surplus of the production can be sold freely. Some of them produce popular rice for self-consumption in addition to main crops. Concerning popular rice production, Usufructos have a non-specialized contract with their related organizations and some amount of popular rice is sold to their related organizations. The remaining amount of rice is used for self-consumption. The amount of their popular rice production is counted from their related organization in statistics and actual conditions of their popular rice production is not known clearly.

ii) Parceleros (6 cordeles)

The government made the decision of giving lands (0.25 ha: 6 cordeles) to families for the production of food with the objective of family self-consumption, according to Resolution No. 356-93. These producers can sell the surpluses of their production freely. Some of them are producing Popular Rice using some part of their free rental land. They also make non-specialized contract with CAI for getting agricultural inputs and sell a small amount of Popular Rice to CAI at around 0.70 pesos/Lb (wet paddy). The remaining amount of rice is used for self-consumption and, in case they have surplus amount, it is mainly sold to CAI at 1.20 to

1.60 pesos/Lb (wet paddy). According to GAIPA, they produced around 68,000 tons of the Popular Rice in 2003 (about 25% of total Popular Rice production) and sold around 17,000 tons (about 25% of their production) to state organizations in 2003.

The formulation of new CCS for Renter producers has been promoted since 2002 by ANAP but their functions are not yet activated.

g. Préstamos

Préstamos is one of the rental land systems for increasing popular rice production in Cuba. The regulation was prepared in 2001 and came into force in 2002. Mainly the land from rice UBPC is lent to retired persons, self-employed, unemployed persons, etc. with a maximum 13.4 ha for one person. At present, Préstamos are producing only popular rice (it is possible that this system might be extended to other crops). The land is free of charge but Préstamos make production contract (non-specialized) with rice CAI and they sell some amount of popular rice to CAI based on the contract. Basically, the remaining amount of popular rice can be sold freely. Most préstamos are using the same production techniques as that of UBPC and they have problems such as lack of agricultural inputs, even if they have non-specialized contract with CAI. Most of them also have problems with land lending rental period (for 1 year) and they cannot make investment in the land because it may be changed every year.

According to GAIPA, they produced around 27,000 tons of the Popular Rice in 2003 (about 10% of total Popular Rice production) and sold around 17,000 tons (about 60% of their production) to state organizations in 2003.

3.1.3 Present Conditions of Popular Rice Production

(1) Cropping area and production of rice in recent years

Cropping area and production of Popular Rice and Specialized Rice from 1996 to 2002 is shown in Fig.3.1.5.

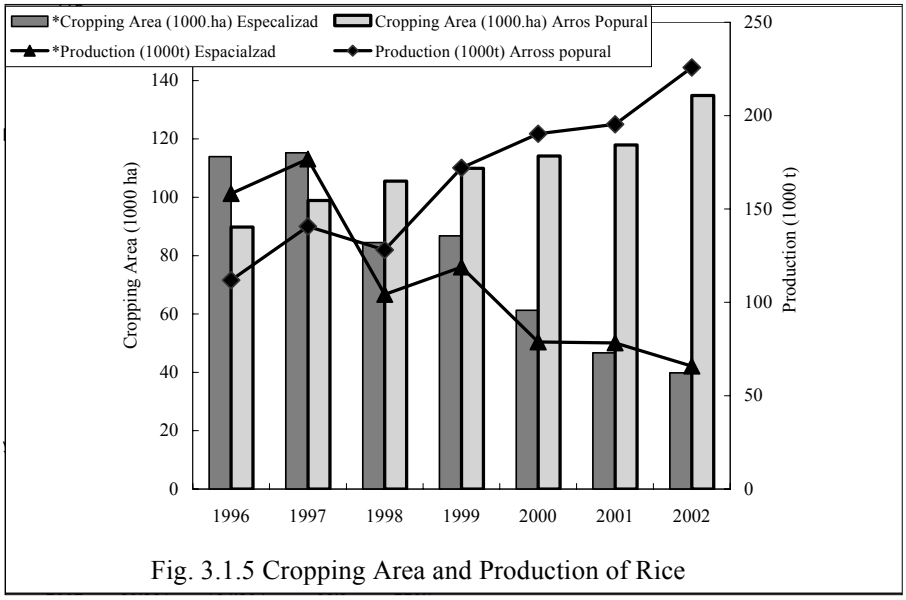


Fig. 3.1.5 Cropping Area and Production of Rice

Due to lack of agricultural inputs, the production of Specialized Rice has decreased from around 104,000 tons in 1998 to 66,000 tons in 2002. On the other hand, due to self-effort by producers and the Governmental support, Popular Rice production has increased from around 112,000 tons in 1996 to 226,000 tons in 2002. The yield (white rice base) increased from 1.23 tons/ha in 1998 to 1.65 tons/ha in 2002 for Specialized Rice and from 1.25 tons/ha in 1996 to 1.67 tons/ha in 2002 for Popular Rice.

(2) Conditions of popular rice production

The Popular Rice Production and Cropping Area in 2002 are shown in Figs. 3.1.6 and.3.1.7.

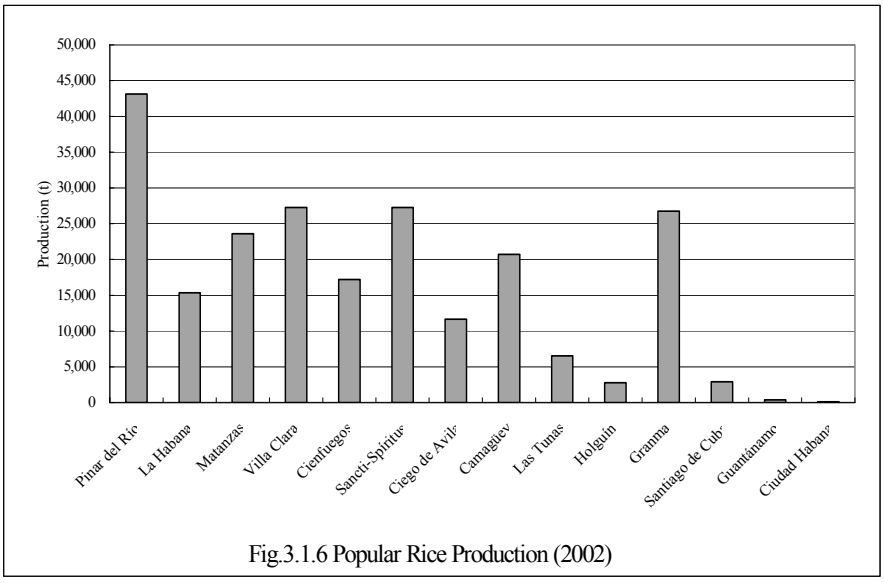


Fig.3.1.6 Popular Rice Production (2002)

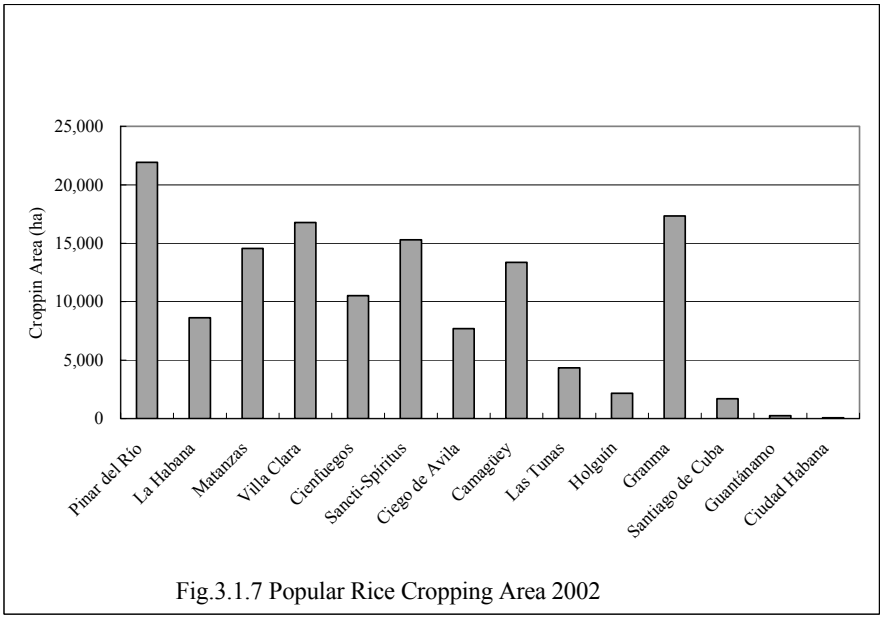


Fig.3.1.7 Popular Rice Cropping Area 2002

Both production and cropping area in Pinar del Río Province is the highest in Cuba and around 20% of total Popular Rice production is produced in this province. Concerning the 5 central Provinces, approximately 104,000 tons of Popular Rice is produced and this is equivalent to around 47% of total amount of Popular Rice production in Cuba.

The Popular Rice productive results of each production unit are shown in Fig.3.1.8.

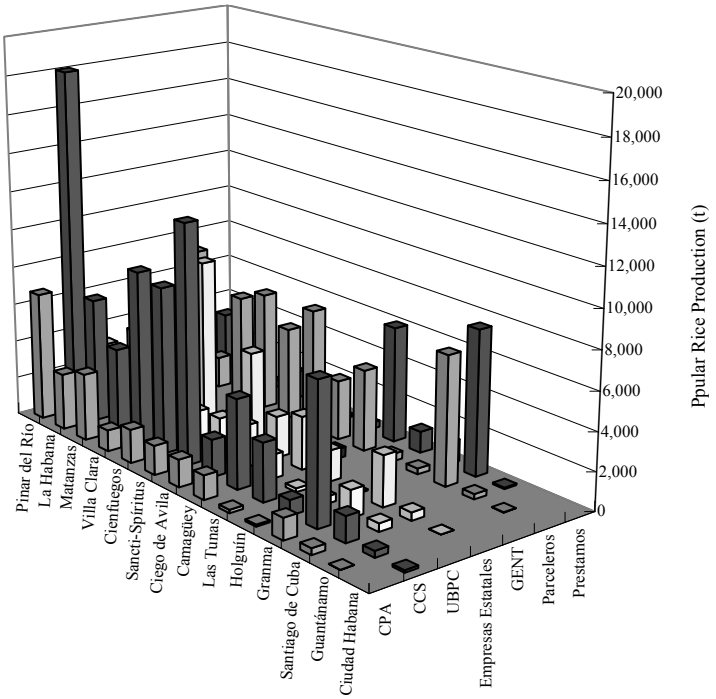


Fig 3.1.8 Popular Rice Production of Production Units 2002

Production of CCS in Sancti Spíritus is quite high. The production of UBPC (non-rice) in Villa Clara and Sancti Spíritus is relatively higher than that of other provinces. It is assumed that this tendency is occurring since there are many sugarcane UBPCs producing popular rice. Production of Préstamos in Camagüey is also relatively high and it is assumed that many of Préstamos can borrow the land from Rice UBPC in Camagüey.

3.2 Rice Production Techniques in Cuba

3.2.1 Rice Cultivation Techniques

(1) Ecosystem of rice cultivation

The rice plant in Cuba is grown in the upland field, the rain-fed paddy field and the irrigated paddy field. The upland field is a normal field where the drainage is excellent, water doesn't collect in surface of the field, and the upland rice plant is grown. The rain-fed paddy field is a paddy field that depended on the rain water with which the irrigation facilities have not been fully equipped. It is located relatively high on geographical features, and an individual field is enclosed by simple levee. The rice in the rain-fed paddy field has been always accompanied with the problems of the drought and the flood. The lowland rice varieties can be grown in the rain-fed paddy field where relatively suitable for the rice cultivation and can not be grown in other rain-fed fields. The irrigated paddy field is enclosed by the levee, can be irrigated and drained well, where the depth of the flooded water can be kept suitable depth for the paddy rice at any time and the paddy rice is grown. The

irrigation method of refraining from the irrigation water by using precipitation when there is a lot of precipitation in the rainy season to reduce the irrigation cost is called Secano favorecido in Cuba. The cultivation techniques used in the Secano favorecido paddy field is the same as the irrigated rice field.

(2) Rice growing season

There are two rice growing seasons in Cuba as shown in Table 3.2.1: the rainy season (summer season, May to September) and the dry season (winter season November to April) and it is possible to make rice double cropping with irrigation system. As the varieties of rice in Cuba are sensitive to temperature, the growing period at the rainy season when the temperature is high is shorter than that at dry season when the temperature is low.

Table 3.2.1 Rice growing season in Cuba

Variety	Middle-ripening variety		Early-ripening variety	
Growing season	Cold season	Rainy season	Cold season	Rainy season
Growing days	150	125-130	125	105-110

Source: IIArroz

Compared with dry season, the yield in the rainy season is low because of less amount of solar radiation, shorter growing period and much damage by the pests/disease than that of dry season.

(3) Cultivation technology

Seedling methods

Traditional rice cultivation in Cuba is carried out mainly by the rainfed - drilling - direct seeding (dry seed) method and done partly by the puddling and leveling - broadcasting - direct seeding (dry and pre-germinated seed) method at frequently inundated land. This traditional rainfed - drilling - direct seeding (dry seed) method has been seeded in 20 - 30 cm in between row by drilling or hill sowing for weeding by hoe.

Popular rice producer's willingness (production stability and high yielding) has improved when the popular rice production program was started and the free sale of the rice production more than the self-consumption was admitted in 1996.

As a result, the popular rice production farmers have shifted from the traditional rice farming to the modern rice cultivation such as the puddling and leveling - broadcasting – direct seeding (dry and pre-germinated seed) or to the puddling and leveling – transplanting. And now, the farmers are changing the cultivation method from the puddling and leveling - broadcasting – direct seeding (dry and pre-germinated seed) to the puddling and leveling – transplanting.

Cultivation area

The popular rice production at present in Cuba is chiefly grown by the transplanting cultivation and the direct seeding. And, the traditional rice cultivation such as rainfed - drilling or hill sowing - direct seeding (dry seed) method has been done at frequently inundated land. Moreover, the rationing cultivation after the harvesting of the transplant cultivation is done in the limited region. The cultivation area of the rationing cultivation is estimated as less than 5%.

The proportion of the transplanting cultivation and the direct seeding in the rice cultivation area (rationing cultivation is excluded) are shown in the table 3.2.2. The transplanting cultivation is 48% and the direct seeding cultivation is 52%.

Table 3.2.2. Comparison between direct seeding and transplanting in the planted area during 2003. Popular Rice

Provinces	Area (ha)	Percentage of National Area	Direct Seeding (ha)	Percentage of Area	Transplanting Area (ha)	Percentage of Area
Pinar del Río	23.207	14	2.943	13	20.264	87
Habana	9.619	6	1.755	19	7.864	81
Matanzas	16.527	10	8.455	49	8.072	51
Cienfuegos	12.226	8	657	53	11.569	47
Villa Clara	20.922	13	11.260	6	9.662	94
Sancti Spíritus	19.446	12	13.064	66	6.382	34
Ciego de Ávila	10.976	7	8.992	84	1.804	16
Camagüey	16.403	10	14.874	90	1.529	10
Las Tunas	5.854	4	4.672	81	1.182	19
Holguín	1.192	0.6	750	51	442	49
Granma	22.146	14	17.398	76	4.748	24
Santiagode Cuba	2.257	1	1.460	68	797	32
Guantánamo	628	0,4	302	41	326	59
National	161.222	100	86.582	52	74.641	48
5 Central Provinces	79.793	49	48.847	60	39.018	40

Source : Arroz popular 2003, Resumen de anual de la producción (GAIPA, enero 7 del 2004)

The region where the country is divided into three, the area of transplanting cultivation to the rice cultivation area is high in the west region with 74% and is low in the east region with 25%. The area of transplanting cultivation is greater than that of direct seeding area in the central region which is the study area. The province where the area of transplanting is superior to that of direct seeding is Villa Clara (94%). On the other hand, the province where the area of direct seeding is superior to that of transplanting are Camagüey (90%), Ciego de Ávila (84%) and Sancti Spíritus (66%). The area of transplanting is slightly less that of direct seeding in Cienfuegos.

By the way, Pinar del Río, where 16% of the popular rice production has been produced, 91% of the popular rice production has been produced by the transplanting cultivation.

Yield

The national average yield of popular rice (paddy rice with 22% of moisture content) is superior for the transplanting method (4,100 kg/ha) compared to the direct seeding (3,000 kg/ha).

Amount of popular rice production

About 55% of the national popular rice production (530,000 tons) is produced by the transplanting cultivation.

Cultivation technique

The cultivation techniques in Cuba are classified according to the main operation system (table below). The popular rice producers use chiefly the methods of items 3), 4), and 5) for growing the popular rice.

Table 3.2.3 Cultivation Technique

Cultivation methods	Sowing time	Sowing methods	Farmer's scale
1) Plowing in dry soil-irrigation -weeding by herbicide and seeding in flooded soil.	Dry season	Broadcasting	UBPC, State Farm, Large-scale farmer
2) Plowing and seeding in dry soil.	Dry season	Broadcasting, Drilling	UBPC, State Farm, Large-scale and small-scale farmer
3) Plowing in dry soil-puddling and leveling-seeding in flooded soil.	Rain season Dry season	Broadcasting	UBPC, State Farm, Large-scale farmer
		Transplanting	Small-scale farmer
4) Puddling and leveling-seeding in flooded soil	Rain season	Broadcasting	UBPC, State Farm, Large and small -scale farmer
		Transplanting	Small-scale farmer
5) Puddling- leveling and seeding in flooded soil. (Second crop of double cropping)	Rain season	Broadcasting	UBPC, State Farm, Large and small -scale farmer
		Transplanting	Small-scale farmer

Outline of the cultivation methods

1) Plowing in dry soil-irrigation-weeding by herbicide and seeding in flooding soil

- After plowing and harrowing in a dry field in the dry season, the levee is made along the contour line.
- The residual water is drained to accelerate the germination of the seeds of weeds, red rice, and the fall rice seeds, after the irrigation water is introduced into the field.
- The non-selective herbicide is scattered to kill weeds, red rice and the germinated seedlings from fallen seeds.
- Pre-germinated seeds or dry seeds will be seeded in the paddy field flooding without puddling and leveling after flooding to prevent from the new germination of weeds, red rice.
- The residual water is drained at one day after seeding and intermittent irrigation will be done until the seedlings are grown up to 15 - 20 cm in height
- Herbicide (Propanil) is scattered to kill the weeds which are grown up.
- The water in the paddy field is maintained after transplanting to 15 days before harvesting when the residual water is drained.

2) Plowing and seeding in dry soil

- Plowing and harrowing in a dry field in the dry season
- Leveling the field after plowing and harrowing

In case of the large-scale farmer: Broadcasting, hill seeding or drilling with dry seeds are carried out by seeding machine.

In case of small-scale farmer: Broadcasting the dry seed by hand or hill seeding or drilling after furrowing by animal or hand are carried out.

The sowing method is described below.

a) After seeding with dry seed, the levee is made along the contour line, then flooded
   - Drain the soil for seed germination.

b) After the levee is made along the contour line and flooded, dry seeds are broadcasted.
   - Drain the soil for seed germination

c) Drained one day after flooding the field where the levee is made along the contour line,

pre-germinated seeds are broadcasted.

- Drain the soil for seed germination.

3) Plowing in dry soil-puddling and leveling-seeding in flooding soil

Plowing will be done in the field where irrigation water can be used in the dry season or when the field is dry before the rainy season starts. After plowing the paddy field is left for a while until weeds will be germinated, then the levee is made along the contour line and flooded.

a) Direct seeding
The paddy field with puddling and leveling is left as it is for one day to sink the float and then the dry seeds or pre-germinated seeds are broadcasted.
- Drain the soil for seed germination.

b) Transplanting
After flooding, puddling and leveling, the seedlings are transplanted with a distance of 15 – 20 cm among them. Seedlings are transplanted randomly to the field after 25 - 29 days in nursery.
- Drain the soil for seed germination.

4) Puddling and leveling-seeding in flooding soil

Direct seeding or transplanting methods (same as 3) are carried out after puddling and leveling.

5) Puddling and leveling-seeding in flooded soil (Second crop of double cropping)

After the first harvesting puddling and direct seeding or transplanting methods same as item 3) are carried out.

Relationship among the leveling of paddy field, cultivation technique and yield

Generally, the leveling condition of paddy field in Cuba is bad. As the area of the paddy field of CAI-Rice is large as 13.42 ha (1 Caballeria), the poor leveling of the paddy field had been supplemented with the small fields compartmented by the levee along the contour line. Even if the area of a paddy field is small, the puddling and leveling is carried out by the large tractor (60 horsepower) with puddling wheels, the low depressed grounds are produced easily and its leveling condition is deteriorated by the repetition of advancement and retreat, and at turnabout. A uniform water level cannot be kept in such fields, even if germinating in puddle (Charco), the rice plants will wither before the stem and leaf goes out to the surface of the water. For the period of the intermittent irrigation while improving the establishment of seedling after broadcasting seeds, the rice plants which grow in the fields higher than the surroundings in the field become poor growth; besides, the weed grows in the place. However, it is difficult for the popular rice producer to obtain the herbicide to controls these weeds. Therefore, the popular rice producer adopt the technique mentioned before, i.e. 3) Plowing-puddling and leveling-seeding, to overcome such problems as mentioned. Therefore, in regards to the popular rice production, the yield of transplanting rice is larger than that of direct seeding rice. Table 3.2.4 shows the comparison of the advantage and disadvantage between transplanting cultivation and direct seeding cultivation in the popular rice production in Cuba at present.

Table 3.2.4 Advantage (A) and disadvantage (D) among direct seeding and transplanting

Item	Siembra directa a voleo en fangueo	Siembra transplanting
Precision of leveling	Bigger (D)	Smaller (A)
Precision of smoothing	Bigger (D)	Smaller (A)
Quantity of seed	Bigger (D), 101-135 kg/ha	Smaller (A, 30 kg/ha
Use of herbicide	Bigger (D)	No (A)
Irrigation		
Irrigation water for nursery	No (A)	Bigger (D)
Irrigation water for seeding period	Bigger (D)	Bigger (A)
Irrigation water after the germination of rice	Bigger (D)	No (A)
Irrigation water for flooding paddy field	Bigger (D)	Smaller (A)
Manual Control of weeds	Bigger (D)	Smaller (A)
Insect pest control	Similar	Similar
Disease injury control		
Disease caused by mycosis such as blast disease.	Bigger (D)	Smaller (A)
Fertilization	Bigger (D)	Smaller (A)
Harvesting		
Reaping and threshing of rice	Similar	Similar
Yield	Smaller (D) (3,000kg/ha)	Mayor (V) (4,100kg/ha)
Total manpower	Smaller (A)	Bigger (D)
Necessity of maximum work force (Type of work and number)	Smaller (A). Seeding. One man 20 cordeles per day (0.8 persons/ha)	Bigger (D) Transplant. One man 1 to 1.5 cordeles per day (24 persons/ha)
The cost of fuel (maximum and minimum)	Similar (14,3-0,20 pesos)	Similar (14,3-0,20 pesos)
Cost of the rent of the machine	Similar	Similar
Total Cost of Production	Smaller (A)	Bigger (D)
Profit	Smaller (D)	Bigger (A)

A: Advantage, D: Disadvantage

(4) Categories of agricultural lands

GAIPA's classification for the use of soils for specialized rice is considered based on following classification:

Category 1: Farmland with high productivity and economic efficiency and without requirements of any kind of investment. From 70% to 100% of the potential yield of rice varieties is obtained in soils of this category

Category 2: Farmland with high productivity and economic efficiency and with requirements of some investment for the leveling, irrigation, drainage, farm road etc. The soils have some limitations for the cultivation, which is the reason that 50% to 70% of the potential yield from the varieties is obtained.

Category 3: Farmland with constraints for rice production with required big investment and taking long time to produce Popular Rice economically. There are many difficulties in soils with this category and hence, 30% to 50% of the potential yield from the varieties is obtained.

(5) The improved rice varieties recommended for popular rice production.

The improved varieties for the Popular Rice developed by the IIArroz are shown in Table 3.2.5. There are other varieties developed by the Rice Experimental Station in Los Palacios (Pinar del Río), which have been largely accepted by popular rice producers, mainly in the western area of Cuba. Among these varieties, INCA-LP2, INCA-LP5, and INCA-LP7 can be mentioned. The varieties recommended for different ecosystems and used for popular rice production are shown in Table 3.2.6.

Table 3.2.5. Improved Varieties recomended for Popular Rice

Variety	Year of release	Yield (1) t/ha		Cicle (días)		Head Rice (2)	Tillering (3)	Resistance (4)			Ecosystem	Optimal planting time
		Dry season:	Wet Season	Dry season:	Wet Season	(%)		*Tagosodes orizicolus* Muir	Hoja Blanca	*Pyricularia grisea* Sacc.		
IACuba 18	1992	8.6	5.3	124	108	59.0	High	R	R	MR	Irrigation	Dec - feb 10
IACuba 19	1992	8.2	5.7	137	119	55.6	Medium	MR	MS	MR	Irrigation	dec - feb 10
IACuba 20	1993	7.1	5.2	123	106	59.8	Medium	R	MR	MR	Irrigation	dec - feb 10
IACuba 23	1993	7.4	5.2	152	134	54.0	Medium	MR	S	S	Irrigation - Upland	Nov. 15 - Dec./ Jun 15 - Jul 31
IACuba 25	1993	4.8	4.0	125	110	51.0	High	R	MR	R	Irrigation - Salinity	Dec - Feb 10
IACuba 27	1999	7.6	5.1	130	108	58.3	High	R	S	R	Irrigation	Dec - Feb 10
IACuba 28	1999	8.5	6.3	136	112	54.7	High	I	S	MR	Irrigation	Dec - Feb 10 / Jul
IACuba 29	1999	6.0	4.0	143	125	52.0	High	R	S	S	Improved upland	Dec - Ap 10 / Jun - Jul
IACuba 30	1999	6.5	4.3	143	120	60.0	High	R	S	S	Improved upland	Dec - Ap 10 / Jun - Jul
IACuba 31	2003	8.7	4.3	127	112	57.0	High	R	S	MR	Irrigation	Dec - Feb 10/ Junio
Amistad 82	1986	7.2	5.6	126	111	58.0	High	R	S	I	Irrigation - Impoved Upland	Dec - Jan / Jun -15 Jul
J 104	1981	8.5	5.9	150	133	54.4	High	MR	S	S	Irrigation	Dec - Feb 10 / Jun -15 Jul
Perla de Cuba	1991	7.3	5.7	125	110	50.0	Medium	R	MR	I	Irrigation - Improved Upland	Dec - Jan / Jun -15 Jul
Fuente	(4)	(4)	(4)	(4)	(4)	(6)		(4), (5), (6)			(5)	(5)

Observation: (1) 13.5 % moisture , (2) Paddy = 100 % , (3)High:15-20 Tillers, Medium:11-14 Tiller, (4) R: Resistance, I: Intermediun, MR: Moderetly resistent, MS: Moderetly susceptible.

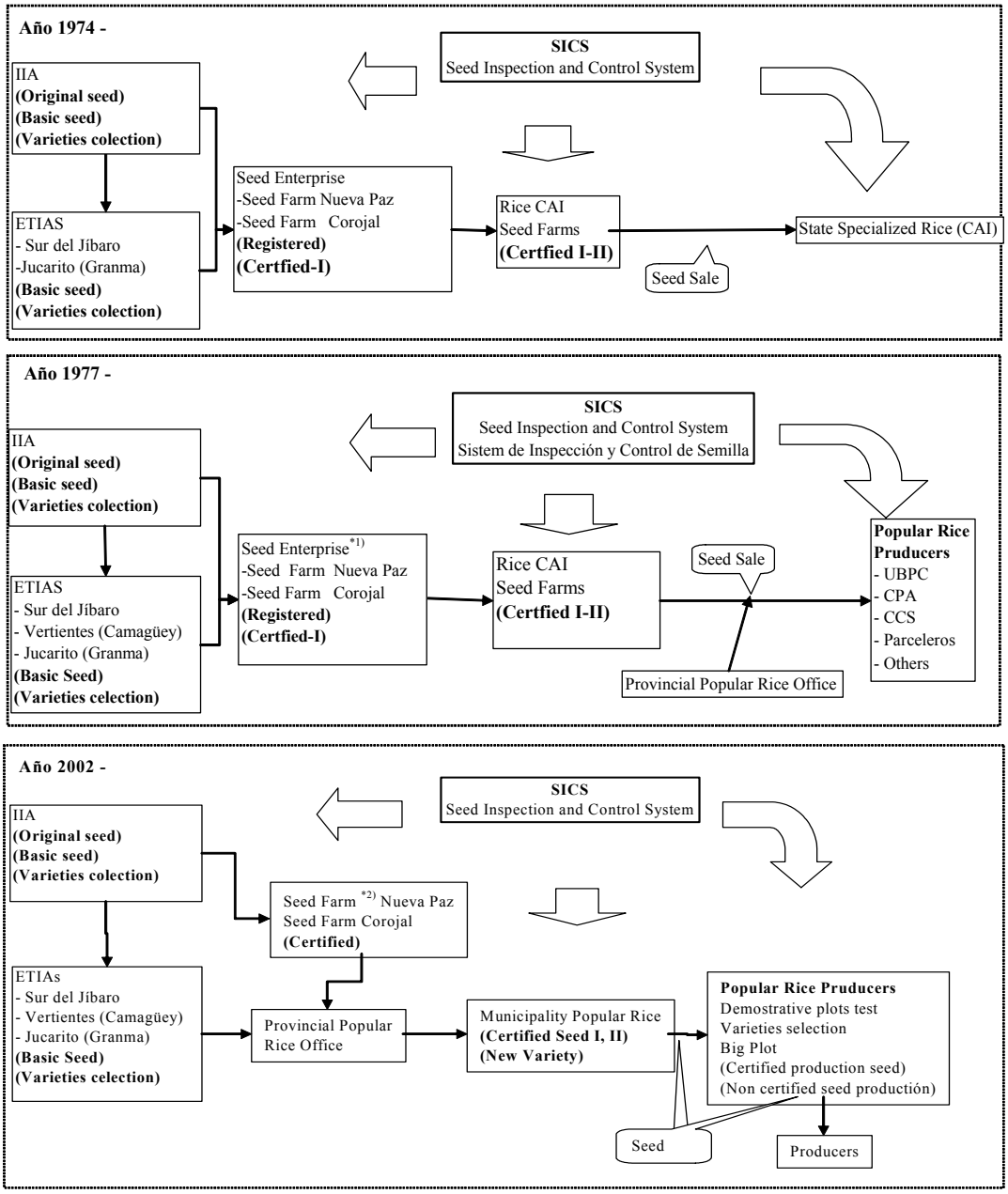
Table 3.2.6 Varieties recommended for each ecosystems

Type of ecosystem	Characteristics	Varieties	Time of seeding
1. Areas with soils problems	Salinity, alkalinity, acidity, toxicity for iron	IACuba 25, Amistad 82, J 104	2nd part. Dec - Feb 2nd part. Dec - Feb Every month
2. Areas with low fertility	Under content of organic matters, Match, Potassium, etc. and limitations of water and fertilizers	IACuba 23 IACuba 24 IACuba 29 IACuba 30 LC 88-66	Every month Every month Every month Every month March – August
3. Areas with height	Without fertilizers limitations and with a good water supply.	IACuba 22 VN 2084 IACuba 28 J 104 Perla de Cuba IACuba 18 IACuba 20 IACuba 27 Amistad 82 Reforma LC 88-66 IACuba 28 J 104	November Dec. – February February March – June July – August
4. non-irrigated land areas	Without any supply of water and with limitations of fertilizers.	LC 88-66 IR 1529-ECIA	May - August

Source: Caracteres generales de las principales variedades empleadas en la siembra popular de arroz, IIArroz (2002)

(6) Development, proliferation, and distribution of the varieties

The flow of seed supply for the Specialized Rice and the Popular Rice production is shown in Fig.3.2.1.



Source:IIA
Note *1): Seed Enterprise belonged to GAIPA
*2): The seed farm were asigned to IIA in 2000

Fig.3.2.1 Flow of Seed Supply for Rice Production

The IIArroz has developed and given convenient varieties for the production of rice seed in large scale governmental seed farms from 1974 until now. The basic seeds of the varieties are given by the IIArroz to the two seed farms, which produce registered and certified I seed categories. This last one is given to farms producers of certified seeds of CAI Rice for the whole country, which produce the certified seed II, that it is the one that they are growing in the CAI Rice, according to the demand. The guarantee of certification of the seed is done by the specialists of the System of

Inspection and Certification of Seed of Vegetable Sanity, entity belonging to the MINAGRI.

The categories of seeds registered and certified I are produced in two farms specialized in seed in the Havana province, which were administered by an enterprise until the year 2002; then they became administered by the IIArroz.

After 1997, when the production of Popular Rice began, the CAI Rice has sold small quantities of certified seeds to those producing of Popular Rice through the Provincial Units of Popular Rice.

The system of the distribution of the seed in the Popular Rice changed largely in 2002, based on growing contract, production and buying with UBPC, CCS, Parceleros and other non-rice organizations.

In the year 2003, the extension officers of the Popular Rice began implementation of a new system to produce seed that consists of hiring with the producers the production of certified seed in their properties to increase the amount that is to be given to producing reference seeds of the new or established varieties so that they obtain seeds of quality under the supervision of seed certification specialists in the municipalities.

(7) Organic manures production

MINAG is engaged in food production through the establishment and development of sustainable agriculture based on organic manures, green manures and appropriate crop rotation for the substitution of chemical fertilizers in order to provide to the soil with the necessary elements for plants and to maintain the environmental balance.

To achieve the highest efficiency in the use of any kind of organic matter, that can be processed as organic manures to be applied on the soil, is a priority task for producers, officers and scientists concerned in the process of agricultural production.

Main organic fertilizers used at present in rice are shown in Table 3.2.7. S*esbania rostrata* has been tested as green manure, bearing a positive increase of the yield. Its main characteristics are shown in Table 3.2.8.

Table 3.2.9 shows some bio-fertilizers proved in rice with satisfactory results in the increase of yield cover the demand of producers. Therefore, it is necessary to support at maximum the production of organic manures, green manures and bio-fertilizers in order to cover the demands of popular rice. At present, there is no center for organic manure production in the municipality.

Table 3.2.7 Organic Fertilizers

Kind of materials	Characteristics of the materials	Manufacturer and distributor
Rice straw	Rice straws are prohibited to burn in the field and recommended to plow into the soil. Rice straws are cut and scattered on the field at the same time as threshing in the harvest with a large-scale combine. Rice straw is piled up at each place in the field with the movement of the thresher in the small throw type thresher. The rice straw is distributed in the field without cutting it in many cases, except when the vegetable is grown as the secondary crop of the rice (dry season crop), the farmer is using the rice straw for the multi then after the harvesting of vegetables the multi are plow into the soil.	Each farmer

Kind of materials	Characteristics of the materials	Manufacturer and distributor
Rice bran	The rice bran generated after rice cleaning is an organic fertilizer rich in phosphorus. The rice bran in Cuba is not a pure rice bran powder but mixed power with husk and bran, because the rice mill of Cuba processes the husking and the polishing of rice at the same time. This powder is not used directly as organic manure, because it is used as feed of hog rising.	Each farmer
Earthworm manure	The materials for earthworm are dung of cattle, stable material, and residue of sugar etc. not including the residue of foods. Earthworm manure are produced and sold by the branch office of the Soil Research Institute at each department office in each department. Main use of earthworm manure is for vegetable and ornament cultivations and small amount of earthworm manure is for rice production.	Each farmer Soils Provincial Department
Dung of bat	The dung of bat contains phosphorus of 25%, and the use to the crops cultivations other than rice farming is recommended.	Soils Provincial Department
Chicken Manure	Chicken manure	Each farmer
Compost	Residual of crop and manure mixed,	Each farmer

Source : Transformando el campo Cubano, Avances de la agricultura sostenible, ACTAF (2001), Plegable de Instituto suelo, Dirección Provincial Camagüey (2003)

Table 3.2.8 Green Manure

Kind of materials	Characteristic of the materials	Manufacturer and distributor
Sesbania	Leguminous crop. The plant has nodular bacteria on roots and stems. With moisture-resistant. A physical amelioration and organic nitrogen of the soil are improved by plowing Sesbania. Sixty-eight kg N/ha can be supplied by incorporating of Sesbania 60 days after sowing.	Rice Research Institute

Source：La Sesbania: un mejorador de suelo arrocero, IIArroz, (2002)

Table 3.2.9 Bio-fertilizer

Kind of materials	Characteristic of the materials	Manufacturer and distributor
Azotobacter	Azotobacter independent nitrogen fixing bacteria. The amount of the nitrogen application is reduced in 15% - 50%.	Soils Provincial Department
Azospirillum	Semi-aerobic nitrogen fixing bacteria of rhizosphere of rice. 25% of the amount of the nitrogen application is reduced.	Nacional Agricultural Ciencia Institute
Fosforina	Insoluble phosphorus in the soil is solubilized and the phosphoric acid absorption by crops is promoted. The amount of the phosphate application is reduced by 50%- 100%.	Soils Provincial Department
Micorriza	Micorrizogens Fungus that improve plant nutrition because they enlarge the radical system. Good results for rice.	Nacional Agricultural Ciencia Institute

Source: Transformando el campo Cubano, Avances de la agricultura sostenible, ACTAF (2001), Plegable de Instituto suelo, Dirección Provincial Camagüey (2003)

(8) Control of plagues and diseases

The main diseases that are harmful to rice in Cuba are shown in Table 3.2.10. The main diseases such as *Pyricularia grisea Sacc, Rhizoctonia solani Khun* and *Sarocladium orizae Sawada* are caused by fungus. IIArroz has recommended some varieties with higher tolerance to Piriculariosis; however, the practices of integral control against diseases have borne the best results.

White leaf, a virus disease, has been completely controlled by using varieties tolerant to the vector insect *Tagosodes orizicolus Muir* (Sogata). All rice varieties recommended by IIArroz are resistant to this insect.

Table 3.2.10 Main Disease of Rice in Cuba

Common name	Scientific Name.	Original causal	The main control practices
Piriculariosis, quemazón, añublo, brusone	*Pyricularia grises* Sacc.	Fungus	- Use of the resistant or tolerant varieties - Agro technical management characterized by density of seed non superior to 150 plantas/m2 - Appropriate dosages of nitrogen; as well as application of potassium according to the requirements of the rice - Appropriate handling of the water, based on increasing the sheet of water when there is incidence of the illness - Chemical treatment to the seed - To incorporate the remains of vegetables to the floor in the infected fields - He/she burns of the stubbles when the infection was intense - Chemical treatment accurately: of the moment, type of products and dose.
Añublo de la vaina	*Rhizoctonia solani* Khun	Fungus	- Use of resistant or tolerant varieties - To incorporate the remains of vegetables with plow or deep fangueo. - To carry out floods during 15 days before to sow and not to exceed the sheet of water during the cultivation more than 10 cm. - Not to make dubbings and rotation with non susceptible cultivations. - Chemical treatment.
Pudrición de la vaina	*Sarocladium oryzae* Sawada	Fungus	- Control of the acarus Steneotarsonemus spinki. - Seed treatment - Determination of the most appropriate fungicides - Use of resistant varieties - Handling of fertilization of N and K
Hoja Blanca	-	Virus	- Resistant varieties - Control of the vectoral insect - Destruction of the guest.

Fuente: Manual del Arrocero, IIArroz (2002), PRINCIPALES ENFERMEDADES FUNGOSAS QUE INCIDEN EN EL CULTIVO DEL ARROZ EN CUBA (2001) IIArroz

Main plagues affecting rice in Cuba are shown in table 3.2.11. The use of varieties resistant to insect *Tagosodes* is very effective, as well as the use of biological products (*Metharizium anisopliae y Bacillus thuringiensis)* to control insects *Lissorhoptrus brevirostris* SUFFR and *Spodoptera frugiperda* SMITH-ABB. *Bacillus thuringiensis* controls *Steneotarsonemus spinki.*

As for the mite, an integrated management has been established including the varieties and aero-technical practices. Although chemical control is effective, it is harmful for the environment; and therefore its use is limited. So far, variety Reforma has shown the best resistance results to mite.

Table 3.2.11 Main Pests to the Rice in Cuba

Común name	Cientifical name	Months of more incidence	Control Method			Tolerant or resistant varieties
			Agrotechnical	Biological	Chemical	
Sogata	*Tagosodes orizicolus* MUIR	April - November	Use of resistans varieties	*Metarhizium anisopliae*	Tamaron	Yes
Chinche hedionda	*Oebalus insularis* STAL	May - October	No	*Metarhizium anisopliae*	Methyl Parathion	No
Picudito acuático	*Lissorhoptrus brevirostris* SUFFR	May - July	Field drainage	*Metarhizium anisopliae*	Fiponil	No
Palomilla	*Spodoptera frugiperda* SMITH-ABB	April - September	Increase water height, covering the plants for 24 hours.	*Bacillus thuringiensis*	Methyl Parathion	No
Acaro	*Steneotarsonemus spinki*	Mars - November	Use tolerants varieties Reforma)	*Metarhizium anisopliae*	-	Yes

Source: Manual del Arrocero, IIArroz (2002)

Biological products are prepared in solid and liquid means; those prepared in solid means have the advantage of preservation at atmospheric temperature between 30 and 60 days, maintaining the active effect. However, those prepared in liquid means must be preserved at low temperature and should be applied soon, during the next seven days after buying.

These bio-chemicals have been produced by CREE (Centros Reproductores de Entomófagos y Entomopatógenos) belong to MINAG. The distribution of the original strains and quality control in CREE has been conducted by the Plant Protection Institute (INISAV).

3.2.2 Post-harvest Practices of Rice in Cuba

(1) Outline of post-harvest practices of rice

Rice post-harvest practices

Rice post-harvest practices can be classified based on several factors such as scale of cultivation land (large and small), farming practice (mechanized or manual/animal power), rice category (Specialized Rice or Popular Rice), etc. as shown in Table 3.2.12.

Table 3.2.12 Summary of rice post-harvest practices

Classification	Contrastive items	Characteristics of rice post-harvest practices
Agricultural land	Large scale and small scale	In large-scale farming practice in Rice CAI, post-harvest practices such as harvesting, threshing, drying, husking and rice milling are mechanized. On the other hand, in small-scale rice farming by individual farmers, practices are mainly dependent on manual/animal power, and partly on small machines.
Farming practices	Mechanized and manual/ animal power	Two-types of post-harvest practices can be observed: one is fully mechanized farming and another is farming practice mainly by manual/animal power and partly mechanized for some of post-harvest practices.
Rice category	Specialized Rice and Popular Rice	For Specialized Rice, producing organizations are comparatively advanced in processing technology and mechanization, but for Popular Rice, a variety of processing activities is observed.
Local differences	Traditional rice growing area and newly developed area	Transplanting, manual harvesting and threshing, sun-drying, commission milling are mainly practiced in traditional rice growing area. On the other hand, large-scale mechanization is progressing in newly developed production area but productivity has declined due to recent shortage of materials and equipment.
Season	Dry season and rainy season	Basically cultivated variety is the same and there is no large difference in post-harvest practices for both crops. However, quality deterioration is observed due to difficulty of wet paddy drying.

Rice post-harvest practices for Popular Rice

According to the Study Area producers, the following is the typical post-harvest practices of the Popular Rice.

Harvesting

Serrated sickle is used to cut the stem length of 110-120 cm at about 20-30 cm from ground level. Making small bundles and drying in the field are not practiced. In the case of paddy seed, after cutting, it is beaten against a drum. Service thresher accompanied by laborers on commission usually do the threshing works. Hand cutting and threshing machine go side by side just like harvesting work by combine.

In large-scale fields of state farms, large combines transferred to CCS and other producing units work for service harvesting. They use timeworn old machines, often requiring repair works. The farmers asking for threshing services pay a service charge and also must procure fuel by themselves, since it is not easy to get fuel. On large-scale farms, they are used to harvest with combines since

the start of state farms. Therefore, when the combines are out of order, they often miss the optimum time for harvesting, resulting in losses.

In Camagüey, around 60% of total production is harvested by state entities or individually owned combines. The remaining 30% is by threshers owned by individuals after reaping by hand. The rest, less than 10%, is reaped and threshed all by hand.

Rice reaping service is rendered by laborers or combine-harvester. Market rate for the services is 20 pesos/cordel. In the case of combine-harvester, customer is required to procure fuel. Current rate is listed below:

Table 3.2.13 Current Rate of Rice Reaping Service

D/M/Y	Location	Service Charges	Remarks
11/12/03	Vertientes	20 pesos /cordel	Combine-harvester, fuel supplied by customer
07/12/03	Vertientes	20 pesos /cordel	Combine, fuel & lubricant supplied by customer
06/12/03	Santo Domingo	20 pesos /cordel	Hand-reaping
05/12/03	Santo Domingo	40/50/60 pesos /cor	Hand-reaping, dry/wet/deep-water field
19/11/03	Mabuya, Chambas	20 pesos /cordel	Combine-harvester
18/11/03	Victoria, Yaguajay	25 pesos /quintal	Hand-reaping, 40pesos/man-day x 15 man-day/ha

Threshing

Although machines are old, harvesting and threshing by combine-harvester are still practiced chiefly in large-scale fields. Threshers are owned by grower organization such as CCS. Individual service processors own some threshers although their number is limited. The threshers are local made Maccogil type (throw-in type) utilizing the PTO from a large tractor. Maccogil type is often used in wheat growing areas in other countries.

Thresher used for seed paddy at IIArroz was IRRI type made in Brazil. It seemed to be suitable for Popular Rice but not many are used now, the existents threshers were obtained through the Programme of United Nations for the Development (PNUD). In order to promote mechanization of threshing work, suitability of IRRI type must be studied.

There is also a possibility that the throw-in type of IRRI proto type threshers used in Southeast Asia may be applied in Cuba. Since the cutting length of stem is about the same, there is a good possibility. One difference is that Cuba paddy before threshing is not dried on field resulting in higher moisture content of the stems; this may cause insufficient separation and clogging of threshing drum.

Threshing service by machine is widely extended in rice producing area. There are two cases for payment: in cash or in kind by paddy. In the case of in kind, 7%~10% of wet paddy exhausted from threshing machine is the normal rate for the service. Also customers need to prepare fuel for a thresher because there is difficulty to get it. The situation differs from milling service because milling machine is mostly driven by an electric motor. Threshing charges are listed below:

Table 3.2.14 Threshing Charges

D/M/Y	Locations	Threshing Charges	Remarks
07/12/03	CAI Ruta Invasora	20 pesos/cordel (combine)	Fuel required
06/12/03	Santo Domingo	10% of wet paddy	
05/12/03	Santo Domingo	10% of wet paddy	Fuel required
04/12/03	Santa Clara	7% of wet paddy	
03/12/03	Camagüey	2.5 pesos/quintal	50pesos x 10p for 200q/day
08/11/03	Victoria, Yaguajay	8 Lb/q (8% of wet paddy)	Fuel required

Source: Interviews with producers.

Paddy drying

Presently, wet paddy is dried on roof and road for reasons of lacking dryers, lack of mat for sun drying, etc. But roof drying is not recommendable due to its limited area, and possibility of damaging roof and work itself is dangerous. There is also a danger in drying on road. Besides, foreign matters such as pebbles and sand may mix with the paddy.

Since wet paddy before drying is threshed as mentioned before, drying is an important process. Especially the paddy harvested in the rainy season is difficult to dry. It often causes colored kernel and quality is rated poor in the market.

Only 5% of the total Popular Rice production in Vertientes is mechanically dried as part of the contract with CAI Ruta Invasora. All the rest is sun dried. Many Popular Rice producing farmers dry their crop on the roof or backyard of their houses if the quantity is small. If large quantity, they hire laborers and dry on the road.

Production quantity is usually expressed in weight of wet paddy. When it is converted into dry paddy, 22% is deducted by weight. This is based on their practice in large-scale state farm, where combine-harvester harvests crops and wet paddy is brought to large-scale rice mill equipped with dryers. Their paddy is weighed by truck-scale. The weight reduction would not be so large unless immature and impurities are removed. As they thresh wet paddy, cleaning and separation may not be complete. Therefore, it is considered that immature grains and other impurities are separated after drying. In case of Popular Rice produced by individual farmers and small-scale producer units, weighing of wet paddy is not needed in the course of their usual practice of hand cutting and sun drying mode of processing. In the rice producing countries, production of paddy is generally expressed in dried paddy weight (13.0%-14.0% wb). The wet paddy is not uniform in moisture content. Therefore, the accuracy in statistics can not be maintained unless it is based on dried paddy.

Drying service for wet paddy has been limited for Popular Rice. Difference in the drying cost is predicted lower between sun drying and mechanical drying. However, sun drying relies thoroughly on weather conditions. On the other hand, mechanical drying is facing the problem of fuel. Table 3.2.15 shows rough drying service charge, although we need more data.

Table 3.2.15 Drying Service Charge

Drying	D/M/Y	Locations	Labors	Day/ person	Capacity/day	Drying cost
Sun	11/02/04	Santo Domingo		30 pesos	10q/pers/2-3 days	
	10/02/04	Aguada de Pasajeros		30 pesos	10 q/pers/2 days	
	20/11/03	Vertientes	4	25 pesos w/meals	300sacks (13ton)	
	01/12/03	Vertientes	9	30 pesos	120q (5.52 ton)	48.91 pesos/ton
Mechanical	05/12/03	Santo Domingo				6% of dry paddy
	01/12/03	Vertientes				35.74 pesos/ton

NB: 23.28 pesos + USD15.68 for 1 ton of paddy by CAI Ruta Invasora

Paddy storage

Dried paddy is usually stored in bags and is kept at the houses, although a part of the paddy is stored in large bins. They cannot expose the grain to fresh air frequently, and because of that there is a problem of mold growth.

Rice milling

- Milling facilities

Rice milling facilities in Cuba are roughly divided into large-scale integrated rice mills belonging to CAI and locally made Engelberg type machines mainly milling Popular Rice. Annual milling capacity of large-scale rice mills is about 400,000 tons (dry paddy) but their machines are old and there are some difficulties in getting spare parts. Individual or CCS that owns Engelberg type machines mill paddy for individual home consumption or for selling at markets.

There are 23 rice mills under CAI and their annual milling capacity is approx. 400,000 tons (dry paddy), capable of milling almost the total rice production of Cuba. However, actually milling is presumably much less than their capacity.

Popular Rice is not milled by such integrated large-scale rice mills, but milled by small mills whose milling yield is low and broken rice content is high. Although this is a great loss to the country, rice growers must have their own reasons such as by-product will not be given back and rice husks cannot be used for feed. Generally, industrial mills are located far away from production areas. Rice milling is a tool of marketing rather than a mere process. The operation rate will rise or lower depending on the mode of marketing.

The primary reason why Engelberg type machines are still widely used is considered to be because new type machine (e.g. rubber roll type paddy husker) is not introduced. It is also because a by-product (mixture of crushed husk and rice bran) is very important as feed for piggery and poultry. In other words, Engleberg type machine is working as a crusher as well as a milling machine.

- Milling yield (recovery)

Engelberg type machine is basically run by motor, and rice is milled in one pass with one machine. In Vertientes, however, two machines were used in two-pass system: the first machine was mainly husking and the second machine was functioning as milling machine. Improvement in milling yield and lower broken rice percentage was observed. But still 40%-50% broken rice was produced, although it depends upon the quality of paddy material.

The important factor of quality appraisal on milled rice is the percentage of whole rice (head rice of more than 3/4 kernel). The procurement price on contract base of milled rice by CAI Ruta Inversora specifies the difference of price for head rice and broken rice as the buying price for milled rice on the base of contract (2003) as follows: 165.99 pesos /q for head rice, and 100.00 pesos /q for broken rice.

Conversion rate of 67% from dried paddy to milled rice is employed but this conversion rate differs by the quality of paddy. In the case of wet paddy rice, the conversion factor is 52%. As for milling recovery of Popular Rice, the milling recovery is 51.2% from wet paddy to milled rice according to "Resumen de las Resultados Produccion del Añno 2002 en el Arroz Popular". It means that the milling recovery of 65.6% from dry paddy to milled rice in case of 22% of weight losses from wet paddy to dry paddy; that is the same condition as mentioned above. There is much immature paddy mixed in the paddy produced in Cuba resulting in lower milling yield.

- Commission milling service

The attitude of commission rice millers may be changed according to the system of service charge that is based on paddy (material) or milled rice (product). They intend to increase the paddy processing capacity in case of paddy, and also preferably produce more bran in case they get a charge for this kind of bran. It means that they don't care much about recovery (yield) from paddy to milled rice. However, this tendency becomes weak where there is competitiveness among rice millers so that customers are able to access them easily. On the other hand, on the base of milled rice, increasing milling recovery can increase commission. This will result in improvement of milling technology. The result of field survey is shown in Table 3.2.16.

Table 3.2.16 Conditions of Rice Milling

D/M/Y	Location	Milling Machine	Milling Charge	Remarks
10/02/04	Aguada de Pasajeros	Engelberg (1)	2-3 Lb of milled rice/q of dry paddy	Part of fuel supplied for tractor
18/11/03	Victoria, Yaguajay	Engelberg (1)	3.00pesos or 2 Lb/q	Based on milled rice
19/11/03	Mabuya, Chambas	Engelberg (1)	1.00pesos/25 Lb	Based on milled rice
03/12/03	Santo Domingo	Engelberg (1)	5% of milled rice	
05/12/03	Santo Domingo	Engelberg (1)	2% of milled rice	Integrated with dryer
05/12/03	Santo Domingo	Engelberg (1)	3% of milled rice	
07/12/03	Vertientes	Engelberg (2)	51.38pesos/ton of dry paddy	Commercial mill

Only one mill adopts the paddy base system in the cases above. More rice mills adopt the milled rice base. Customers usually bring back rice bran for livestock feed.

Storage of milled rice

At present, in Cuba, storage period is short because national productions are not sufficient and the imported rice is distributed systematically for ration use and social use. Producers generally mill their paddy before its consumption it or commercialization; there is no custom of milled rice storage.

Forms of rice for selling

There are three forms of rice sales by producers (wet paddy, dried paddy and milled rice), of which they sell rice mostly wet paddy, next milled rice and then dry paddy.

Post-harvest losses

Although shattering characteristics are cited as an item for developing a better variety, there is no record of post-harvest loss assessment. In Popular Rice harvesting work, loss by manual harvesting is said to be more than that by combine harvesting. IIArroz Technical instructions state that the loss by combine-harvester should be kept below 4%. Further, the service charges for threshing, drying, milling, etc. are based on the fixed rate against processed quantity, which makes it less attractive for them to accept technical improvement for reducing losses.

According to FAO Food Balance Sheet (1995-2001), the country generated losses of 22,000-33,000 tons yearly in the practices of storage and transportation, that is equivalent to 5.2% of the total supply. It does not include losses generated from other post-harvest practices such as harvesting, threshing, drying, and milling.

No loss value is shown in the current rice production statistics. The production by real weight

doesn't require reducing losses, but the production estimated by field survey for yield should be reduce losses from the estimated production. It is said that the production survey of Popular Rice depends on reports from individual producers. However it might be difficult to continue this method because it is time consuming. It will be necessary to establish the new method in lieu of report of actual weight of production, in order to get crop situated index before harvesting.

(2) Future tasks

Appropriate technology

- Development of appropriate post-harvest technology

The improvements in post-harvest practices must be fit with the method of cultivation. The main thing is that the cultivation and post-harvest are subordinate, and their role is to reduce the losses and maximize the added value of the product made by cultivation. Therefore, from the cultivation to post-harvest processes, it must be a consistent and harmonious system (which does not always mean mechanization. Production of Popular Rice prevents large-scale rice production. This must be kept in mind when planning an improved system. For instance, transplanting enables planting in rows and facilitates introduction of harvesters. The harvesters enable bottom-cutting, which in turn, enables ear threshing by machine.

- Maintenance of post-harvest equipment

It is said that people work hard to find ways to operate equipment and machines for over a long time with adverse conditions of parts supply. Japanese-made large scale paddy husking and milling facilities built in early 1970s are presently operating at CAI facilities.

- Paddy drying

As an item to be proved in the post-harvest field of the study, we would prefer to solve the drying problem of wet paddy not only by machine, but also by work system.

a. The drying of wet paddy is one of the obstacles for producing Popular Rice. Especially, when harvested in the rainy season, it often produces colored kernel and moisture damaged kernel and the price is lowered in markets. Consequently, introduction of mechanical dryers are much expected. But this would face the problem of oil shortage. Fortunately, electrification of rural village has progressed to a high degree. Therefore, the use of ambient temperature air dryer using motor to dry grain to MC 18%-19%, at which level the grain can be stored for a short period of time, may be effective to alleviate the situation. Naturally, the relative humidity of the ambient air must be lower than a certain level. The dryer should be designed so that a combustion furnace can be attached later when the fuel supply is improved.

b. After hand reaping, wet paddy with straw is dried in the field as the first drying process before going to threshing process that becomes easier because of dry straw.

- Rice milling

The Engelberg type machines are presently used as a one-pass system in which both husking and polishing are done at the same time. It therefore produces a large amount of broken rice. Its milling yield is low and husks and bran are mixed. In other words, quantitative as well as

qualitative loss is large. Existing Engelberg type machines can be used for milling purpose only. In order to reduce the broken rice content to less than 10%, the broken rice should be separated and the rice should be classified. Sieve separators should be introduced to separate less than 1/2 kernel.

3.2.3 Agricultural Mechanization

(1) Present situation of machinery use in popular rice cultivation

a. Land preparation

At the present, the preparation of soil is carried out with machinery and also with animal traction. According to the producer's conditions, this work is carried out by three different methods: dry, dry–puddling and direct puddling. In dry, plowing is made with 60 PS tractors, such as the YUMZ-6, MTZ-50 and MTZ-80 or other similar ones, using implement plows of three disks and moldboard plough for animal traction. They also use tractors DT-75 from 75 to 90 PS and T-150 of 150 PS with plows of 4 ~ 5 disks and harrows of different models. These machineries can be own or rented. Works of harrowing, landplane and construction of levees use the same size tractors and ridging implements for levee construction.

In a case of dry-puddling method, the plowing is carried out by disk plow or harrow and puddling is executed with the tractor YUMZ-6 to which is installed puddling wheels, harrows, rollers and implements for landplane. Direct puddling is carried out with the same equipment and implements. On occasions, to combine motorized equipment with the animal traction for the land preparation works, they use animal traction instruments with different farm tools of industrial construction or handmade.

The tractors used for popular rice have low technical capacity, they are old with more than 15 years use, and the consumption of fuel, lubricant and spare parts are high. Lack of batteries, tires and engine spare parts, which are the tractor's main components, additionally increase fuel consumption. The major part of land preparations are carried out by implements used for many years and obsolete, and this contributes to degradation of the soil. They lack implements of animal traction which are appropriate for popular rice production on small rice field.

For land preparations, there are neither small machineries such as power tillers and their implements, nor farm instruments of manual traction and appropriate tools; only animal traction implements exist, although they lack adequate implements to execute land preparations efficiently.

The price of the machinery service for land preparation has a wide variation among the different state productive organizations, UBPC, Cooperatives and individual farmers; prices range from 2 to 25 pesos per cordel (417 m^2) depending on type of works that they carry out.

b. Seeding and transplanting

At the present time, seeding and transplanting is carried out manually with low work productivity. In the 5 selected municipalities, neither motorized machineries for seeding and transplanting motorized nor animal traction exist. The densities of rice plant per square meter are not uniform and in some areas of the sowed field they are high and in others they are low; low unit yield of cultivation doesn't allow a good use of soil. The manpower for the realization

of these works is expensive. For direct seeding, the payment is generally 30 pesos per one day of work, and in the case of transplanting the prices oscillate between 30 and 80 pesos per cordel.

c. Fertilization

Sometimes fertilization for some area is applied manually after the plant's germination and its growing period for the objective of increasing grain yields. Some organic matters is also applied in the same way. In the case of rice of transplanting, it is fertilized manually after transplanting. The transport of fertilizer is carried out by wagons in tow of tractors and animal traction, and it costs 30 pesos per day.

d. Weed control

In some places, weed control is made with use of selective herbicides applied by knapsack type sprayer. The method for ponding field, if it is available is to control the overgrowths using the selective herbicides and by means of water, if it is available. In the case of rice in dry conditions, the control is manual, using a hoe or weeding directly at growths near to the rice plant. The levees are weeded manually with machetes. It is not possible to control weeds mechanically because there is no tradition of seeding the rice in arrays. The wage for weed control manual is 30 pesos per day on an average.

e. Pest control

When there is some chemical or biological pesticide, they are applied in many cases with knapsack type sprayer, and in minor cases with engine sprayer; popular rice production generally lacks those products. When manpower is hired, it is paid 30 pesos per half day.

f. Harvesting and thrashing

In the municipalities of Vertientes, Chambas and Yaguajay, they use modern combine harvesters rented to popular rice producer from the state sector, fundamentally through the rice production CAIs. There are other combines in the selected municipalities that were disposed from CAI because of their low productivity and efficiency, and they were sold to the producers of different organizations of popular rice production and specific farmers that repaired them with their own resources and state help. In Aguada, 50% of the harvest is mechanized excepting the parceleros that harvest less than 20% of the rice with combines. In Yaguajay around 60% is harvested with combines; the CCS and parceleros harvest manually. In this municipality, they loose rice because the seven combines of the popular rice production unit are very deteriorated. Santo Domingo harvests approximately 38% of the rice with combines, although the CCS and the parceleros harvest 80% of their production manually using machetes and sickles, and then they use threshers.

When harvest is done manually, the manpower is paid 50–60 pesos per cordel or 30 pesos per day. When harvest is made mechanically, it is generally paid 20 pesos per cordel or 15% of harvested rice.

Thrashing is executed by means of diverse type machines of domestic product mobiles that belong to the farmers of the area, and they also rent them. The prices of the services of thrashing are basically three methods: 10% of the thrashed grain, 3 to 6 pesos per quintal or 30 pesos per day. Thrashing is executed manually in small areas and for grain dedicated to the production.

g. Drying

Excepting to the municipality of Santo Domingo where approximately 30% of rice is dried in a particular grain dryer, other selected municipalities dry rice manually by radiation of the sun, the humid grains are placed on high and compacted places such as roads, roofs and the other places that are concreted or asphalted. In these places, it can be spread and be picked up easily in case of rain. Practically speaking, drying factories don't exist for popular rice. The drying is paid 2 to 6 pesos per quintal depending of humidity contents of grains or 20 up to 30 pesos per one day work.

h. Milling (Rice hulling and pealing)

The hulling of rice grain is carried out with different types of mills and national products that generally polish grain with the same part that hulls grain shells; this type mill breaks many grains and on occasion, the same ones introduce many impurities.

In popular rice production, appropriate rice milling machines are in shortage, so that the quality of final product processed is low, and because of this, a great quantity of grain of produced white rice is lost. The pealing of rice grains is carried out independently from hulling only in the industrial mills that exist in CAI of rice production. Popular rice producers receive or lend services of hulling and pealing of rice grains at the price of 5% of the white rice or 3 to 6 pesos per benefited quintal.

(2) Actual situation of machinery and workshops of producers

a. Rice CAI

The situation of the machinery is better than in the other productive organizations, because they have relatively new combine harvesters and tractors that were acquired in 1997 and 1998. They have good workshops for repair and maintenance with highly qualified personnel. They also have industrial dryers and mills with good working conditions and also different means of transport. They also possess tractors and implements which they have used for many years. Financial difficulties don't allow them to acquire spare parts to restore machineries, or to buy tires and batteries. CAI of rice production of Vertientes and Santi Spíritus offer services of machinery rental for land preparation, basic harvest works, and repair workshops for the popular rice producers.

b. UBPC

In the case of specialized rice of UBPC, the situation is similar to the Rice CAI, but if they cultivate rice for self-consumption and sale for the workers and their families, difficulties of mechanization and workshops are a major problem for the mechanized processes with motorized equipment as well as with animal traction. The energy sources and implements are insufficient and have already been used for many years so that operation and maintenance cost is high and financial difficulties are present for the repair of machines and animal traction instruments as well as for their operation and maintenance. The mechanization of manual traction doesn't exist; the costs of hiring of labor are high, especially for the labor in a seeding and harvesting of rice. The rent of the machinery is also expensive. The workshops have the financial difficulties for their appropriate operation. They don't have machinery for seeding, transplanting is manual and it is little used. The harvest between 30% and 100% is carried out

with combines.

c. CPA

The situation of machinery in these productive organizations is similar to that of UBPC that is not specialized in rice cultivation.

d. CCS

The main difficulties in mechanization are that they possess old machines used for many years of exploitation, and hence their technical capacities are low. They use more animal traction implements than CPA and UBPC. Generally they don't have workshops, and don’t possess machineries of manual traction. They have financial difficulties for repair and maintenance of machinery. They lack machineries for harvesting, cutting plants, thrashing of grain, dryers, rice hulling and pealing; in addition, they need to improve land preparation technologies, and also there is presently a shortage of implements for animal traction.

e. Préstamos

Most of Préstamos don't have machines and mainly hire them from the productive organizations that rent them paddy field. When these entities cannot offer machinery service, it will mainly affect land preparations and harvests. Because they don't always carry out agricultural activities on time, it forces them to contract these services with private producers or to hire manual workers.

f. Parceleros

In general, the mechanization instruments that they possess are of animal traction for land preparations, transportation of the products and agricultural inputs, and also they possess knapsack type sprayer and some rice grain mechanical or electrical milling equipment. They don't possess implements of manual traction such as transplanter or seeder, etc. Sometimes they rent machinery for land preparations and they carry out around 20% of harvests with hired combines. In the municipality of Chambas, the animal traction is in shortage, and in Vertientes, it doesn't exist at all.

(3) Operation and maintenance of machinery

a. Machinery rental system

There are common use machinery systems by rental from the agriculture organizations, UBPC, CPA, CCS and individual farmers, since some differences of each region exist, and the system plays an important role to use the machinery efficiently. The combine harvesters, tractors, threshers, rice mills, transportation trucks, and various machines are shared. Since UBPC and CPA have their own equipment, they also rent and hire it depending on the situation of machinery use. Most of equipment of CCS belongs to the individual members, so they rent and hire it among themselves, and also with other organizations. The majority of individual farmers, Préstamos and Parceleros, don’t have agricultural machineries expect animal traction implements. Thus, they hire machines, combines, tractors and so on from the other organizations which possess machinery as the occasion demands.

Except the case of rental among CCS members, the contracts are using a standard written form covering work contents, rental price and name of both parties and so on. Generally the rental

price contains costs of equipment and operator, etc., but it does not include fuel cost, and so fuel needs to be secured by the hiring party. Normally payment is made after finishing the work. There are some differences on the rental prices depending on the organization and region. The payment of tractor rental for land preparations is made per working area. In the case of combine harvesters, per working area, unit weight of harvested grains or approximately 15% of total production. For threshers after manual harvesting, it is paid per unit weight of harvested grains or 10% of total production, and for rice milling by domestic milling machine, it is per 3 to 5% of processed white rice.

These farm works using rental equipment are carried out generally in the five provinces of the study area, since they are faster and more efficient than works by manpower and animal traction. Since the farm works can be finished within an appropriate period for rice cultivation, the demand of machinery use for land preparations before seeding and harvest is high. In the most of regions, the number of combines for rice harvesting is insufficient. When combines cannot be obtained, the producers hire man power for harvesting and threshers, and total cost included man power cost is higher than the combine use case, also there is the possibility to loose the product by not having adequate period for harvesting.

b. Fuel supply (Diesel)

Fuel is assigned to the producers from MINAGI and MINASZ through CAI or other organizations. The price of diesel fuel assigned by the ministries is very low (0.20 – 0.30 pesos/liter) although there are some differences by distribution channel and time. But the quantity of fuel assigned for popular rice production is limited, and for popular rice production without any contract, there is no fuel assignment. When producers cannot secure the necessary quantity of fuel for popular rice production, sometimes they use the fuel assigned from other products. For example, UBPCs and CPAs of sugar cane sometimes use part of fuel assigned for sugar cane cultivation for popular rice production, since fuel quantity assigned for sugar cane by MINAZ is larger than that for popular rice.

There are more cases for CCS and individual producers, when they cannot secure the necessary fuel quantity by allotment, so they have to get fuel through the free market at a high price (USD 0.55/liter).

c. Machinery and spare parts supply

As for the distribution of agriculture machinery spare parts, metal working products such as gears and shafts, etc. are consigned to manufacturers at base workshops of provinces (workshop of CAI and UBPC). These workshops possess lathes, milling machines, electric drills, welding machines and repair tools sets, etc, and technical experts for metal working and machine repair, and play important roles for operation and maintenance of agriculture machinery in each region.

Imported spare parts, batteries, tires, bearings etc. are distributed by GERMA (Grupo Empresarial de Logístico Ministerio de Agricultura) affiliated to MINAG and DIVEP (Distribución y Venta de Piesas y Agregados) affiliated to SIME. GELMA makes and sells equipment and spare parts of agricultural machinery and also repairs them. GELMA possess workshops in each province. DIVEP has branches in each province or municipality. On the other hand, SIME has factories of machineries and produces spare parts and agricultural

implements (animal traction plows etc.), and sells via DIVEP.

To obtain imported spare parts such as batteries, tires, bearings is difficult, because foreign currency (USD) is required. The insufficiency of workshop facilities, old equipment for repair, shortage of mechanic tools, lack of foreign currency to purchase new equipment and imported spare parts are all problems for operation and maintenance of agriculture machinery.

3.2.4 Irrigation and Drainage

(1) Irrigation use in popular rice production

1) Irrigation of CCS members

In CCS, most farmers possess and use their own irrigation system or equipment. Even though collective irrigation systems are observed in some CCSs, such systems are a minor case in general. In the individual irrigation system, farmers take water from small rivers, spring water, small ponds and groundwater and sometimes farmers use small pumps for irrigation. In the case of pump irrigation, farmers own their pump in general and shared or collective use of pumps or motors for pumps (tractors) by several farmers is observed in some CCSs.

In accordance with the field observation, the ratio of individual irrigation use was high in Santo Domingo, Aguada de Pasajeros and Vertientes Municipalities. Communal use of pumps or motors was also observed in some cases; however, farmers take turns with equipment use and irrigation practice was individual. In Chambas Municipality, even though the majority of the irrigation was individual system, collective irrigation systems were also observed. Yaguajay Municipality prominently uses irrigation. The major water source commonly observed was surface water of small rivers and collective irrigation systems with gravity system, which were constructed and operated by a group of farmers.

In the case of pump irrigation, diesel pump is popular among individual farmers in the Study Area. Most farmers meet difficulty in maintaining their pumps because of superannuated equipment and lack of spare parts; however, the most severe common problem was obtaining fuel. The difficulty for obtaining diesel fuel is considered as a constraint of irrigation. Due to this difficulty, many farmers have the desire to introduce electricity pump because the cost of electricity is much lower than diesel fuel. However, the introduction of electricity pump is not proceeding due to lack of sufficient capacity of power supply system in some provinces and due to difficulty of farmers to bear the expense burden for transformer and transmission line to farm.

In the case of gravity systems used mainly in the Yaguajay Municipality, farmers rely on unstable small rivers for water resources. Hence, farmers can meet shortage of water for irrigation only sometimes and the production is vulnerable to climatic conditions.

2) Irrigation of Préstamos in CAI/UBPC

Contrary to individual farmers in CCS who generally use their own irrigation system, *Préstamos*, who rent land from CAI/UBPC, can receive irrigation water from the irrigation system operated by CAI/UBPC. Although CAI/UBPC operate and maintain the system and provide water to *Préstamos*, they are not required to take care of the system except for the terminal canals and around the field. However, the condition of irrigation system of CAI/UBPC is generally poor due to lack of maintenance and *Préstamos* sometimes meet difficulty to obtain

water even though the system has the capacity. Because *Préstamos* are not landowners and their right to occupation is not secured for multiple years, the intention of *Préstamos* to invest in land and facilities is difficult to see. In addition, CAI/UBPC decide the area of land to be rented to *Préstamos* according to the available water in the system after calculating the necessary amount for the production of specialized rice. The low efficiency of the irrigation system restricts expansion of popular rice production by *Préstamos*. In order to increase and stabilize popular rice production by *Préstamos*, it is necessary to increase the efficiency of water use of the specialized rice production as well as to improve the efficiency of the irrigation system of CAI/UBPC to generate stable supply of water for *Préstamos*.

(2) Water management

1) Management of water resources

The National Institute of Hydraulic Resources (INRH) has responsibility for water management of resources in Cuba. In general in the irrigation system, the facilities/equipment of dams and headwork and main canal system is managed by INRH and the facilities after the division point is managed by MINAG or MINAZ. Water users have a contract for provision of water service with INRH. Actual execution of contract and collection of water charge are carried by the Hydraulic Provision Enterprise (EAH), which is an organization established under the provincial branch of INRH. In the contract, the annual water use plan and monthly plan, which is reviewed quarterly, are defined. Water charge is collected in principal based on the actual use of water. In the case of individual farmers organized into CCS, the user prepares his farming plan and water use plan for the contract under the instruction of the provincial MINAG, and then the plan is finalized after the authorization of EAH/INRH.

The tariff of water use for irrigation is established as noted in the table 3.2.17:

Table 3.2.17 Tariff of Water Use for Irrigation

Surface water with gravity system (dam):	water charge according to the amount of use $5.00MN/1,000m^3
Surface water with pump system (river):	water charge according to the capacity of pump $9.30MN/pump capacity of liter/sec
Groundwater with pump system	water charge according to the capacity of pump $9.30MN/pump capacity of liter/sec
Surface water managed by users Micro dam River stream	water charge according to the amount of use $0.90MN/1,000m^3-year $1.80MN/1,000m^3-year

However, it is rare to measure the amount of water use for small users and the case was observed that a water user does not have a contract with INRH. In the case of lease farmers such as *Préstamos* and *Parcerelos*, irrigation is considered as a part of land resources and the contact of water use is concluded between the land owners and INRH so that producers pay water charge through land owners. In the case of *Préstamos* from CAI/UBPC in the Vertientes Municipality, each Préstamos has a contract for irrigation with UBPC as well as contract for farmland, and the UBPC has a contract with INRH. As a special case, all land lease farmers in Chambas municipality have made their water use contract through the *Empresa en Invercion Arroz Chambas*.

2) Water requirement for rice cultivation

The water requirement for rice cultivation, which is the fundamental element of irrigation planning, has been studied by IIArroz, IIRD and INRH, and the reference values were set in Resolution No.21/99 in 1999, for the purpose of applying a contract on water provision service between users and INRH. However, the water requirement set in the above resolution focused on specialized rice production and it considered the cultivating technology applied in the CAI/UBPC such as a large scale mechanized farming practice. Irrigation planning in the CAI/UBPC is usually based on the 5-year frequent drought condition and the water requirement is set for this condition.

Table 3.2.18 Net Total Water Requirement of Specialized Rice (m^3/ha)

Province / Applying Technology	Winter rice		Semi-spring	Spring rice	
	Mid-term variety	Short-term variety	Mid-term variety	Mid-term variety	Short-term variety
Sancti Spíritus					
Dry preparation - Direct seeding on well drained paddy field	11,799	9,763	10,700	9,150	7,940
Dry preparation - Direct seeding in flooding paddy field				9,685	8,362
Dry preparation - Direct seeding in flooding paddy field, applying disinfection				10,985	9,640
Muddy preparation - Direct seeding in flooding paddy field				9,833	8,721
Camagüey					
Dry preparation - Direct seeding on well drained paddy field	11,543	9,226	10,600	8,971	7,905
Dry preparation - Direct seeding in flooding paddy field				9,585	8,382
Dry preparation - Direct seeding in flooding paddy field, applying disinfection				10,285	8,543
Muddy preparation - Direct seeding in flooding paddy field				9,659	8,966

Source: Resolution No.21/99, MINAGRI

Because water requirement of rice depends on the water management and farming practice in the field, it is unsuitable to apply the water requirement of specialized rice for popular rice cultivation which is small and mid-scale farming with low inputs. The study on the water requirement of popular rice has not yet been compiled in concerned institutes and the reference value has not yet been set. Actually, the water equipment of specialized rice is applied to popular rice in most contracts on water provision service between popular rice producers and INRH. Due to that, the concerned organizations such as IIRD and INRH consider the establishment of the reference of water requirement suitable for the farming practice and technology of popular rice as an important objective.

3) Irrigation efficiency

According to Resolution No.21/99, the irrigation efficiency of specialized rice cultivation is set as 68% in the central region, and this value is applied to the irrigation planning in the contract of INRH. According to the material of the INRH, IIRD, CENHICA, the following irrigation efficiency of gravity irrigation for rice was proposed:

- For traditional system 50%
- For semi-engineering system 60%
- For engineering system 70%

These proposals of irrigation efficiency are considered not to be realistic at present because of

malfunctioning of the irrigation system due to lack of maintenance or inadequate water management in the field. According to the 2nd National Meeting for Rice Irrigation, 1987, the actual irrigation efficiency observed in the field in the Camagüey Province was reported as 33.6%, which is much lower than the reference one. In general, the necessary data to estimate irrigation efficiency is not being measured in the field and the efficiency of the irrigation system is not being evaluated at present, both in specialized rice and popular rice.

Traditional System: A dense ridge is introduced in the field along the contour of original topography as far as possible, without large scale earthwork for land leveling in this System. Ridges are broken during the land preparation work so that they have to be constructed in each cropping. The shape of plot is irregular and its size is small, 0.1~0.2 ha in general. The irrigation in the field block is carried plot-to-plot. This System has problems of waste land in the field, which was reported to occupy 27% of the total field, due to a lot of ponding areas where rice cannot germinate, called *Charco*, and areas used for ridges which cover a long distance in the field. In addition, it takes a long period to flood and drain the field so that it is difficult to manage the field uniformly in the System.

Semi-engineering System: The System was developed to reduce the problem of the Traditional System through introducing land leveling by earthwork and permanent ridge system. The average lot size of the System is 1~3 ha. This System can reduce the waste land of the field by *Charco* and long ridges drastically. This System had been introduced widely in the specialized rice production area in the Sancti Spíritus, Matanzas and Granma Provinces.

Engineering System: An improved irrigation and drainage system in the field is introduced so as to enable optimum water management in the field, as well as introduction of land leveling by earthwork. The standard lot size become 4~6 ha and each field lot has an individual inlet. Several types of the System have been developed, i.e., *Systema Frente Ampleo*, *Kuban System*, *Kransnodar System*, etc.

4) Water management in field level of individual farmers

As mentioned above, most of individual farmers producing popular rice use irrigation individually with personal equipment, except for *Préstamos* of UBPC. The reasons of individual use of irrigation are: a) the farmlands of CCS members are sometimes scattered and in that case it is difficult to introduce collective system physically, and b) most of them rely on small-scale irrigation such as well, spring water, small rivers and drainage canal for water resources. Additionally, in the case that farmers who mainly cultivated upland crops start to produce rice, so it is also considered as a reason that the farmers use equipment for upland crop irrigation for rice irrigation, as observed in Santo Domingo Municipality. Regarding scattering of farmland, a lot of compact cluster of farmland with few farmers were observed, which is defined as *Finca*, even those clusters were scattered. Even within *Fincas*, development and utilization of collective irrigation system is not widely observed except for Yaguajay Municipality and a part of Chambas Municipality.

The irrigation system using individual pump has the advantage of reducing conveyance loss from the aspect irrigation efficiency because canal length can be shortened. The system using pump and tubes connected directly was observed in Santo Domingo Municipality, and had smallest water loss and high efficiency. On the other hand, these individual systems have a

disadvantage in needing investment for the equipment and the operation and maintenance cost of pump facility. Considering the present situation that most individual farmers use diesel pumps, the introduction of collective system of irrigation will contribute to reduce fuel consumption in farm management.

The farmers using pump irrigation were observed to have high concern for water saving. They usually applied intermittent irrigation and operated pumps as necessary while observing the flooding condition of fields frequently. This concern for water saving is due to the fact that fuel cost for irrigation occupies a large share in the farming cost, and saving water strongly affects saving fuel consumption and cost. The size of lots in the paddy fields using pump irrigation is comparatively small from 0.1~0.5 ha and it compensates for lack of adequate land leveling. However, ridges and levees in the field are crudely constructed and levee coating is not applied. Thus, the horizontal percolation of the field is expected to be large.

To identify the practices of water management in the field, an interview survey was carried in the 5 selected municipalities. The summary of the results is given below.

Type of water resources and type of irrigation system

Of the 25 samples, there were 8 users of large-scale irrigation system with dam, 8 users of groundwater, 7 users of small rivers or drainage canals, and 1 user each of river and micro pond. All of the users of dam system were *Préstamos* who were users of the gravity irrigation system operated by rice UBPC. The users of small river and drainage canal usually use water by gravity; however 3 of the 7 users had to use supplementary pumps to take water. The users of groundwater use pumps. It was observed that reliance on pump irrigation is generally high in the 5 municipalities except for *Préstamos* who get water from irrigation system of rice UBPC.

Table 3.2.19 Respondent's Water Sources and Type of System

Water source	Type of system	
	gravity	pump
Dam system	8	-
Micro pond	1	-
River	-	1
Small river/drainage canal	4	3
Groundwater	-	8

Water management in the field

The situation of the water management in the field is summarized from the aspect of irrigation method and ponding depth. 9 of the total 13 sampled pump irrigation users apply intermittent irrigation while almost half apply continuous spillway irrigation when using gravity system. 7 of the total 13 pump irrigation users control ponding depth at less than 5~6 cm and they keep the ponding depth less than fields using gravity system where ponding depth is 6~10 cm. It was observed that the users of pump irrigation apply careful water management in the field and make effort to save water in general.

Table 3.2.20 Type of System, Irrigation Method and Maximum Ponding Depth

Type of system	Irrigation method		Maximum ponding depth in the field					
	continuous	intermitted	2~3cm	3~4cm	5~6cm	6~7cm	10cm	15cm
gravity	6	7	-	-	-	7	5	1
pump	3	9	3	4	1	2	2	-

On the other hand, the comparison of ponding depth of fields applying direct seeding and transplanting is shown in the table below. In general, direct seeding of paddy is applied on well drained paddy field by individual popular rice producers. In such case, after seeding with land preparation in dry condition, the ponding depth is kept at 2~3 cm in the field in the first stage and the ponding depth is increased according to the growth of paddy so that it is kept 6~7 cm at last. The maximum ponding depth controlled of more than 10 cm is also observed sometimes. In the case of transplanting, most fields are maintained in constant ponding depth from the initial to water release which is observed to be managed with target of less than 3~4 cm even though it varies widely by field conditions.

Table 3.2.21 Type of Seeding and Maximum Ponding Depth

Type of seeding	Max depth of water sheet in the field					
	2~3cm	3~4cm	5~6cm	6~7cm	10cm	15cm
direct seeding	1	-	-	8	3	-
transplant	2	4	1	1	4	1

(3) Electrification of irrigation

Use of small pump for irrigation is popular among the individual farmers including CCS members. They mainly use diesel pumps at present, even though a few cases of electric pumps were observed. The diesel fuel is possible to be obtained in the formal market(CUPET, Oro Negro); however, the price is high and farmers have to pay in CUC. In the case of tobacco, vegetables and *viandas* productions, farmers receive support for diesel, which farmers can buy at a lower price than in the formal market and they can pay in pesos, from state enterprises related to production.

In the popular rice cultivation using diesel pump irrigation, to obtain diesel is one of the most serious constraints of expansion of irrigation. Due to large cost of diesel, it was observed that farmers avoid cultivating rice in the dry season, which requires a larger amount of water than rice in the rainy season, even though they would like to cultivate rice in the dry season more than rice in the rainy season because of its higher yield.

The cost of electricity is much lower than diesel fuel when used for irrigation. Most of farmers using diesel pumps have the desire to replace their pumps to electric ones. The electrification of irrigation pumps is considered widely as an important subject, as it is included in the action plan to promote popular rice production in the basic policy of MINAG. However, the electrification of irrigation pumps in popular rice production has not progressed much. The following two points are considered as constraints of the electrification.

a. Condition of power supply : According to the exchanges in Aguada de Pasajeros and Santo Domingo Municipalities, it is difficult to obtain the permission to install electric irrigation pumps due to limited capacity of power supply. In the remaining 3 municipalities, the permission is not a constraint in the case of small irrigation pumps which cover 10 ha more or less. The situation differs in regions due to the conditions of power supply.

b. Cost share : The electric pump installation cost is high and this restricts the progress of electrification. To support farmers, various programs are prepared in each province; however, most of them are not actually implemented due to lack of budget. Thus, farmers have had to carry out the electrification of irrigation pump at their own expense so far.

As an advanced example of electrification of irrigation in the popular rice production, the CCS Antonio Maceo in Horquita of Abreus Municipality, Cienfuegos Province was observed. The CCS has 206 members who produce rice, potato and various crops and raise livestock. Most of their cultivating area, which covers 470 ha (including 140 ha of popular rice area), is irrigated and it relies on groundwater. 260 ha of irrigated area is electrified and this is equivalent to 60% of the whole irrigation area. The electrification was implemented by the CCS and its members without governmental support. The major reasons which enabled the electrification are described below:

a. The farmland of the CCS is adjoining to the farmland of the large-scale state enterprise for various crops "*Empresa Cultivo Varios Horquita*", 100% of which is developed with electrified irrigation system. The electrified irrigation pumps of the CCS are supplied power from the transformation unit of the center pivot system of the enterprise, where there are 25 systems using their surplus capacity. Owing to this situation, the CCS and its members were able to introduce electricity to their field by investing in power cables, which were several hundred meters in length for each pump, without investment for the transformers. The CCS pays the electricity cost to *Empresa* based on a contract between them.

b. The farmlands of the members of the CCS are compactly located for small groups of farmers, called "*Finca*", that usually consist of farmland of 5~6 farmers. Irrigation system including well and pump used to be developed and operated collectively in those groups. Therefore, there was no difficulty to combine several *Fincas* which were located adjacently and to introduce a collective pump system. This reduced the investment of electrification of irrigation pumps.

As observed in the case of Horquita, it is important for electrification of irrigation to specify the areas which have easy access to existing power equipment and to serially promote electrification from such area which can be developed with comparatively small investment. In addition, development of collective irrigation system is also important to reduce investment. Because compact physical location of farmland is indispensable to the collective system, it is necessary to specify the areas which have suitable arrangement of fields in order to promote electrification of irrigation.

(4) Current situation of irrigation in provinces and municipalities selected for the Study.

The information below was collected through some interviews with persons who attend to irrigation, hydraulic resources and also the responsible persons of popular rice from the provinces and municipalities selected for this study.

Cienfuegos Province

The information concerning the distribution of irrigation areas is shown in table 3.2.21. It shows that just 16.4% of the areas that are devoted to popular rice production are cultivated under irrigation. On the other hand, it was observed that these areas are sowing in dry and rainy season, so it means they are using double cropping.

Table 3.2.22 Distribution of the Total Areas, under Irrigation and Sowed under Irrigation during 2003 of Popular Rice in Cienfuegos Province

Crops	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation 2003	
			Dry season	Rainy season
Popular rice	12 225.6	7166.28	2 002.3	7166.28

According to type of user it was observed that CCS and CPA correspond to just 33% from the total irrigation area meanwhile for UBPC corresponds 13%.

In general, gravity system is the most important technique used for irrigation of popular rice areas with the formation of small dikes, while for other crops it is sprinkling with its different modalities.

Cienfuegos province has a water resource potential of 601.7 million m3. It owns six dams operated by Hydraulic Provision Enterprise and 15 microdams operated by the MINAZ and MINAG. There are also 7 groundwater reservoirs with a potential of 348.0 million m3 of which the main ones are: Juraguá (13.8 million m3), Abreus (15.8 million m3) and Hanábana (65.9 millions of m3), located almost in their entirety of Aguada de Pasajeros Municipality.

In terms of water sources, 40% of the areas is supplied from groundwater while 60% take it from superficial sources.

Aguada de Pasajeros Municipality

Only information on CCS is available for Aguada de Pasajeros Municipality. The sowed area was 1,779.5 ha. In these areas, 55% are under irrigation and the remaining 45% are rainfed paddy field. The high portion of rainfed paddy field that characterizes popular rice production in the municipality, has the advantage that farmers can produce rice without fuel for irrigation as well as the disadvantage that the production is unstable due to being strongly affected by rain conditions.

The municipality possesses a water potential of 184.1 million m3. Approximately 80% of the water that is used for irrigation in rice cultivation comes from the groundwater of Hanábana reservoir.

The surface water of the municipality is used by small-scale farms and scattered resources in general, of which 54% is used with gravity system without pump.

In the municipality, the irrigation of individual farmers is by private equipment and used individually, and no collective irrigation system was observed. Most of the water resources of irrigation systems are small ones such as groundwater, small river and spring water and they usually use pumps. Even though the irrigation systems are developed as individual ones, collective use of pump or tractor, of which PTO is used for motor of pump, are observed in several cases. One example of collective use, the CCS Jesus Sardines which is located in Consejo Popular Victoria and consists of 156 members, has 9 groups of collective use of pump motor which are composed of 3~5 farmers each. A rough estimate is that 20~30% of members of this CCS participate to collectively use irrigation equipment of all forms.

The typical irrigation system of individual farmers in the municipality is composed of pumps placed at wells or small rivers and small and short canals connecting the pump and field. Plot-to-plot irrigation is applied on the property of farmers. Each lot is developed at a scale of around 0.5 ha and its shape is irregular according to the topography.

The total number of pumps possessed by the CCSs and their members in the municipality is

reported to be 589 units, of which 577 (98%) are diesel pumps and 12 (2%) are electric pumps (by Provincial MINAG Popular Rice Group). Most of pumps used in the municipality are diesel.

In this municipality, no remarkable medium or large scale irrigation system which is used in popular rice production was observed.

Villa Clara Province

Santo Domingo Municipality

The water potential of this municipality is divided in two fundamental areas: Manacas and Cascajal. In the Manacas area, almost the entire water for irrigation comes from underground water through deep wells which have been exploited already for several years and they irrigate about 800 ha consuming an annual volume of 4.5 million m3 of water. In the Cascajal area, all water also comes from underground resources to irrigate about 600 ha of cultivation that consumes an annual volume of 3.5 million m3 of water.

Because groundwater is superior as a water resource for individual popular rice producers in the municipality, pump irrigation is the major system which is possessed privately and operated individually. In the municipality, irrigation systems using flexible tubes instead of digging small canal were observed widely. The system is thought to be originally developed for upland field irrigation and farmers now use it both for upland and paddy field irrigation. This system is considered to have water saving advantages owing to less water conveyance loss and enabling careful and accurate water management in the field by plot. However, it takes a lot of effort for farmers to shift tubes from one plot to another. The scale of plots is remarkably small, generally 0.1~0.15 ha.

In this municipality, no remarkable medium or large scale irrigation system which is used in popular rice production was observed.

Sancti Spíritus Province

Table 3.2.23 shows that for this province, 100% of the areas corresponding to specialised rice are under irrigation. Nevertheless, for popular rice production, just 21% of areas are favoured with irrigation.

Table 3.2.23 Distribution of Total Areas under Irrigation and Sowed under Irrigation in 2003 during the Cultivation of Popular Rice in Sancti Spíritus Province.

Crops	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation (2003)	
			Dry season	Rainy season
Specialized rice	28,906.7	28,906.7	6,930.1	4,845.4
Popular rice	19,445.8	4,047.2	1,686.5	4,047.2

In the case of areas sowed under irrigation in 2003, the entirety of the popular rice plantings are in the rainy season, and at the same time, a small quantity are done two times in a year. The sowed area of specialised rice represents almost 40% of the total area dedicated to this cultivation. The biggest areas under irrigation belong to CAI followed by CCS, CPA and State Farms.

For techniques of watering employed, in 89% of areas gravity is more used and in the rest sprinkling, having as main supply source superficial water.

The water potential of this province is of 2860.4 million m3, of which 60% is exploitable

consisting of superficial water 87.5% and underground 12.5%.

Yaguajay Municipality

Table 3.2.24 shows the distribution of popular rice areas where 78% of total are under irrigation, of which 19.5% sowed in dry season.

Table 3.2.24 Distribution of Total Areas, under Irrigation and Sowed under Irrigation in 2003 during the Cultivation of Popular Rice in Yaguajay Municipality

Crop	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation (2003)	
			Dry season	Rainy season
Popular rice	3,529.5	2,751.1	536.8	2,751.1

According to types of users, the biggest in areas with irrigation is UBPC followed by CCS, State Farm and CPA.

In this municipality, all areas under irrigation use gravity technique and are supplied from superficial source water where 83% do not need to use pumps for water reception. However, there are a lot of systems that need to use pumps temporally during low water levels in rivers. The situation of irrigation use in popular rice production in the areas of El Río, Mayajigua and Simon Bolivar, which are major production areas of popular rice in the municipality, are summarized below:

Table 3.2.25 Summary of Irrigation System of Rice Production in C.P. El Río, Mayajigua and Simon Bolivar

Number of producers (units)			
CCS	10	UBPC	4
CPA	3	Parceleros	50

Total area of rice production (ha)	832	
Irrigated area (ha)	832	100% of total area
Collective irrigation system with electric pump (ha)	134	16% of irrigated area
Individual irrigation system with diesel pump (ha)	27	3% of irrigated area
Collective irrigation system with gravity system (ha)	671	81% of irrigated area
Not necessary to use pump (ha)	550	82% of gravity system
Sometimes necessary to use pump (ha)	121	18% of gravity system

Source: Provincial MINAG Popular Rice Group, 2004

For irrigation in the popular rice production in the municipality, most systems rely on small rivers or drainage canals where the flow is strongly affected by the condition of rainfall. This means that water supply is very unstable and that water shortage occurs even in the rainy season as well as being difficult to use in the dry season.

The collective irrigation system by Fincas consists of about 10 producers was widely observed. The CCS Frank Pais No.1, which is located in the Mayajigua area and has 190 members of which 165 are landowners, is an example of the distribution of collective system. The CCS has 12 gravity irrigation systems operated collectively and 20 individual pump irrigation systems.

In the area along the Río Jatibonico del Norte River which runs on the boundary of Yaguajay and Chambas municipality, the River is used as the water resource for irrigation. The CCS Savino Hernandez, which is located in El Río area and consists of 154 members (68 families) is an example of a river water user. The CCS used be supplied water by the electric pump station of the UBPC La Presa located in the Río Jatibonico based on a contract, but the CCS took water from the River by their own collective diesel pump starting from this year. The CCS has 5 farmer

groups which consists of 6~8 farmers and use and irrigation system collectively, of which 4 groups take water from Río Jatibonico by diesel pump and 1 group uses groundwater. In those cases, the pump belongs to a member of the group privately and members pay a fee to the owner, which is usually paid in kind. The canal systems are constructed and maintained by all users. In addition, there are 10 small diesel pumps used for irrigation privately in the CCS.

In the area Consejo Popular Nela which is at the east end of the municipality, there is Aridanes Dam. The dam was constructed in 1968 and it is not used at present due to damage by Hurricane in 1998. It is necessary to have rehabilitation; however, there is no plan due to lack of budget.

Table 3.2.26 List of Irrigation System with Dams in Yaguajay Municipality

Name of Irrigation System	Name of dam	Catchment Area (km^2)	River	Capacity (million m^3)	Construction year
Not working	Aridanes	192.00	Arroyo Prieto	4.50	1968

Source: INRH

Ciego de Ávila Province

In general, this province is devoted to popular rice and of 10,789.6 ha there is 40% under irrigation (Table 3.2.27). From total areas 77% is irrigated with the use of underground water, while superficial resource is 23%, with 12% using pumps and the rest gravity. For the distribution of area according to the type of user, the UBPC had areas that represented 43% of the total followed by the CCS with 22%.

Table 3.2.27 Distribution of Total Areas, under Irrigation and Sowed under Irrigation in 2003 during the Cultivation of Popular Rice in Ciego de Ávila Province

Crops	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation (2003)	
			Dry season	Rainy season
Popular rice	10,789.6	4,321.2	2,697.4	8,092.2

Chambas Municipality

The current area of popular rice is 2,415.6 ha of which 2,281.4 ha are under irrigation that represents 94.4% of the total (Table 3.2.28). In 100% of areas that are sowed under irrigation, the predominant water supply is from superficial source. The irrigation system most used is gravity. In 2003, during the rainy season 1,664.08 ha were sowed under irrigation.

For distribution of the areas according to type of user, the situation is similar to the province: that is to say, the UBPC with 25% followed by the CCS with 22%.

Table 3.2.28 Distribution of Total Areas, under Irrigation and Sowed under Irrigation in 2003 during the Cultivation of Popular Rice in Chambas Municipality

Crops	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation (2003)	
			Dry season	Rainy season
Popular rice	2,415.6	2,281.4	758.23	1,664.08

The irrigation use by the type of water resource in the municipality is shown in the table below. 70% of irrigated area relies for its water resources on surface water with gravity system.

Table 3.2.29 Irrigated Area by Type of Water Resources

Type of Water resources		Area (ha)	%
Surface Water	Using Pump System	558.2	17.2
	Using Gravity System	2,281.4	70.4
Groundwater		402.6	12.4
Total		3,242.2	

Source: Ciego de Ávila Province Popular Rice Group, 2004 Remarks: This table shows irrigated area of rice and various crops.

The major water resources for popular rice production are Río Jatibonico del Norte River, Liberación de Florencia Sytem and El Carvario Dam, and spring water, small rivers and groundwater are used in the remaining area. Half of the area using gravity system is expected to be supplied by the Liberación de Florencia System. The dams and irrigation systems in the municipality are summarized below.

Table 3.2.30 List of Irrigation System with Dams in Chambas Municipality

Name of Irrigation System	Name of dam	Catchment Area (km^2)	River	Capacity (million m^3)	Construction year
El Calvario Irrigation System	El Calvario	20.14	Río El Calvario	14.73	1991
Liberación de Florencia System	Chambas II	128.00	Río Chambas-Las Pojas	33.33	1990
	Chambas I	168.00	Río Cañada Blanca	45.75	1988

Source: INRH

The Río Jatibonico del Norte River, which runs along the boundary of Chambas and Yaguajay municipality, is used by the producers along the river. Due to the topographic condition of low river bed, all users of the River have to use pumps to take water from the River. The usage of the River for popular rice production is listed below:

- 1 CCS sowing popular rice of around 170 ha
- 1 CPA（MINAZ） sowing popular rice of around 13 ha
- 1 GENT sowing popular rice of around 270 ha
- 1 State Enterprise for Fisheries sowing popular rice of around 13 ha

The Liberación de Florencia System is composed of 2 damps, 2 derivers and a main channel of 4 km. From this water source, it was constructed the irrigation system composed of 37 km of irrigation channels. Chambas River of 36 km is also included in the system..

Table 3.2.31 Assignment Plan of Water Delivery of Liberación de Florencia System in 2004

Unit: million m^3

Ministry	Type of organization	Number of producers	Total amount	Sugarcane	Not sugarcane		Estimated cultivation area of rice* (ha)
					Crops other than rice	Rice	
Water assignment for agriculture and sugarcane use							
MINAG	CCS	4	6.165	-	-	6.165	206
	UBPC	6	5.345	-	0.773	4.572	152
	Empresa Invercion Arroz	1	15.343	-	13.976	1.367	46
MINAZ	CPA	2	2.634	0.806	-	1.828	61
	UBPC	6	14.386	6.542	0.176	7.668	256
	Others	5	14.129	2.401	0.312	11.416	381
Total of agriculture and sugarcane use			58.002	9.749	15.236	33.016	1,101
Water assignment for other use			7.309				
Ground total of water assignment			65.311				

Source: UEB Complejo Hidráulico Norte, Remarks *: Estimation by the asumotion of gross water consumtion as 30,000m^3/ha.

The facilities were observed to be in good condition and both of dams and canal system are maintained adequately. A part of secondary channel has not been completed and channels are used as earth channel without lining. The major target of the irrigation was set for sugar cane in the original plan. At present, there are many fields taking water from the system, which were originally not included as its beneficiaries because of significant reduction of water use by the sugarcane farm. Due to topographic conditions, a lot of fields need pumps to take water from the system.

El Calvario Dam was developed as a sugarcane farm and 1 CCS produces popular rice on 7 ha using the system.

Camagüey Province

Cultivation of rice in 2003 was sowed, without including Préstamos, on a total of 11,364 ha and 63.1% of these areas were under irrigation, being 67.4% in dry season and the rest in the rainy season (Table 3.2.32).

Table 3.2.32 Distribution of Total Areas, under Irrigation and Sowed under Irrigation during 2003 for the Popular Rice in Camagüey Province

Crops	Total area (ha)		Area under irrigation (Without *Préstamos*)	Area under irrigation (2003)	
	With *Préstamos* including	Without *Préstamos* Including		Dry season	Rainy season
Popular rice	16,403	11,364	7,170	4,832	2,338

Vertientes Municipality

The sowed area of popular rice, without Préstamos, was 4,526 ha with 2,686 ha being under irrigation that represented 59% of the total (Table 3.2.33). In relation to the distribution of irrigation areas for the type of supply source, underground water has 69.6%, corresponding to CCS 40%. However for superficial water, 77% of the areas that are irrigated with this supply source correspond to Préstamos.

The municipality has as main irrigation systems, Jimaguayu/Vertientes and Congo/Cenizo, both belonging to CAI named as Ruta Invasora.

Table 3.2.33 Distribution of Total Areas, under Irrigation and Sowed under Irrigation in 2003 during the Cultivation of Popular Rice in Vertientes Municipality

Crops	Areas (ha)			
	Total area	Area under irrigation	Area sowed under irrigation (2003)	
			Dry season	Rainy season
Popular rice	4,526	2,686	2,686	-

The major water resource of the municipality is the irrigation system which take water from dams constructed in the three major rivers (Río Duran River, Río San Pedro River and Río Naja River) and from groundwater. The outline of dam system in the municipality is shown below. The Congo Cenizo System provides water to UBPC El Cenizo, the Jimaguayú-Vertientes System provides to UBPC La Lima, UBPC Diguez Pupo and UBPC Daniel Readigo, and the Najasa-Los Negros System provides to the military farm (Granja Militar). These UBPCs, except for the military farm, have produced specialized rice under the CAI Arroz Ruta Invasor. However, UBPC Daniel Readigo and UBPC La Lima produced popular rice instead of specialized rice for the last 3 years (from 2002 to 2004). CAI explained that it was a part of a trial for introducing popular rice

technology, especially for the low input cultivation, from production of specialized rice. These UBPCs have a plan to restart to produce specialized rice from 2005. Under these 4 UBPCs, there were 215 Préstamos (in 2003) who rented land from UBPC and produced popular rice using these irrigation systems.

Table 3.2.34 List of Irrigation System with Dams in Vertientes Municipality

Name of Irrigation System	Name of dam	Catchment Area (km^2)	River	Capacity (million m^3)	Construction year
Congo Cenizo System	Hidro. Durán	-	Río Durán	3.10	1991
	Durán II	48.90	Río Durán	22.00	1979
Jimaguayú-Vertientes System	Hidro. Gibraltar	-	Río San Pedro	2.15	1992
	San Pedro	206.00	Río San Pedro	27.80	1991
	Jimaguayú	592.00	Río San Pedro	200.00	1970
Najasa-Los Negros System	Najasa I	266.80	Río Najasa	73.50	1973

Source: INRH

An outline of major irrigation system in the municipality is shown below. 32% of the irrigation area of the Jimaguayú-Vertientes System and a 9.5% of Congo Cenizo System are assessed as "in bad condition". In accordance with interviews with Préstamos who are users of these systems, it is believed that paddy field which cannot be irrigated adequately is due to lack of maintenance which is widespread in the system.

Table 3.2.35 Summary of Irrigation System in Vertientes Municipality

Items	Jimaguayú-Vertientes System		Congo Cenizo System	
Total area for rice cultivation (ha)	10,025		4,267	
Area developed irrigation (ha)	8,111		3,329	
Situation of system of paddy field (ha)				
Engineering system	-		89	
Semi-engineering system	8,111		3,240	
Traditional system	-		-	
Condition of irrigation system (ha)				
Good	-	0%	1,444	43.4%
Fair	5,552	68.5%	1,568	47.1%
Bad	2,529	31.5%	317	9.5%
Canal system (km)				
Length of irrigation canal	141		62	
of which main canal	38		6	
Length of drainage canal	181		61	
of which main canal	33		28	
Water users for rice (unit)				
Number of UBPC	3		1	
Number of CPA	2		1	
Number of CCS	1		-	

Source: Camagüey Province Popular Rice Group, 2004

The producers of popular rice, except for UBPCs and Préstamos part of CPA which are located adjacent to the UBPC's irrigation system, in general rely on groundwater and small rivers for water resource. Most individual farmers in CCS and Parceleros use groundwater for irrigation. In such case, pump equipment is in general owned privately and operated individually, and collective systems were not observed. The number of pumps possessed by CPA and CCS is recorded as 67, of which 15 are 80~100 mm, 49 are 100~120 mm, and 3 are more than 150 mm.

Table 3.2.36 Area under Cultivation of Rice with Irrigation by Water Resources in 2003

(unit: ha)

Type of producer		Total of irrigated area	Type of water resources			
			Surface water		Groundwater	
Specialized rice	UBPC	2,377	2,377	100%	-	0%
Popular rice	CPA	368	225	61%	143	39%
	CCS	1,042	-	0%	1,042	100%
	Parceleros	843	42	5%	801	95%
	Préstamos	1,309	905	69%	404	31%
	Other	293	-	0%	293	100%
Total of popular rice		3,855	1,172	30%	2,683	70%

Source: Camagüey Province Popular Rice Group, 2004

3.3 Conditions and Problems of Popular Rice Production in the 5 Municipalities

In the five municipalities in the Study Area, popular rice is mostly produced in various production units such as UBPC, CPA, Parceleros, Préstamos, Empresa, GENT, and CCS. There is no Rice Production Unit in the Study Area which is producing Popular Rice for sale to market, except Préstamos in all surveyed municipalities and CPA in Vertientes. However, in the Parceleros, popular Rice and various crops (such as frijol, maize, vegetables, etc.) as second cropping in paddy fields are produced, but the purpose of the rice production is for self-consumption. In Préstamos, only Popular Rice is produced.

The other hand, CPAs and CCSs have main objectives such as sugar cane, tobacco, various crops including vegetables, and animal husbandry. Their Units carry out Popular Rice production for self-consumption, home seed-raising, and sale of excess to market. Hereinafter, the “rice production” is defined as Popular Rice production.

Interview survey on the present conditions of agriculture and rice production in the five municipalities in the Study Area was carried out. The results of the survey are summarized below (see Table 3.3.1).

3.3.1 Present Conditions of Popular Rice Production

(1) Aguada de Pasajeros Municipality

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, animal husbandry (which is mainly dairy cattle), and various crops including vegetables. Annual total area of rice cultivation in 2003 was about 3,000 ha, which was ranked at 4th in the five municipalities, and rice production was about 11,700 tons in wet paddy. Average yield in wet paddy was 4 ~ 4.5 tons/ha in dry season, and 3.4 ~ 4 tons/ha in rainy season, respectively. Ratio of area of double rice cropping for total paddy area was about 50%, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

With regard to soil of paddy field, almost all of paddy field in the municipality is well-drained, and the soil texture is light heavy soil.

There is no data in detail on soil texture of the Study Area. Therefore, soil texture is defined as follows: Heavy soil contains so much clay that all farm works cannot be carried out without tractor or animal. Light heavy soil contains so much clay that plowing is carried out with tractor, but other farm works can be carried out with animal power. Other soil is defined as light soil.

For source of irrigation water in paddy fields, 42% of total paddy area is from well and river, from which water is pumped up by tractor power. The rest of 58% of total paddy fields is rainfed field,

which can cultivate rice only in the rainy season.

Every Popular Rice Production Unit in the municipality is shown in Table 3.3.1. Every UBPC, CPA, GENT and CCS carry out the double rice cropping in a year in the range of 50% to 60% for total paddy field of each unit. However, other units cultivate rice in only the rainy season.

With regard to rice cultivation methods in the municipality, the results of interview survey are summarized as Table shown in the following pages. .

Rice transplanting method is carried out in almost all of the paddy fields in the municipality. Coverage of rice transplanting method in the municipality is very high as compared with that in other surveyed municipalities. Coverage of certificated rice seeds in the municipality is less 30%. Chemical fertilizer and chemicals are unavailable, so that almost all farmers fertilize with organic matter in their paddy fields. As organic matter, whole rice straw is used in general with added cachasa and dried excrement of livestock in some cases.

Cachasa is sediment in processing of sugar cane. According to the farmer's interview survey, cachasa is sold at sugar cane factories at the same unit price of 35 PS/ton, even though the moisture contents of cachasa are different, and fertilize 17 tons/ha to paddy field. The result of chemical analysis of one sample is as follows: moisture content about 49%, organic matter 50.69%, C/N ratio 11.62 in fresh matter basis, and N 1.4%, P 1.17%, K 0.42% on dry matter basis.

Farm works of rice cultivation are carried out mainly by animal power and common use of tractors, which belong to CCS and farmers. In general, farmers in CCS carry out integrated farming, composed of upland farming, lowland farming and livestock farming. Farmers cultivate root vegetables, tomato and others in upland field, rice, maize, frijol, etc. in lowland field, and raise several heads of dairy cattle.

(2) Santo Domingo Municipality

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, various crops including vegetables, rice, and animal husbandry (which is mainly dairy cattle). Annual total area of rice cultivation in 2003 was about 3,400 ha, which was ranked at 3rd in the five municipalities, and rice production was about 13,600 tons in wet paddy, which was ranked at 2nd in the five municipalities. Average yield was 3.3 ~ 4.6 tons/ha in dry and rainy season. Ratio of area of double rice cropping for total paddy area was about 70%, which is very high as compared with that in other surveyed municipalities, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

With regard to soil of paddy field, almost all of paddy field in the municipality is well-drained, and the soil texture is light heavy soil with 50% for total paddy fields and light soil in the rest.

Source of irrigation water in all paddy fields is well and river, from which water is pumped up by stationary motors and tractor power. In general, there are few irrigation canals; therefore, irrigation is carried out by metal and plastic tubes to each field.

Table 3.3.1 Characteristics of Popular Rice Production in Each Municipality of Survey Area (1/2)

Items	Aguada	Santo Domingo	Yaguajay	Chambas	Vertientes
1 **Outline of Agriculture in Each municipality (2003)**					
1) Order of produce	sugar cane＞rice＞ animal husbandry＞ various crops including	sugar cane＞various crops＞rice, animal husbandry	sugar cane＞animal husbandry＞ various crops＞rice	sugar cane＞rice＞tobacco＞ animal husbandry & various crops	sugar cane＞rice＞animal husbandry＞various crops
2) Annual total area of rice cultivation	2,979 ha	3,427 ha	3438,2 ha	2,416 ha	6,307 ha
3) Rice production (wet paddy, ton)	11,697 tons	13,662 tons	12,173	9,567	21,022
4) Average yield (wet paddy ton/ha)					
In dry season	3.97 ～4.49	4.55 ～ 3.33	4.40	4.76	3.40
In wet season	3.40 ～3.93	4.55 ～ 3.33	3.40	3.60	3.10
5) Crops as second cropping in paddy field	maize, frifol, vegetables	maize, frifol, vegetables	Maize, frifol, vegetables; 60%. Fallow ;40%.	maize, frifol, vegetables	fallow after rice cultivation except double cropping of rice
6) % of area of double rice cropping for total paddy area (Ratio of area of double rice cropping)	48%	Aprox. 70%	16%、	45%. Rotation of lowland (double rice cropping) with upland (natural pasture).	6%
2 **Soil of paddy field**					
1) Well-drained paddy field or imperfect-drain paddy field	well-drained paddy field; 5% imperfect-drain faddy field; 95%	well-drained paddy field; 100%	Northern area; imperfect drained paddy field Southern area; well-drained paddy field	well-drained paddy field; 100%	well-drained paddy field; 100%
2) Soil texture	light heavy	light heavy 50%, light 50%	Northern area; light heavy soil Southern area; light soil	heavy soil 90%, light soil 10%	heavy soil 40%, light soil 60%
3 **Irrigation**					
1) Sources of irrigation water and level of irrigation facilities	well & river; 42% rain-fed; 58% irrigation canal; no	well & river; 100% irrigating with pipe or hose	river; 100% irrigation system; no Area of rice cultivation in dry season is limited by shortage of irrigation water.	dam; 75%, well & spring; 25% in CCS, well; 100% irrigation canal; existing quantity of water; enough	dam; 70%, well; 30% in CCSs, well; 100% Area of rice cultivation is restrained by shortage of fuel for pumping up of well water.
2) Drainage facilities	drains; no	no	no	existing	partly existing
4 **Number of popular rice production units and ratio of area of double rice cropping**					
1) UBPC	14 50%	20 100%	24 15%	30 0%	4 0%
2) CPA	5 50%	6 100%	9 7%	7 0%	14 0%
3) Parceleros	110人 0%	3,460人 60%	736人 9%	310人 15%	211人 0%
4) Prestamos	8人 0%	99人 100%	-	25人 0%	240人 9%
5) Empresas	2 50%	6 100%	3 15%	8 0%	5 0%
6) CCS	9 65%	17 100%	29 17%	7 17%	13 0%

Table 3.3.1 Characteristics of Popular Rice Production in Each Municipality of Survey Area (2/2)

Items	Aguada	Santo Domingo	Yaguajay	Chambas	Vertientes
5 **Rice cultivation**					
1) Coverage of rice transplanting method	95 ～ 97%	90%	31%	24%	0%
2) Coverage of certified rice seeds	10 ～30%	0%	0%	40% in whole CCSs	80% in contract with CAI, 20% in others
3) Availability of chemical fertilizer	impossible	impossible	impossible. 30% of necessary quantity of urea is satisfied by appropriation of urea for sugar cane.	impossible	impossible. Sometimes, urea is supplied by CAI.
4) Availability of chemicals	impossible	impossible	impossible	impossible	impossible
5) Fertilization of organic matter	whole rice straw, adding cachasa and dried excrement of livestock in some cases.		stump of straw only. Straw is burned in field.	compost with earthworm, mixture of rice straw with excrement of livestock, and cachasa	There is no custom of fertilization of organic matter. Rice straw is burned in field.
6) Mechanization	mainly using animal powers. common use of tractors (plowing, disk harrow for		tractor and animal powers	mainly using tractors. partly using animal powers	mainly using tractors. partly using animal powers
7) Farming type of farmers in CCSs	Farmers carry out integrated farming, composed of upland farming, lowland farming and animal husbandry. Upland; root vegetables, tomato, etc lowland; rice, maize, frifol, etc animal husbandry; several heads of dairy cattle		CCSs are classified by main products in each CCS, such as sugar can, various crops production, animal husbandry, etc. Farmers carry out integrate farming with production of rice and the main products.	CCSs are classified by main products in each CCS, such as tobacco, sugar can, various crops production, animal husbandry, etc. Farmers carry out integrate farming with production of rice and the main products.	CCSs are classified by main products in each CCS, such as sugar can, various crops production, animal husbandry, etc. Farmers carry out integrate farming with production of rice and the main products.
8) Problems of rice production	shortage of farm materials, fuel, registered seeds, etc.	ditto	Besides of general problems, farmers in CCSs wish to expand the farming lands, because they have much labor forces and small lands.	Shortage of machinery, farm materials, fuel, registered seeds, and difficulty of electrification of pump.	The municipality is characterized by a vast extent of farm land, low density of population. Therefore, necessity of mechanization is larger due to shortage of labor forces. Shortage of machinery, farm materials, fuel, registered seeds, and difficulty of electrification of pump.
9) Expectation to research	increasing registered seeds	ditto	increasing registered seeds	increasing registered seeds compact tractors suitable to small plot of paddy field (25PS)	ditto
10) Expectation to extension workers	increase of training, promotion of electrification, and vehicle for extension activity	ditto	ditto	ditto	ditto
11) Plans in near future (surveyed CCSs)	Increase of rice production, and electrification	ditto	ditto	Increase of rice production, and electrification	Introducing of rice transplant techniques in condition of less labor forces

Every Popular Rice Production Unit in the municipality is shown in Table 3.3.1. All Units carry out the double rice cropping in a year in the range of 60% to 100% for total paddy field.

With regard to rice cultivation methods in the municipality, the results of interview survey are summarized below.

The rice transplanting method is carried out in about 90% of total paddy field in the municipality. Coverage of rice transplanting method in the municipality is very high, the same as that in Aguada municipality, that is, 50% to 70% in UBPC, CPA, EMPRESA and 100% in other Units. Coverage of certificated rice seeds in the municipality is small. Chemical fertilizer and chemicals are unavailable, so that almost all farmer fertilize with organic matter in their paddy fields. As organic matter, whole rice straw is used in general with added cachasa and dried excrement of livestock in some cases.

Farm works of rice cultivation are carried out mainly by animal power and common use of tractors which belong to CCS and farmers.

In general, farmers in CCS carry out integrated farming, composed of upland farming, lowland farming and livestock raising. Farmers cultivate root vegetables, tomato, etc. in upland field, rice, maize, frijol, etc. in lowland field, and raise several heads of dairy cattle.

(3) Yaguajay Municipality

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, animal husbandry, various crops included vegetables, and rice. Annual total area of rice cultivation in 2003 was about 3,438.2 ha, and rice production was about 12,173 tons in wet paddy, which was ranked at 4th in the five municipalities. Average yield was 4.4 tons/ha in dry season and 3.4 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 17% in CCS, which is low as compared with that in other surveyed municipalities, and the range of 60% of total paddy fields in dry season was cultivated frijol and maize with companion planting and vegetables as second planting, and the rest field was fallows.

With regard to soil of paddy field, paddy field in northern part of the municipality is imperfectly drained. On the other hand, paddy field in southern part of the municipality is well-drained. The soil texture in northern part is light heavy soil, and that in southern part of the municipality is light soil.

Source of irrigation water in whole paddy fields is river, from which water is pumped up by tractor or electric power, and there are few irrigation and drainage systems. The shortage of river's water in dry season restricts area of rice cultivation in dry season.

Every Popular Rice Production Unit in the municipality is shown in Table 3.3.1. All rice production units carry out the double rice cropping in a year in the range of 7% to 17% for total paddy field of each unit, except Préstamos.

With regard to rice cultivation methods in the municipality, the results of interview survey are summarized below.

The rice transplanting method is carried out in the range of 26% to 50% in CPA, Parceleros and CCS, but other Units did not introduce the rice transplanting method. Coverage of rice transplanting method in the municipality is comparatively low in the five surveyed municipality.

Coverage of certificated rice seeds in the municipality is low. Chemical fertilizer and chemicals are unavailable in general, but 30% of necessary quantity is supplied by appropriation of urea for sugar cane.

On the other hand, almost all farmers do not fertilize with organic matter in their paddy fields. Rice straw is burned in fields.

Farm works of rice cultivation are carried out by common use tractors and individual animal power.

CCs are classified by main products in each CCS, such as sugar cane, various crops production, animal husbandry, etc. Farmers carry out the integrated farming with production of rice and the main products.

(4) Chambas Municipality

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, tobacco, animal husbandry and various crops including vegetables. Annual total area of rice cultivation in 2003 was about 2,400 ha, which was ranked at 5th in the five municipalities, and rice production was about 10,000 tons in wet paddy, which was ranked at 5th in the five municipalities. Average yield was 4.4 tons/ha in dry season and 3.6 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 45%, and the rest of rice cultivation in dry season was cultivated frijol and maize with companion planting and vegetables as second planting.

With regard to soil of paddy field, almost all of paddy field in the municipality are not inundated and is well drained, and the soil texture is heavy soil in the range of 90% for total paddy fields and light soil in the rest.

Source of irrigation water is dam in fields for 75% of total paddy area, and well and spring in the rest. In CCSs, irrigation of well water is predominant, from which water is pumped up by tractor power. Area of rice cultivation is restricted by shortage of fuel for pumping up of well water. CCSs have irrigation canals and drains.

Every Popular Rice Production Unit in the municipality is shown in Table 3.3.1. Parceleros and CCSs carry out double rice cropping in a year in the range of 15% and 17% for total paddy field of each unit, respectively. However, other units cultivate rice only in the rainy season.

With regard to rice cultivation methods in the municipality, the results of interview survey are summarized below.

The rice transplanting method carries out in the range of 10%, 50% and 45% in CPA, Parceleros, and CCS, respectively. Coverage of rice transplanting method in the municipality is comparatively low in the five surveyed municipalities.

Coverage of certificated rice seeds in the municipality is 40% of total required seeds in CCSs. Chemical fertilizer and chemicals are unavailable, so that almost all farmer fertilize organic matter in their paddy fields. In general as organic matter, compost with earthworm, mixture of rice straw and excrement of livestock, and cachasa are used.

Farm works of rice cultivation are carried out mainly by common use of tractors which belong to CCS and farmers. Use of animal power is a small in the municipality.

CCs are classified by main products in each CCS, such as sugar cane, tobacco, various crops

production, animal husbandry, etc. Farmers carry out the integrated farming with production of rice and the main products.

(5) Vertientes Municipality

The order of produce of agriculture and animal husbandry in the municipality is sugar cane, rice, animal husbandry, various crops including vegetables. Annual total area of rice cultivation in 2003 was about 6,300 ha, which was ranked at 1st in the five municipalities, and rice production was about 21,000 tons in wet paddy, which was ranked at first in the five municipalities. Average yield was 3.4 tons/ha in dry season and 3.1 tons/ha in rainy season. Ratio of area of double rice cropping for total paddy area was only about 9% in Préstamos, which is very low as compared with that in other surveyed municipalities, and almost all paddy field is fallowed after rice cultivation in dry season or in rainy season, except fields of double rice cropping.

With regard to soil of paddy field, almost all of paddy field in the municipality is well-drained, and the soil texture is heavy soil in the range of 40% for total paddy fields and light soil in the rest.

Source of irrigation water is dam in the range of 70% of total paddy area, and well and river in the rest. In CCSs, irrigation of well water is predominant, from which water is pumped up by tractor power. Area of rice cultivation is restricted by shortage of fuel for pumping up of well water. There are few irrigation canals and drains.

With regard to rice cultivation methods in the municipality, the results of interview survey are summarized below.

Coverage of rice transplanting method, which requires more labor than that in direct sowing method, is very limited in the municipality, because the municipality is characterized by a vast extent of farm land, low density of population, and shortage of labor.

Coverage of certificated rice seeds in the municipality is small. In the case of farmers who contract with CAI, 80% of total farmers receive the certificated rice seeds in exchange for sale of rice, but others cannot get the registered seeds. Chemical fertilizer and chemicals are unavailable, and also almost all farmers do not fertilize with organic matter in their paddy fields because there is no custom of use of organic fertilizer. Rice straw is burned in fields.

Farm works of rice cultivation are carried out mainly by common use of tractors which belong to CCS and farmers. Use of animal power is small in the municipality.

CCs are classified by main products in each CCS, such as sugar cane, various crops production, animal husbandry, etc. Farmers carry out the integrated farming with production of rice and the main production.

The characteristics of five surveyed municipalities on popular rice cultivation are summarized as shown in Table 3.3.2.

Table 3.3.2 Characteristics of five surveyed municipalities

Item	Aguada	Santo Domingo	Yaguajay	Chambas	Vertientes
Total area	4th	3rd	2nd	5th	1st
Rice production	3rd	2nd	4th	5th	1st
Yield	High	High	High	High	Low
Double cropping (CCS)	65%	100%	17%, low	17%, low	0%, low
Soil	light heavy	light heavy 50% light 50%	Light heavy 50% light 50%	heavy 90% light 10%	heavy 40% light 60%
Irrigation	Well, river 42%	Well, river 100%	River 100%	Dam 75% Well spring 25%	Dam 70%, Well 30%
Transplanting (CCS)	100%	100%	50%	45%	0
Certified seeds	Less 30%	Low	Low	40%	High
Organic fertilization	Whole rice straw, and others	Whole rice straw, and others	no	Earthworm compost, straw and excrement	no
Farm works	Tractor, animal	Tractor, animal	Tractor, animal	Tractor	Tractor

3.3.2 Problems of Popular Rice Production in the 5 Municipalities

Common problems in the surveyed five municipalities are as follows:

1) Shortage of farm materials, such as chemical fertilizer, chemicals, certified seeds, etc.
2) Shortage of fuel for pumping up of well and river water, and difficulty of electrification.
3) Broken-down machinery, shortage of machinery and lack of machinery for post harvest.
4) Lack of irrigation-drainage system and large loss of irrigation water in old canals.
5) Low utilization of the rotation crop with rice.
6) Low utilization of the residual crop for soil improvement.
7) Deficient drying process.
8) Deficient milling process.
9) Insufficient training of producers

Specialized problems in each municipality are as follows:

1) The Vertientes municipality is characterized by a vast extent of farmland, low density of population. Therefore, necessity of mechanization is large due to shortage of labor. Broken-down machinery and shortage of machinery are serious for the municipality, and farmers cannot introduce the technologies of double rice cropping and rice transplanting.
2) In the Chambas Municipality, all farm works with machinery are required due to heavy soil. Broken-down machinery and shortage of machinery are serious for the municipality
3) In the Yaguajay Municipality, the farmers in CCSs wish to expand their farmlands because they have much labor and small lands.

Expectation of farmers to IIArroz and extension workers is as follows:

1) Increase of quantity of certificated rice seeds
2) Development of compact tractors (25 hp) suitable for small plot of paddy field
3) Development of machinery for rice transplanting
4) Increase of opportunity of technical training
5) Promotion of electrification for pumping up of irrigation water
6) Vehicles for extension activities

3.3.3 Present Conditions of Each Popular Rice Production Units in Surveyed Municipalities

(1) Number of popular rice production unit and area of rice production

There are seven types of Popular Rice Production Units in the five surveyed municipalities. UBPC, CPA, EMPRESA GENT and CCS have organizations. On the other hand, in PARCELEROS and PRESTAMOS, individual farmers carry out popular Rice cultivation on borrowed land. These units have different main objectives such as production of sugar cane, tobacco, animal husbandry, various crops including vegetables. In addition, there are producers in the surveyed area whose the production of Popular Rice is a main objective such as PARCELEROS, PRESTAMOS, four CPAs and one CCS in Vertientes municipality. The interview survey on the present conditions of various Popular Rice production Units in the five municipalities in the Study Area was carried out. The results of the survey are summarized as follows (see Table 3.3.3).

Table 3.3.3 Farm Scale of Popular Rice Cultivation in 5 Municipalities (2003)*

	Main production in unit/Item	Aguada	Santo Domingo	Yaguajay	Chambas	Vertientes
1) UBPC	Sugar cane	11	14	11	15	2
	Animal husbandry	2	2	10	4	2
	Various crops including vegetables	1	4	3	11	0
	Total number of units	14	20	24	30	4
	Total area of paddy fields (ha)	125	62	443	396	80
	Total area of rice cultivation in 2003 (ha)	188	124	509	396	80
2) CPA	Popular rice	0	0	0	0	4
	Sugar cane	3	3	9	5	8
	Animal husbandry	0	2	0	0	2
	Various crops including vegetables	2	1	0	2	0
	Total number of units	5	6	9	7	14
	Total area of paddy fields (ha)	188	83	362	268	284
	Total area of rice cultivation in 2003 (ha)	282	166	387	268	284
3) Parceleros	Popular rice (farmers)	110	>0.25ha:487,<0.25:2,973	736	310	150
	Various crops including vegetables (farmers)	0	0	(736 ; as second crops)	0	61
	Total number of units (farmers)	110	3,460	736	310	211
	Total area of paddy fields (ha)	141	1,120	647	391	25
	Total area of rice cultivation in 2003 (ha)	141	1,792	705	450	25
	Range of area of paddy field (ha/household)	1.24 - 0.25	0.25 - 0.17	0.25	0.25	0.83 - 0.21
	Average area of paddy field (ha/household)	0.56	0.20	0.25	0.25	0.25
4) Prestamos	Popular rice (farmers)	8	99	—	25	240
	Total number of units (farmers)	8	99	—	25	240
	Total area of paddy fields (ha)	28	136	—	329	2,697
	Total area of rice cultivation in 2003 (ha)	28	272	—	329	2,940
	Range of area of paddy field (ha/household)	6.20 ～0.83	13.42 ～ 0.04	—	13.42 ～ 4.14	13.42 ～ 4.00
	Average area of paddy field (ha/household)	2.28	0.72	-	13.20	10.74
5) Empresa	Sugar cane	—	3	1	1	2
	Animal husbandry	—	1	1	1	1
	Various crops including vegetables	—	2	1	4	0
	Total number of units	—	6	3	6	3
	Total area of paddy fields (ha)	—	99	548	403	497
	Total area of rice cultivation in 2003 (ha)		198	630	403	497
6) GENT	Sugar cane	1	—	—	0	1
	Animal husbandry	0	—	—	2	1
	Various crops including vegetables	1	—	—	0	0
	Total number of units	2	—	—	2	2
	Total area of paddy fields (ha)	141	—	—	121	54
	Total area of rice cultivation in 2003 (ha)	141	—	—	121	54
7) CCS	Popular rice	0	0	0	0	1
	Sugar cane	0	1	8	2	6
	Tobacco	0	1	1	3	0
	Animal husbandry	1	1	3	0	6
	Various crops including vegetables	8	14	17	2	0
	Total number of units	9	17	29	7	13
	Total area of paddy fields (ha)	600	370	1,060	403	1,818
	Total area of rice cultivation in 2003 (ha)	990	740	1,240	472	1,818
	Total number of CCSs-members	1,735	2,392	3,700	582	1,514
	Presumptive number of total farm households in whole CCSs	450	797	925	500	505
	Presumptive number of rice cultivated households in whole CCSs	450	797	925	500	303
	Range of area of paddy field in each farm household (ha/household)	13.42 ～ 0.41	2.48 ～ 0.04	13.42 ～ 0.21	13.42 ～ 0.25	40.26 ～ 6.71
	Average area of paddy field in each farm household (ha/household)	1.45	0.31	0.62	3.11	20.13

Note * : Some data must be confirmed.

Table 3.3.3 shows the number of Popular Rice Production Units, total area of paddy fields and total area of rice cultivation in 2003 in each surveyed municipality. In PARCELEROS, PRESTAMOS and CCS, in which individual farmers carry out farming on their own land or borrowed land, the table also shows the range (maximum and minimum) of area of paddy field and average area of paddy field in each farm household.

One of the objectives in the Study is the sustainable technical development for rice cultivation. The range of area of paddy field and average area of paddy field in each farm household are very important as background condition of technical development. The characteristics of these two items in each surveyed municipality are summarized below.

In CCSs, average area of paddy field in each farm household (and range) is about 20 ha (40 - 7 ha) in Vertientes, about 3 ha (13 – 0.25 ha) in Chambas, about 1.5 ha (13 – 0.4 ha) in Aguada, 0.6 ha (13 – 0.2 ha) in Yaguajay and about 0.3 ha (2.5 – 0.04 ha) in Santo Domingo.

In PRESTAMOS, average area of paddy field in each farm household (and range) is about 11 ha (4 - 13 ha) in Vertientes, about 13 ha (4 - 13 ha) in Chambas, about 2.3 ha (0.8 - 6 ha) in Aguada, and about 0.7 ha (0.04 - 13 ha) in Santo Domingo.

In PARCELEROS, average area of paddy field in each farm household (and range) is about 1.5 ha (0.25 - 1 ha) in Aguada, 0.25 ha (all farmers) in Chambas and Yaguajay, about 0.25 ha (0.2 - 0.8 ha) in Vertientes, and 0.2 ha (0.2 - 0.25 ha) in Santo Domingo.

These areas show only paddy field areas in farming, and do not show the total farming areas, for which data was unobtainable. Every Unit and farmer have other farming areas of main production, such as production of sugar cane, tobacco, animal husbandry, various crops including vegetables, outside area of rice cultivation.

The optimal period of direct sowing and transplanting of paddy rice is four months from November to February in dry (cold) season, and two months from May to June in wet (spring) season. According to experience of extension workers, the maximum acreage which one farm household can transplant rice seedlings manually may be about 6 ha. If this is true, the farmers who have paddy field of over 6 ha, need the use of direct sowing or mechanization of transplanting. With regard to average farmer cultivated Popular Rice, the farmers which have paddy field of over 6 ha can be found in CCSs in Vertientes, in PRESTAMOS in Vertientes and Chambas.

(2) Present conditions of popular rice production in each unit

The interview survey was carried out on the present conditions of various Popular Rice production Units in the five municipalities.

1) UBPC

a. Most UBPCs produced Popular Rice is used for self-consumption. For example, all produced rice in UBPCs in Santo Domingo, Vertientes and Yaguajay is used for self-consumption. However, UBPCs in Aguada and Chambas 50% to 70% of the total produced rice is for self-consumption, and the rest for sale to ACOPIO and markets.

b. With regard to irrigation for rice cultivation, irrigation water is supplied from dam for cultivation of sugar cane in Vertientes and Chambas. UBPCs in other municipalities use water

of wells and rivers as irrigation water for rice cultivation. Water quantity in the rainy season is sufficient in all surveyed municipalities. However, in dry (cold) season, irrigation water is short due to shortage of water quantity of reservoir in drought years in Vertientes, and due to shortage of fuel for pumping up water of wells and rivers in Yaguajay.

c. UBPCs in Aguada and Santo Domingo have already introduced double rice cropping and the rice transplanting method is used in 50% to 100% of the total paddy fields. On the other hand, UBPCs in Yaguajay have introduced the double rice cropping only on 15% of the total paddy fields, and UBPCs in other municipalities have not introduced either rice cultivation method.

d. Average yield in wet paddy in UBPCs in Vertientes is 1.02 tons/ha in both seasons, which is very low as compared with that in other surveyed municipalities. In other municipalities, average yield in UBPCs is 3.5 to 5 tons/ha in dry season and 3.1 to 4 tons/ha in rainy season.

e. Chemical fertilizer are unavailable in general, but in Yaguajay, 30% to 40% of necessary quantity is supplied by appropriation of urea for sugar cane in UBPCs

f. UBPCs in Aguada, Santo Domingo and Chambas use actively organic matter as organic fertilizer, In Yaguajay, rice straw is sometimes used, while no organic matter is used in Vertientes.. Rice straw is burned in the fields.

g. Farm works of rice cultivation are carried out by tractors but a few UBPCs have no combine. Therefore, harvest of rice is carried out by manual labor.

2) CPA

a. CPAs produce Popular Rice and use 50% to 100% of total produced rice for self-consumption, and the rest for sale to CAI, ACOPIO and markets.

b. With regard to irrigation for rice cultivation in CPAs, conditions are as the same as that in UBPCs, except CPAs in Chambas, where irrigation water is supplied from dam, wells and spring.

c. CPAs in Aguada and Santo Domingo have already introduced the double rice cropping and the rice transplanting method in 50% to 100% of total paddy fields. On the other hand, CPAs in Yaguajay have introduced the double rice cropping in only 7% and the rice transplanting method in 26% of the total paddy fields. CPAs in Chambas and Vertientes have not introduced either rice cultivation method.

d. Average yield of wet paddy in CPAs in Vertientes is 1.7 tons/ha in the rainy seasons, which is very low as compared with that in other surveyed municipalities. In other municipalities, average yield in CPAs is 4.1 to 4.4 tons/ha in dry season and 3.2 to 5 tons/ha in rainy season.

e. Conditions of availability of chemical fertilizer and fertilization with organic matter in CPAs are the as same as that of UBPCs.

f. Farm works of rice cultivation in CPAs are carried out by tractors in general. Harvest of rice is carried out by combine in CPAs in Vertientes, Chambas and Yaguajay, and by manual labor in the other two municipalities.

3) PARCELEROS

a. Basically, PARCELEROS produce Popular Rice and use all produced rice for

self-consumption, but PARCELEROS in Vertientes, Chambas and Yaguajay use a part of produced rice for sale to ACOPIO and market.

b. With regard to irrigation for rice cultivation in PARCELEROS, conditions are the worst among Units. The conditions of irrigation are rainfed in Aguada, using domestic well water in Santo Domingo, using water of streamlet or drain water in UBPCs and CPAs in Veritentes. On the other hand, PARCELEROS are supplied from dam in Chambas and from river in Yaguajay. Water quantity in both seasons is not sufficient and unstable in PARCELEROS in Aguada, Vertientes and Yaguajay. On the other hand, water quantity in both seasons is sufficient in PARCELEROS in Santo Domingo and Chambas.

c. PARCELEROS in Yaguajay, Santo Domingo and Chambas, which have comparatively sufficient irrigation water, have already introduced double rice cropping in 9%, 15% and 60% of total paddy fields, respectively. In other municipalities, PARCELEROS have not introduced it yet. With regard to the rice transplanting method, PARCELEROS have introduced in 0% in Vertientes, 29% in Yaguajay, 50% in Chambas, and 100% in Aguada and Santo Domingo.

d. Average yields of wet paddy in PARCELEROS in four municipalities ranged from 4.4 to 4.8 tons/ha in dry season, except that in Vertientes, in which rice cultivation is not carried out in dry season. In the rainy season, average yields of wet paddy in PARCELEROS in four municipalities are ranged from 3.2 to 4.4 tons/ha, except that in Vertientes, where the yield is very low, 2.7 tons/ha.

e. Chemical fertilizer is unavailable in all surveyed municipalities. With regard to fertilization with organic matter, PARCELEROS in Chambas actively use organic matter as organic fertilizer, such as earthworm compost, mixture of rice straw and animal excrements, cachasa, etc., but PARCELEROS in other municipalities only apply rice straw or do not fertilize with organic matter in their paddy fields and rice straw is burned in the fields.

f. Farm works of rice cultivation in PARCELEROS are in general carried out by manual labor. When tractor use is necessary, PARCELEROS borrow one from other Units.

g. In Yaguajay, PARCELEROS carry out crop rotation in paddy field, cultivating rice in the rainy season and companion planting of frijol and maize for second cropping in dry season. On the other hand, PARCELEROS in other municipalities do not cultivate in dry season, except for double rice cropping

4) PRÉSTAMOS

a. PRÉSTAMOS produce Popular Rice in Aguada and use 99% of total produced rice for self-consumption and 1% for sale to EMPRESA. PRESTAMOS in Vertientes use 60% of total produced rice for sale to CAI, from which PRESTAMOS receive certified rice seeds by contract, and the rest is used for self-consumption. PRESTAMOS in Chambas use 80% of total produced rice for sale to ACOPIO and GENT and the rest is used for self-consumption.

b. With regard to irrigation for rice cultivation, conditions in PRESTAMOS in Aguada are the worst and unstable. On the other hand, water quantities in other municipalities are sufficient in both seasons; water resources in PRESTAMOS are wells in Santo Domingo, supplied of dam water from neighboring CPAs and UBPCs in Vertientes, and dam water in Chambas.

c. PRESTAMOS in Santo Domingo and Vertientes have already introduced double rice cropping in 100% and 9% of total paddy fields, respectively. PARCELEROS in Aguada and Santo Domingo have introduced the rice transplanting method in 100% of total paddy fields. In other municipalities, PARCELEROS have not introduced either rice cultivation method or have only introduced the rice transplanting method in a trial field.

d. Average yield of wet paddy in PRESTAMOS in Santo Domingo, for rice cultivation in dry season in 100% of total paddy field, is 3.8 tons/ha. In the rainy season, average yield of wet paddy in PARCELEROS ranges from 3 tons/ha in Vertientes to 3.9 tons/ha in Aguada.

e. Conditions of availability of chemical fertilizer and fertilization with organic matter in PRESTAMOS are the as same as that of PARCELEROS.

f. PRESTAMOS in Santo Domingo carry out rice cultivation with common use of tractors. In other municipalities, PRESTAMOS borrow the machinery from CPAs and CCSs.

5) EMPRESA and GENT

a. EMPRESAs and GENTs produced Popular Rice and use almost all produced rice for self-consumption.

b. With regard to irrigation for rice cultivation, water resources in these two units are wells in Aguada and Santo Domingo, river in Vertientes and Yaguajay, and dam water in Chambas. Water qualities in the surveyed municipalities are sufficient in both seasons, except in dry season in Vertientes and Yaguajay.

c. In the two units which have already introduced the double rice cropping and the rice transplanting method, for percentage area of paddy fields is 50% and 100% in Aguada, 100% and 65% in Santo Domingo, 15% and 0% in Yaguajay. In other municipalities, neither technique has not been introduced yet.

d. Average yields of wet paddy in the two units range from 3.9 to 4.5 tons/ha in dry season. In the rainy season, average yields are 2.4 tons/ha in Vertientes, 2.9 tons/ha in Yaguajay, and 3.4 to 3.8 tons/ha in other municipalities.

e. Conditions of availability of chemical fertilizer and fertilization with organic matter in the two units are the as same as that of UBPCs and CPAs.

f. Farm works of rice cultivation in the two units are carried out by owned tractors. Harvest of rice is carried out by ramshackle combine in Santo Domingo, but by manual labor in other municipalities.

6) CCS

a. With regard to the consumption of produced Popular Rice, 70~80% is for self-consumption in four municipalities except for Yaguajay, where only 20% is for self-consumption. The rest of produced rice is sold to CAI, ACOPIO or in markets. In Vertientes, 17% of production is sold to CAI and producers receive certified seed as compensation. In Chambas 15% and in Yaguajay 5~15% is sold to ACOPIO.

b. With regard to irrigation for rice cultivation, water resources in CCSs are wells, which are used under common use; in Aguada, Santo Domingo and Vertientes, and in some cases, river

is also used as water resources in these municipalities. Water quantities in these municipalities are sufficient in both seasons. In Chambas, CCSs use spring water for 60% and river water for 40% of total paddy fields. Water quantities are sufficient in the rainy season but are short in dry season due to shortage of fuel to pump up water from river. In Yaguajay, CCSs use river water and water quantities are short in dry season due to the same conditions with Chambas, although condition is improved by electrification of pumps in some CCSs.

c. Percentage of area of paddy field, which have already introduced double rice cropping for total paddy fields is 65% in Aguada, 100% in Santo Domingo, 17% in Chambas, 17% in Yaguajay. In Vertientes, CCs have not yet introduced the technology due to shortage of fuel to pump up water from river. With regard to the rice transplanting method, CCSs have already introduced it in 100% paddy fields in Aguada and Santo Domingo, in 45% to 50% of total paddy fields in Chambas and Yaguajay. However, in Vertientes, CCSs have not been introduced yet due to large-scale of individual rice cultivation.

d. Average yields of wet paddy in CCSs in dry and rainy season are respectively: 4 ton/ha and 3.5 tons/ha in Aguada, 4.6 tons/ha and 4.6 tons/ha in Santo Domingo, 4.8 tons/ha and 3.5 tons/ha in Chambas, 4.4 tons/ha and 3.4 tons/ha in Yaguajay. In Vertientes, average yield is 2 tons/ha in the rainy season. Moreover, average yields of direct sowing and rice transplanting are 2.2 to 4.4 tons/ha in direct sowing and 6.6 to 7.8 tons/ha in rice transplanting in some CCSs.

e. Chemical fertilizer is unavailable in general, but in some cases, less than 30% of necessary quantity is supplied by appropriation of urea for sugar cane in CCSs in Chambas and Yaguajay. Moreover, CAI in Vertientes there are loads of urea occasionally to CCSs.

f. In Vertientes, CCSs does not fertilize with organic matter in their paddy fields. Rice straw is burned in the fields. On the other hand, CCSs in Aguada and Santo Domingo return whole straw to paddy fields, and in Chambas actively carry out fertilization with organic matter (such as straw, mixture of straw and half-dry excrements, cachasa, dried excrements, etc.). In Yaguajay, 80% of total farmers of CCSs return whole straw to paddy fields, but 20% of farmers burn top straw in the field.

g. Farm works of rice cultivation in CCSs are carried out by integration of common use tractors, livestock power and manpower. Especially, in Aguada and Santo Domingo, the common use tractors are only used for plowing of paddy field and other farm works are carried out by livestock power and manpower.

7) Summary

The discussion on Popular Rice production units mentioned above are reordered and summarized by surveyed municipality below.

a. Aguada: PARCELEROSs and PRESTAMOSs in Aguada have not enough water resources for irrigation, and therefore, they cannot cultivate rice in dry season and cannot introduce the double rice cropping. Rice yields in Aguada show comparatively high level with a few differences among units in rice yield. Some reasons for such high level yield of rice are introduction of rice planting method and returns of whole straw to paddy fields.

b. Santo Domingo: All rice production units in Santo Domingo have reliable water resources,

and already carry out double rice cropping and rice transplanting methods in all paddy fields. With regard to rice yield, the yields in UBPCs, PRESTAMOS and EMPRESAs are lower than that in other units. The rice yields in CPAs, PARCELEROS and CCSs show comparatively high level, with a few differences among units and between cropping seasons. Some reasons for such high level yield of rice are introduction of rice planting method, returns of whole straw and fertilization with cachasa to paddy fields.

c. Yaguajay: All rice production units in Yaguajay carry out irrigation by use of river water, and have problem of shortage of irrigation water in dry season. Therefore, percentages of introduction of double rice cropping for total paddy fields in whole units are ranged from only 7% to 17%. UBPCs and EMPRESAs have not introduced the rice transplanting method yet, but other units have introduced in range of 26% to 50%. The yields of every unit show comparatively high level, and a few differences among units. Some reasons of such high level yield of rice are introduction of rice planting method, fertilization of less than 30% with necessary quantity of urea, which is supplied by appropriation of urea for sugar cane, and returns of whole straw to paddy fields.

d. Chambas: CCSs in Chambas irrigate rice from spring or river. Other units use water of dam as source of irrigation water. Irrigation water from river in dry season is often short due to shortage of fuel for pumping up from river, but the problem will be resolved by electrification of pumps. In Chambas, CCSs and PARCELEROS are introducing double rice cropping (15 - 17%) and rice transplanting method (45 – 50%), but other units have not introduced them yet. The yields of these two units show comparatively high level due to introduction of rice transplanting method, 4.8 tons/ha in dry season. The rice yields of all units in the rainy season ranged from 3.2 to 4 tons/ha, and showed a few differences among units. Some reasons of such high level yield of rice are introduction of rice planting method in CCSs and PARCELEROS, and active fertilization with organic matter, such as straw, mixture of straw and half-dry excrements, cachasa, dried excrements, etc.

e. Vertientes: PARCELEROSs in Vertientes have not enough water resources for irrigation, and therefore, irrigation water is in shortage and unstable. In general, the large-scale farming size in Vertientes restricts the introduction of double rice cropping and rice planting method due to shortage of labor. Rice yield is lower than that of other municipalities. Especially, the yields of UBPCs and CPAs are low, 1.0 to 1.7 tons/ha. The yields of other units range from 2 to 3 tons/ha. Some reasons of such low level yield of rice are difficulty to introduce new rice planting method, and no returns of rice straw and no fertilization with other organic matter to paddy fields.

3.4 Rice Marketing

3.4.1 Demand and Supply

(1) Government organizations for rice distribution

The government organizations closely in charge of rice distribution are shown in the chart below. MINAG is the responsible ministry for production of domestic rice, and MINCEX is responsible for importing rice from other countries. MINCIN is administratively in charge of the rice distribution all over the country for both domestic and imported rice. INRE is the competent

agency for food reserve. GAIPA, ALIMPORT, ALIMEC are the implementing bodies under the management of each ministry.

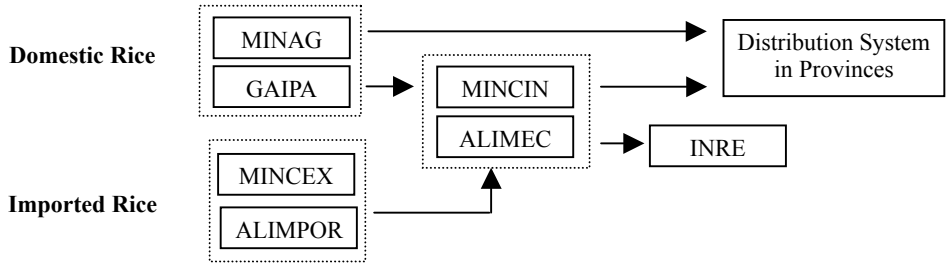


Fig 3.4.1 Government Organizations for Rice Distribution

ALIMEC

ALIMEC is an enterprise created for the commercialization of all food products included in the basic basket. Ministry of Economy and Planning is in charge of making the purchase plan for imported products according to the plan of MINCIN/ALIMEC. ALIMEC distributes imported rice for monthly distribution. Normally, it is more than 40,000 tons/month, but it varies by month.

Basic basket	28,000 MT/month (ration rice)
Social use	9,500 MT/month (children center, school, hospital, older people home)
OEE[4]	5,200 MT/month

In some cases, an additional amount is provided for some of the provinces (e.g. 1,000 tons/month for the eastern provinces, allotted to children and elderly citizens).

OEE is a store system where imported rice is sold at the following prices with a ceiling price of $3.50/lb for rice from Vietnam and $4.00/lb rice from the USA.

Rice for distribution is procured from various supply sources as mentioned below:

- Imported rice through ALIMPORT (main source)
- Specialized Rice from CAI
- Popular rice through ACOPIO and Popular Rice Unit (minimal quantities)

ALIMPORT

ALIMPORT is the State Enterprise that is the government food import agency with the following organization chart:

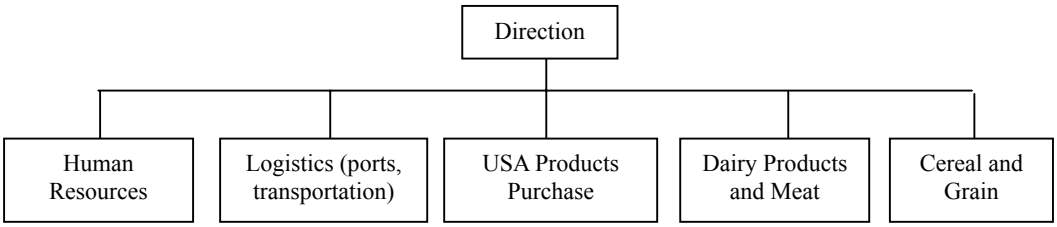


Fig. 3.4.2 Organization of ALIMPORT

[4] OEE (Economic State Organization) is systems of shops (posts) in which they sell imported rice.

ALIMPORT is in charge of importing food products mainly for the basic basket. It is also in charge of all food products imported from USA. Rice import has been mainly from Vietnam and USA. The yearly record of imports is shown in the table below.

Table 3.4.1 Annual Import Contracts of Rice

Year	Quantity of Contract (ton)	Amount of Contract (million USD)	Average Unit Price (USD/ton)
1990	268,577	82.0	305.31
1991	274,124	68.5	249.89
1992	285,851	83.9	293.51
1993	383,542	112.7	293.84
1994	313,783	72.5	231.05
1995	350,954	110.7	315.43
1996	368,026	133.1	361.66
1997	284,876	78.8	276.66
1998	391,489	117.7	201.28
1999	359,767	102.3	284.35
2000	415,000	88.0	212.05
2001	437,429	92.9	212.38
2002	513,208	111.3	216.87
2003	362,907	80.5	221.82

Source: ALIMPORT, April 5, 2004, Note: Average unit prices by the calculation of amount and quantity.

(2) Demand and supply balance of rice

Rice balance for consecutive years

Rice balance in accordance with FAO data is shown in Table 3.4.2. Quantities of rice reserves have varied in every year, but there is a tendency of increasing in the most recent years. Quantities carried over to the next year at yearend have also increased as working stock. The food stock for rice has exceeded the quantity of 15~20% of the consumption that is standardized by FAO. It is understandable that food security is regarded as a priority national policy.

Table 3.4.2 Annual Supply / Demand Balance of Rice in Cuba (1,000 tons)

Year	Over carried	Supply			Demand		Carrying over
		Domestic production	Import	From previous year reserve	Total consumption	Reserved for next year	
1995	0	149	345	0	493	0	1
1996	1	246	347	0	562	31	1
1997	1	279	298	31	557	21	31
1998	31	187	318	21+10*	515	0	52
1999	52	246	461	0	604	103	52
2000	52	204	403	103	536	72	154
2001	154	217	496	72	808	205	226

Source: Data from FAO, Note: *(special supply)

Rice balance in 2002

The balance of demand and supply can be estimated for 2002 as shown in Table 3.4.3.

A small amount of Specialized Rice also is sold in the state market for supplemental consumptions other than ration rice.

Although the rice for ration use and social use shared a large portion of rice demand, the amount depends on the government policy for food security.

Table 3.4.3 Balance of Supply and Demand in 2002

Supply (ton in milled rice)			Demand (ton in milled rice)		
Imported rice	513,000	ALIMPORT 513,208	Ration rice	336,000	ALIMEC 28,000 ton x 12 = 336,000
Specialized Rice	55,000	GAIPA	Social use	114,000	ALIMEC 9,500 ton x 12 = 114,000
Popular Rice	225,000	GAIPA	Tourism/TDR	9,000	Estimated based on number of tourists and TDR
			Self consumption	139,000	GAIPA 225,000 x62%=139,500 ton
			Sale in market and others (incl. OEE)	103,000*	OEE 5,200x12=62,400ton Popular Rice 40,972.8 tons in 2003
			Stored rice	5,000*	Assumption of domestic rice only
			Seed	34,000	Estimated based on 5% of total production
Total	793,000			740,000	

Note: * Estimation and assumption by Study Team

Preliminary calculation for rice supply/demand balance for each municipality

Balance (e) in the following table means rice supply capacity for each municipality, that is the balance taking consumption from production in each municipality. However, balance (e') increases to more than (e) because in actuality ration rice and social rice flow into the municipality from the outside of the municipality. According to this tentative calculation, every municipality listed in the table is capable to produce rice sufficient for consumption in the municipality. The government is operating particular distribution channels for ration rice and social rice that are mainly inclusive of imported rice, and rice producers normally receive their rations too.

Table 3.4.4 Production and Demand Balance of Rice (Tons in milled rice)

Municipality/ Province	Aguada de Pasajeros/ Cienfuegos	Santo Domingo/ Villa Clara	Yagujay/ St. Spíritus	Chambas/ Ciego de Ávila	Vertientes/ Camagüey
Population 2001	31,040	55,655	60,577	40,936	53,443
Production 2002 (a)	4,051.55	6,276.44	5,203.96	2,813.87	9,063.74
Ration rice (b)	844.91	1,514.93	1,648.91	1,114.28	1,454.72
Social rice (c)	489.12	877.02	954.58	645.06	842.16
Demand (d)	1,862.40	3,339.30	3,634.62	2,456.20	3,206.58
Balance (e)= (a)-(d)	2,189.15	2,937.14	1,569.34	357.67	5,857.16
(e')=(a)+(b)+(c)-(d)	3,523.18	5,329.09	4,172.83	2,117.01	8,154.04

(a) Popular Rice in 2002 (Some municipalities produce Specialized Rice other tan Popular Rice)
(b) 5 Lb/month/capita
(d) Study Team assumes 60 kg/year/capita

(3) Amount of rice consumption

From the viewpoint of food security, it is important to know how the government plans for ration and social uses. Selling amount of Specialized and Popular Rice are also necessary to investigate. Since there is no agro-processing product from rice, the consumption rate per capita at present can be obtained based on total supply amount and population data.

(4) Quality and preference

CAI has quality specifications for Specialized Rice. The quality standards or specifications of Popular Rice are required for producers and consumers. The rice in Cuba is evaluated by non-sticky variety, head grain, long grain and transparency. Especially, since a variety of Perla is tasty and glossy, it is shipped to the tourism business. In Cuba, the stored rice is preferred because the boiled volume of rice exceeds that of newly harvested rice.

3.4.2 Rice Marketing

(1) Marketing channel

Rice marketing in Cuba is basically controlled by the government and divided into that for state rice and Popular Rice. The state rice is sourced from imported rice and Specialized Rice produced based on the specialized contract. It is used for ration rice and social use. It is reported to be sold partly through the state market in order to stabilize the rice market price for consumers. On the other hand, individual farmers and rice producing units produce Popular Rice and it is more than half used for self-consumption, but some of it is sold to the government institutions or in the markets using any means (through their corporation, middleman or by themselves).

The outline of marketing flow of rice in the country is shown in Fig.3.4.3. The exact flow of rice may be slightly different from each area because the names of the dealers in various stages of marketing channel may differ depending on the area.

Popular Rice is produced by several classifications of producing units: namely, CPA, CCS, UBPC, Empresa Estatales, GENT, Parceloros and Préstamos (Refer to other chapters for details).

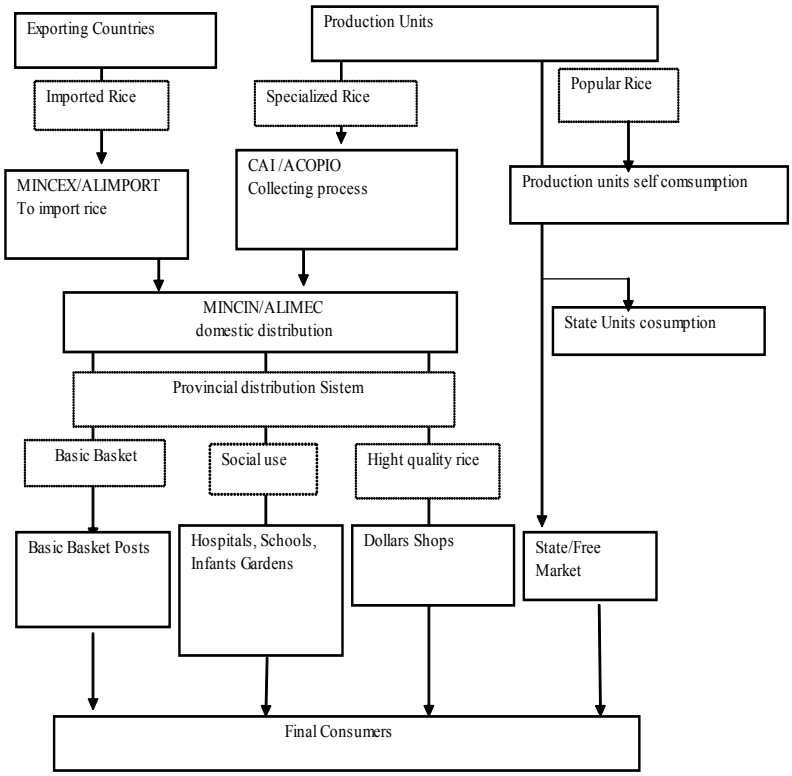


Fig. 3.4.3 Current Main Marketing Flow of Rice

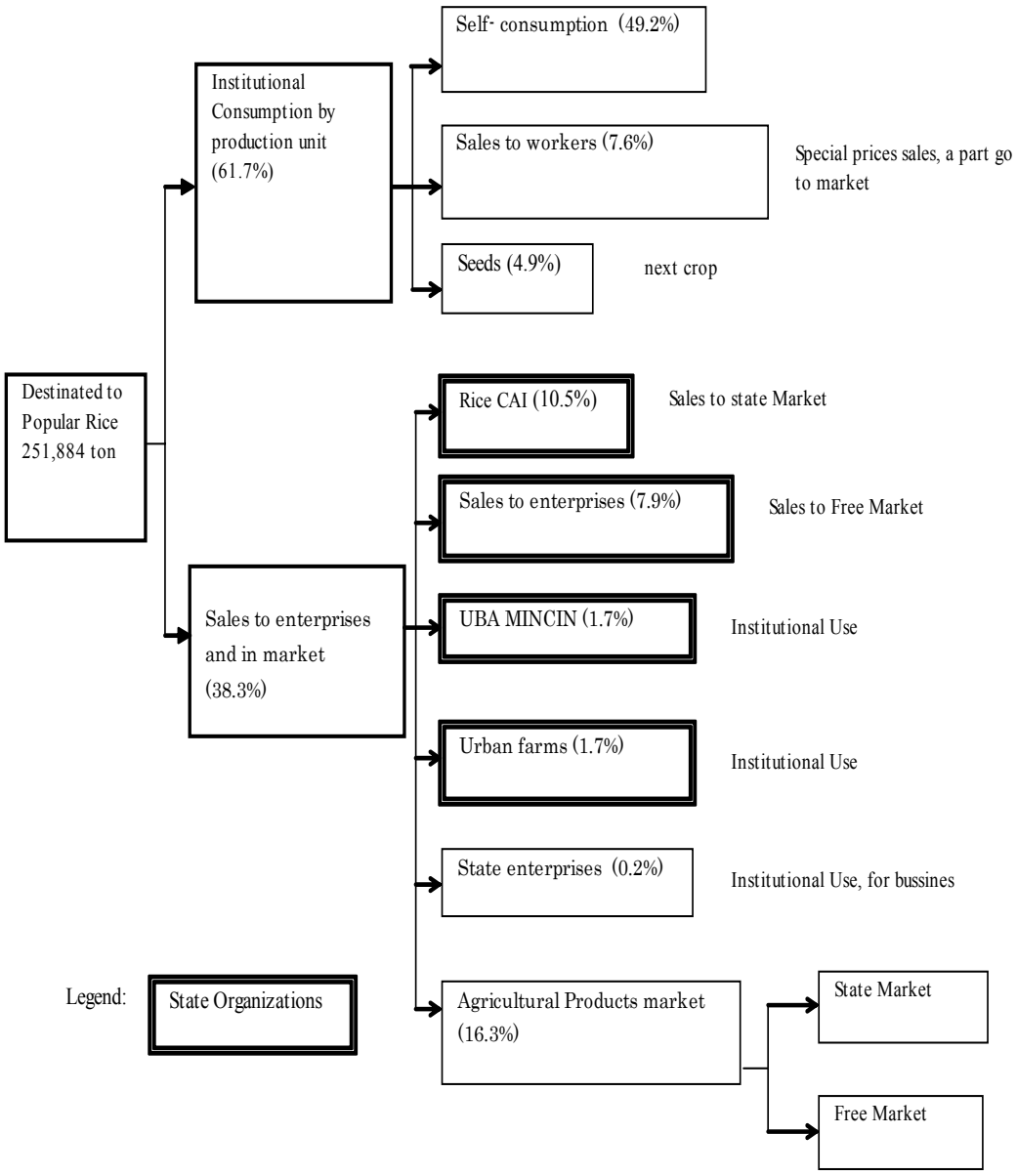
Empresa Acopio (commercial enterprise), CAI Arrocero (Rice CAI)/ Unidad de Arroz Popular (Popular Rice Unit) are the main buyers of the governmental organizations and they are selling Popular Rice in the state market. Empresa Alimentos (Food Enterprise), Granja Urbana (Urban Farm) and other government institutions also buy Popular Rice and they use it for self-consumption for their own institutions or their business. There are state markets in which ceiling price applies and the free market where price varies according to supply and demand and quality as well.

Popular Rice producers can sell their produced rice in their own municipality. But for selling outside of their municipality, many of them have a difficulty in transportation. They are facing serious fuel shortage and the means of transportation are very tight. Few producers own a means of transportation for themselves so they rent trucks from wherever possible.

(2) Destination of popular rice

According to GAIPA, the amount of Popular Rice production was 225,700 tons in 2002 of which the governmental institutions bought 39,600 tons (17.5%).

The amount of Popular Rice reducing self-consumption and sold to the governmental institutions may be sold by producers using any marketing channel in the market (state or free).



Source: Resumen Annual de la Produccion, GAIPA

Fig. 3.4.4 Destination of Popular Rice 2003

According to GAIPA data in 2003, 62% of Popular Rice was destined for consumption within producing units, and 38% was destined for outside of producing units. Of this, 49% was for self-consumption by producers themselves. And the marketed rice mainly was sold in markets and

forwarded to government institutions for distribution. Marketing flow for Popular Rice is shown in Figure 3.4.4:

Popular Rice producers are now closely related to marketing of rice. Producers have shops in nearly all markets in towns and they engage in retail sales. This is in line with the government policy on marketing to eliminate intermediate margins.

(3) Popular rice sales to state sector

Popular rice sales by the production unit by Province for 2002-2003 are shown in Table 3.4.5 in tons.

Table 3.4.5 Popular Rice Sales to State Sector

Province	Year	Production /Selling	Total	CPA	CCS	UBPC	Empresa Estales	GENT	6 Cord. Autoab. Parceleros	Préstamos Convenios
Cienfuegos	2002	Production	17,208.00	1,756.00	8,655.00	1,747.00	185.00	0.00	4,805.00	60.00
		Selling	1,031.67	1.79	1,019.01	2.53	8.43	0.00	0.00	0.00
	2003	Production	21,763.70	1,176.80	9,019.20	2,045.90	1,100.90	0.00	8,286.70	134.20
		Selling	4,774.40	211.00	2,726.40	356.40	230.70	0.00	1,213.70	36.20
Villa Clara	2002	Production	27,249.00	1,111.00	8,969.00	869.00	8,678.00	14.00	6,169.00	1,439.00
		Selling	1,049.80	0.00	543.10	0.00	506.70	0.00	0.00	0.00
	2003	Production	35,971.70	1,508.40	11,778.60	4,291.20	7,797.20	1,028.30	8,273.50	1,294.50
		Selling	14,564.60	432.30	5,940.10	922.00	3,433.70	235.40	2,971.40	629.70
Sancti Spíritus	2002	Production	27,263.00	1,526.00	12,407.00	1,976.00	4,926.00	0.00	6,316.00	112.00
		Selling	10,470.38	410.06	8,167.27	162.93	31.50	0.00	1,596.62	102.00
	2003	Production	33,186.40	4,328.50	13,459.00	3,472.90	4,621.40	0.00	5,910.20	1,394.40
		Selling	13,312,40	1,053.10	7,124.80	1,670.70	1,649.90	0.00	461.90	1,352.00
Ciego de Ávila	2002	Production	11,635.00	1,426.00	1,951.00	2,186.00	2,169.00	443.00	3,124.00	335.00
		Selling	2,532.80	540.94	918.20	212.52	537.00	0.00	240.15	84.00
	2003	Production	19,055.20	1,780.50	3,502.60	4,869.50	2,858.70	221.60	5,106.00	716.50
		Selling	5,540.90	387.90	1,523.00	664.20	403.70	10.10	2,079.20	462.80
Camagüey	2002	Production	20,726.00	1,268.00	4,630.00	1,252.00	2,767.00	511.00	4,254.00	6,044.00
		Selling	2,334.60	21.20	549.50	20.90	577.80	0.00	513.20	652.00
	2003	Production	24,095.70	2,041.90	3,987.20	1,657.60	1,885.60	340.60	7,345.10	6,837.60
		Selling	7,098.60	170.50	1,203.40	443.10	601.60	15.90	672.60	3,991.50
National	2002	Production	225,657.00	21,999.00	78,517.80	21,120.80	33,312.20	2,440.80	46,635.60	21,630.50
		Selling	39,455.10	2,541.20	20,433.20	1,101.00	5,874.10	44.60	4,673.30	4,787.70
	2003	Production	272,204.20	26,386.10	88,124.50	27,149.30	30,082.50	5,042.70	68,532.20	26,886.90
		Selling	96,365.50	6,807.60	39,167.00	6,168.90	8,637.30	1,429.90	17,544.00	16,610.80

Source: Resumen Annual de la Production, 2002-3, GAIPA. Sales amount to free market is not included.

The table reveals the following points:

- Popular rice production of the whole country has increased by 21% over the previous year of 2002, and the sales volume has soared by 244%.
- Sales volume and ratio have not been stable by reason of significant fluctuation of production by year even in the same production unit.
- The increasing of sales volume and ratio depends on production increase because the balance is normally destined for market after deducting the fixed volume for consumption within a production unit. However, there is an exception when the state enterprise increased their sales volume and ratio even though their production decreased from the previous year.

3.4.3 Market

(1) Free market for agricultural products

There are three types of agricultural markets.

1) The law for opening direct sales shops was passed by Congress on September 1, 1994 and free sales within a fixed rate (20%) of productions were liberalized from October 1, 1994. There are 332 free markets in whole of Cuba run by MINCIN. The seller must pay a tax, 5%/10%/15% (depending on the place) of the expected sales amount in advance before starting sale on the day of sales. Although Popular Rice has no price competitiveness against the government ration rice (which is priced at 0.25 pesos/Lb), even so people are buying Popular Rice because there is a limitation for purchasing ration rice (6 Lbs/month/inhabitant in Havana city and Santiago de Cuba, and 5 Lbs/month/inhabitant in other areas). This means that popular rice has the important role of supplement supply in addition to the government ration rice. In this sense, the government policy for increasing of Popular Rice production is quite clear and everybody understands that increase of Popular Rice production will decrease imported rice and it will contribute to saving foreign currency.
2) Placitas de Acopio (parallel market) founded under MINAG in 1991. The local government sets the ceiling prices.
3) Integrated vegetable farm in which state divisions and cooperatives sell vegetable at the place of production. The local government and MINAG set the ceiling prices.

In state markets, the government sets ceiling price (top price) and Popular Rice is sold though CAI and Acopio. In the free market, Popular Rice is sold freely but the price is affected by the state market price and basically the marketing price is stabilized. Even so, the price in the free market is around 10-20% higher (some times 80% higher with high quality) than that in the state market and some people buy it. Based on non-specialized contract, Popular Rice producers should sell some amount of Popular Rice to CAI or Acopio, but they can sell Popular Rice freely. CAI and Acopio also buy Popular Rice and buy Popular Rice on non-contract basis and sell it in the state market in order to stabilize the marketing price of Popular Rice.

The tax for the direct sale shop is 15% of the sales. However, in Havana and Santiago de Cuba, it is 5%. It is reported that 2,383 markets for agricultural product (MPA) were set up in 1999. There is also a direct sales market system called “feria” where agricultural producers sell their products directly to consumers.

(2) Actual conditions of rice price

Outline of rice price

We understand the present price level of rice to be as follows. It is assumed to be 0.75-1.00 pesos/Lb for wet paddy. This is the total amount paid for some agricultural services only and does not include family labor. Producers selling prices are wet paddy 1.0-1.1 pesos/Lb, dried paddy 1.2 pesos/Lb, milled rice 2.4-2.5 pesos/Lb and the selling price of milled rice is 3.3-3.5 pesos/Lb. The difference between the producer price and retail price is transportation cost, tax, charges for using market facility. In most cases, farmers and CCS send sales personnel to markets and so there is no so-called middleman’s margin (although they have to pay for transportation and sales personnel).

However, recently there are cases in which middlemen buy from CCS and others in order to sell elsewhere.

Producer's price

Producer's selling price of rice differs by the condition of rice, whether it is wet paddy before drying or dried paddy. The price of milled rice also differs by whole grain rice and broken rice. If broken rice content is high, naturally the price will be lower.

Price of wet paddy, dried paddy and milled rice are presented next. If the relation between these is reasonable, the producer can choose and undertake necessary post-harvest process. Dried paddy weight is supposed to be 22% less in comparison with the weight of wet paddy. An example in Vertientes is shown below.

Table 3.4.6 Non-specialized Contract Base Producer Price in Camagüey (pesos/q)

Dry season crop Nov-Feb					Rainy season crop Mar-Aug				
Paddy		Milled rice			Paddy		Milled rice		
Wet	Dry	Mixed	Head	Broken	Wet	Dry	Mixed	Head	Broken
<80	<93	145	165.99	100	80	90	145	165.99	100

Table 3.4.7 Non-contract Base Producer Price in Villa Clara and Vertientes (pesos/q)

Dry season crop Nov-Feb					Rainy season crop Mar-Aug				
Paddy		Milled Rice			Paddy		Milled Rice		
Wet	Dry	Mixed	Head	Broken	Wet	Dry	Mixed	Head	Broken
<110	<140	<260 (250-300)			<110	<140	<260 (250-300)		

Notice on Rice Buying Price (28th Oct, 2003) by Popular Rice Unit, Villa Clara is as shown below. In other countries, yield per ha of dry season crop is higher, but due to poor quality, the price is usually lower as compared with the rainy season crop rice. But here it is the opposite. The prices of milled rice are the same both for rainy season and dry season crops. It may be due to encouragement of production of dry season crop. But its effect is largely reduced because prices of both milled rice are the same. Some reasons may exist such as the difference in milled rice recovery rate.

Table 3.4.8 Farm Gate Price of Popular Rice

Type of rice	Dry season crop, Nov-Feb	Rainy season crop, Mar-Aug
Wet paddy	80~100 pesos /q	70~ 90 pesos /q
Dry paddy	100~120 pesos /q	80~100 pesos /q
Milled rice	Less than 250 pesos /q	Less than 250 pesos /q

Source: Popular Rice Unit, Villa Clara

Non-specialized contract is a contract form for selling Popular Rice and obtaining agricultural inputs such as seed, fertilizer, chemicals, and fuel for agricultural machines. That is reason why some of producers including non-rice producing units are making this contract with CAI and some amount of Popular Rice is sold to CAI with the price of 0.7 pesos/Lb in paddy based on the contract. Some producers also sell some Popular Rice other than that of non-specialized contract to CAI or ACOPIO with around 2.5 pesos/Lb in milled rice.

Farm gate price is largely affected by market price for retail set by the state market. In other words, paddy price is decided by deducting various marketing expenses and cost of processing from the retail price.

Consumer price

However, the consumer price itself in Cuba varies a lot. Ration rice is sold at 0.25 pesos/Lb, contribution rice to staff in producing unit is sold at 0.6-0.7 pesos/Lb, in the state market rice is sold at 2.5-3.5 pesos/Lb, and it is sold at 2.5-5.0 pesos/Lb in the free market. On the other hand, high quality rice (long perfect grain) is sold at USD1.0-2.0/Kg in TDR.

Imported price

According to the report to JICA Project Formulation Mission in 2001, the price of imported white rice was around USD190/ton and a production cost for national rice lower than this will be the target price. According to estimation of IIArroz, in case of Specialized Rice, it is reported that the production cost will become around USD170 /ton if the yield is 5 ton/ha in paddy rice (2.1 ton/ha in milled rice).

(3) Price formulation

Among the social guaranty system in Cuba, the ration rice system has an important role. Although the amount of ration rice is limited, it is difficult to consider that ration rice enters into the free market even there is big price difference between the price of ration rice and marketing price of rice. Soaring rice marketing prices will affect the living conditions of the people, but if the market price is controlled too low, Popular Rice producers will lose their incentive for extending their production and selling the surplus amount of rice other than self-consumption into the market.

The portion of broken rice is one of major elements for marketing price of rice. However, usually in Popular Rice, only a small broken part is left out and most of the broken rice is not separated.

According to Unidad de Arroz Popular (Unit of Popular Rice) in Villa Clara, the prices of rice on 28th October, 2003 are presented in Table 3.4.9. The ceiling consumer's price was set based on the ceiling price of milled rice by the government. The price of dry paddy against producers price of milled rice were 40%-48% in dry season and 32%-40% in the rainy season. The margin of rice mill process may be large. The marketing cost of milled rice is 32%-40% and it is comparatively high. This may be caused by the fact that the trading amount is small for each contract and the rate of marketing cost becomes high.

Table 3.4.9 Rice Prices on October 28, 2003 in Villa Clara

Item	Trading Form	In dry season Nov-Feb		Rainy season Mar-Aug	
		Price (pesos/q)	Difference	Price (pesos/q)	Difference
Producer's price	Paddy	80-90	0	70-90	0
	Dry paddy	100-120	20-30	89-90	10
	Milled rice	<250	130-150	<250	150-150
Consumer's price	Milled rice	<350	100	<330	80

3.4.4 Problems and Subject

There is no centralized system for processing Popular Rice, produces using small-scale treatment system. For instance, although private Engelberg type rice mill cannot be expected to have high productivity and the amount of broken rice is large, many producers are using it. On the other hand, the large-scale rice milling plant with high capacity (even though it is old) belonging to CAI treated a lot of rice in the past, and now some of these facilities are idle. Since there is strong connection between production and marketing system, these conditions are one of the main problems relating to

the entire rice production system in Cuba.

For the rationality of Popular Rice production, many agricultural inputs cannot be obtained freely with local currency and it seems that producers have a standard of values other than money. On the other hand, agro-service marketing is being formulated now and local currency has started to be used for these services. For the price of Popular Rice, some producers are satisfied and some them are not. For the cost of agricultural machines, most producers have no experience for purchasing of agricultural machines and they are renting such machines. They know very well about rental cost and fuel, but do not consider very much about depreciation and replacement cost. Since there are usually no spare parts in the market, there is also difficulty in thinking about the real cost of spare parts.

For increasing Popular Rice production, it is necessary to establish appropriate and sustainable market system for Popular Rice (for both producers and consumers).

3.5 Rural Society

3.5.1 General Description

(1) Structure of rural administration

The Figure 3.5.1 shows basic structure of governmental administration in Cuba.

Cuba, composed of 15 provinces nationwide, has the local administration structure as follows. Province is composed of municipalities, usually 5 up to 15 municipalities in each one. Municipality is also formed by the administration units called as Consejo popular, which can be seen in many cases to be 5 to 10 units in each Municipality. Consecutively, Circunscripción is formed as the smallest governmental administration unit generally composed of several residential plots. Circunscripción covers around 1,000 persons in urban areas, and also a smaller population in rural areas such as around 500 persons.

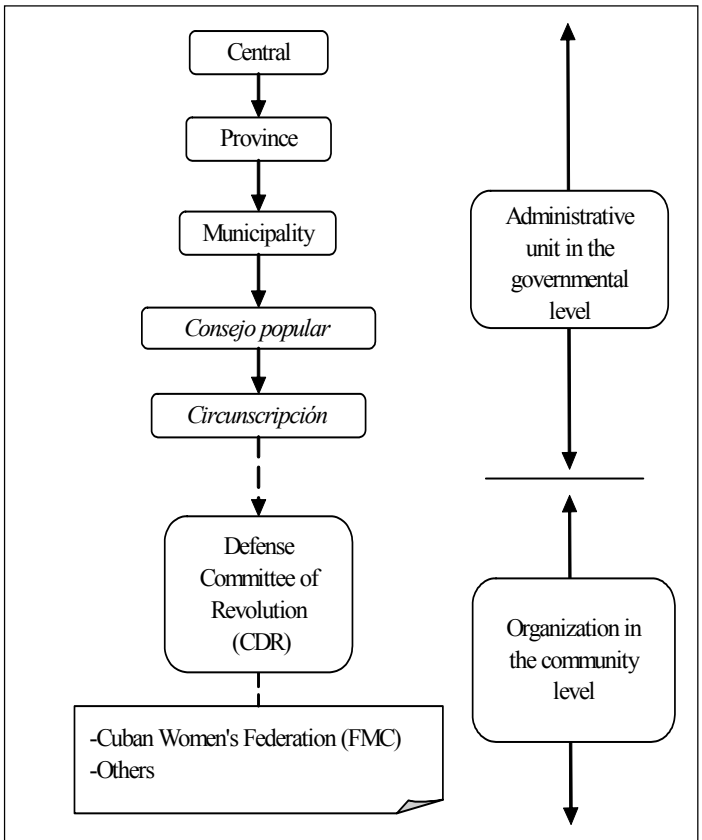


Fig. 3.5.1 Basic Structure of Administration in Cuba

Presidents in Municipal and Consejo popular are respectively appointed through election by representatives at each level. Only Circunscripción selects a representative (delegado) through direct election voted by local people themselves. Only Circunscripción among those administration units runs their own administration on a volunteer basis.

(2) Relationship with rural administration and producer organizations

In Cuba, producer organizations exist as one of the important entities composing the community. CPA and CCS in some cases, contribute a part of their agricultural produce to hospital, school, pregnant women, and persons badly off as social consumption.

3.5.2 General Social Conditions of Targeted Areas

(1) Social indicators

The basic social data of targeted 5 provinces and municipalities are shown in Table 3.5.1.

Table 3.5.1 General Data of Targeted Provinces (2001)

Province	Cienfuegos	Villa Clara	Sancti Spíritus	Ciego de Ávila	Camagüey
Population: (000)	397	836	436	411	790
Area (km^2)	4,180	8,660	6,740	6,910	15,990
Num. of Municipalities	8	13	8	10	13
Municipality	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Vertientes
Population: (000)	31	55	60	-	53
Area (km^2)	680	880	1,042	-	2,024
Popular Council	6	11	15	8	9

Source: Anuario Estadistico de Cuba 2001, Edicion 2002, Oficina Nacional de Estadisticas

(2) Historical background of rice production in the targeted municipalities

- Aguada de Pasajeros (Cienfuegos)

  Aguada de Pasajeros, the largest rice producing municipality in Cienfuegos, is regarded as the area to have started rice production the earliest in Cuba. Rice, which is now the major agricultural produce of the municipality as well sugarcane, has become more popular, especially since early 1960's in the era of land reform. Aguada de Pasajeros has made effort to promote rice production through "Local rice festivals" held every year from 1975 to early 90's where the best rice producer was awarded. The municipality also presently owns Rice Museum, which exhibits history of rice production, variety of rice cooking, as well as functions as a meeting spot for extension activities.

- Santo Domingo (Villa Clara)

  People in Santo Domingo have cultivated rice since early 1960's. Its production has been accelerated from 90's "special period" for the purpose of self-consumption. Although most people had cultivated rice on a small scale on state idle land by unofficial occupation, they gained legal status as Parcelero since late 90's owing to Law 356. (Note: Other areas also seemingly went through a similar process and original forms of Parcelero's appearance).

  In addition, only Santo Domingo among all the municipalities has accepted Parcelero to CCS.

- Yaguajay (Sancti Spíritus)

  Yaguajay formed the original shape of its township around 1900; it was in Las Villas province until establishment of Sancti Spíritus province in 1975. Construction of multi-purpose dam was launched in 1965, but its construction was canceled in the middle. Other unique points should also be noted: Yaguajay has more Parceleros next to that of Aguada de Pasajeros, and has higher proportion of CCS which are not CCSF in comparison with other municipalities.

- Chambas (Ciego de Ávila)

  Chambas had forestry sector as one of the essential economic resources in the primary sector until 1950's. However, forestry sector lost its solid position in the economy as forest resources became depleted and nearly completely disappeared. Persons in charge of the forestry sector now engage in agriculture (including rice cultivation) at first, and the fishery sector.

- Vertientes (Camagüey)

  Vertientes formed its township initially in 1896 on the opportunity of a new sugarcane factory. The major agricultural produce was sugarcane since then, but rice production also appeared gradually since 1930's. Crucial momentum for rice production in Vertientes occurred in 1967, when Vertientes was selected as the priority area of National Rice Program along with Florida in Camagüey. The program offered not only more rice production as a result, but also improvement of social infrastructure including irrigation facilities, roads, housing, etc. The program involving better life standards brought more population into Vertientes.

  Although it is reported that population in the municipality is still on the increase, the density of population in Vertientes is lower than other municipalities partly due to its relatively larger area.

3.6 Extension System for Rice Cultivation

3.6.1 Extension System for Rice Production

Technical assistance on rice production in Cuba is implemented by the structure shown in the chart below.

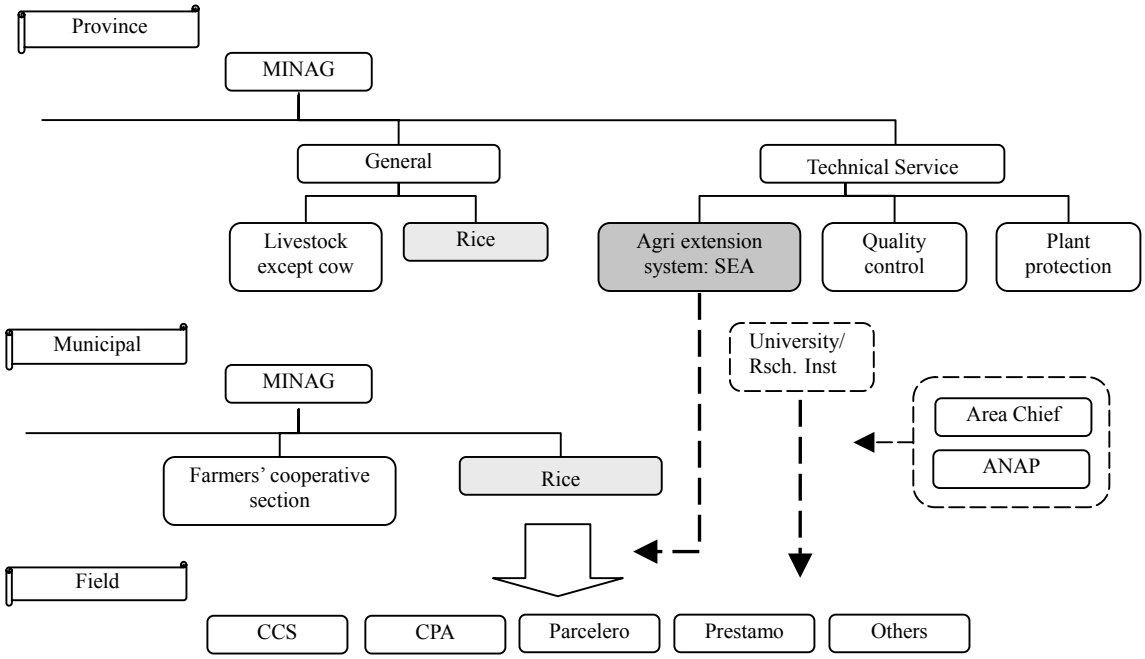


Fig.3.6.1 Structure of Technical Assistance in Cuba for Popular Rice Production

Province and municipality have one officer each on rice production in their MINAG delegation. An officer at the level of province occupies the position to control and manage rice production in a whole province, while extension officers at municipal level are in charge of technical assistance to producers at field level along with management of rice production in their own municipalities.

Direction of "Agriculture extension system" in MINAG supports extension activities in the whole province, whose main role dedicates technical components and soft components (such as facilitators for producer meeting/workshops in the framework of participative concept).

Extension officers implement several types of technical assistance, whose basic policy/contents to offer, and materials (text, video) are provided by central and province of MINAG. In response to the basic policy of extension activities, extension officers submit an annual action plan to their own province in January and monthly action plan in the beginning of each month. On the other hand, activity report describing actual extension activities has no specified rule on frequency of its submission. The situation of its frequency and form is different from province to province (every two weeks, every month, every two months, etc).

Extension activities adopt several modes in order to offer technical support (such as lecture on occasion of producer meetings, showing video and others). Table 3.6.1 shows the primary modes of technical assistance presently taken by extension officers.

Table 3.6.1 Primary Bodes of Technical Assistance in Extension Activities

	Contents	Location	Primary instructor
Technical lecture (oral only)	• Introduction of new varieties • Management of insect disease damage • Use of machines • General (information)	• Extension officer himself visits the meetings of CPA/CCS Invites producers to public facilities, meeting place of ANAP	• Extension officer
Seminar	• Instruction on specified theme	Invites producers to public facilities, meeting place of ANAP	• Research institution such as IIA
Video	• Specified theme	• Shown at public facilities, theater, or individual houses of members (evening－night)	• Extension officer
Field instruction	• Technical instruction at farmland	• farmland（individual farmland of CCS member, farmland of CPA）	• Extension officer
Verification of new varieties at field (collection of varieties)	• Several types of new varieties are planted as trials by individual farmers. Has role as exhibition plot to neighboring producers.	• Individual farmers or CPA (actually, most cases are individual farmers of CCS）	• Extension officer

3.6.2 Current Condition of Extension

The fact that there is only one extension officer in each municipal indicates the physical limitation for them to cover the whole municipal area. Besides the limitation of manpower, extension officers in many cases don't have their own transportation mode in large areas. Therefore, under the difficult conditions in terms of flexible movement, extension officers make the most of regular meetings of producer organizations as extension activities to give lectures in addition to calling-up producers to public facilities. Therefore, most extension activities of extension officer direct to producers are limited to a part of producers who have enthusiasm.

Table 3.6.2 shows the record of extension activities in 2003.

Targets of extension activities among many of CPA and CCS are selected by the criteria of rice production. Besides this criteria, extension officers provide assistance to their own acquaintances and also in response to requests from producers in a flexible manner.

Table 3.6.2 Record of Extension Activities in 2003

Province	Cienfuego	Villa Clara	Sancti Spíritus	Ciego de Ávila	Camagüey
Municipal	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Veritientez
	Participants/ times	Participants/ times	Participants/times	Participants/ times	Participants/ times
Technical lecture	100	173/7 main part.： CCS、CPA	unknown/14 main part.：CCS (＋CPA、state enterprise)	unknown	1,200/30
Seminar	3	2/64	0	unknown	500/20
Video	30	2/121	5/400	16	450/15
Field instruction	120 (duplicating the number of technical lectures)	15 days	36 days	unknown	Unknown
Verification of new varieties at field	8 producers	1 producer	2 producers	unknown	17 (including institute)
Others	Meeting in the Rice Museum (12 times)	forum （presentation by producers）	Circulation of agriculture magazine		

Note：Data obtained through interview and questionnaire to extension officers. Some numbers extremely large is described as “unknown”.

Extension officers collaborate with “Area Chief” in MINAG municipality, whose role is to monitor agricultural activities in general (excluding the technical assistance part) through interchanging information on a regular basis. Moreover, extension officers hold/participate in meetings with local administration units, ANAP and others to manage smooth implementation of extension activities. Some examples of technical assistance offered by university are seen in some provinces; however, actual implementations so far are quite limited and small ones.

3.6.3 Challenges in Extension Activities

There are some viewpoints that hamper promotion of extension activities as shown below.

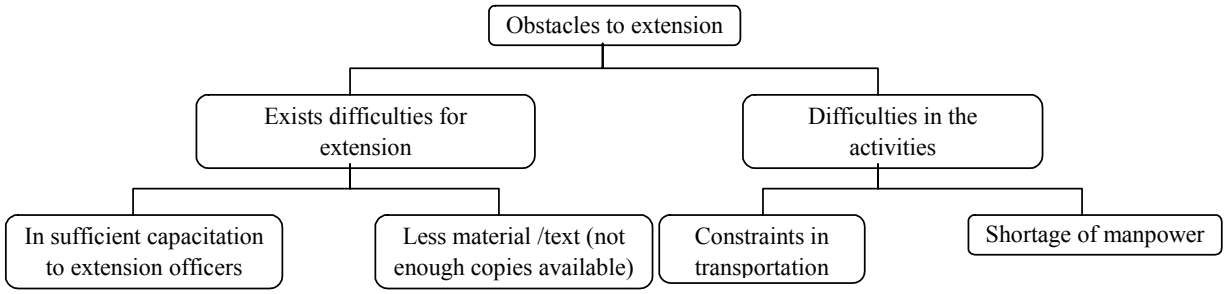


Fig. 3.6.2 Summary of Problems of Extension

Extension officers recognize the transportation problem as the most serious among those because it directly influences their own activities. The limited modes of transportation make their visits to other locations more and more difficult.

It is also pointed out that severely limited budget for extension activities causes difficulties to make copy of texts to distribute in lecture meetings, even though they may have good texts.

SWOT (Strength, Weakness, Opportunity, Threat) Analysis：Cienfuegos

Agriculture University of Cienfuegos, MINAG and others held SWOT analysis workshop on agricultural extension in 2003 (the workshop was held independently from the JICA study). The following are primary examples of their description.

S（Strengths）：	Strong relationship with producer cooperatives and local organizations. Strong relationship with research institutes
W（Weakness）：	Less support to extension officers, Lower salary despite hard work, Extension activities are non-continuing ,Shortage of capacity building of extension officers
O（Opportunities）：	Development of scientific sector receives priority at central and province level, Some international communication through internet
T（Threats）：	Few experts and technicians, Information is not managed well, Limited opportunities to use computer, Limited opportunities to obtain new information

3.6.4 Current Conditions of Extension Activities by Rice Research Institute

From the beginning of the Program of Rice Development in 1967, the Institute of Investigations of the Rice has been in charge of designing and applying the System of Agricultural Extension in the cultivation of rice. This system was directed to specialized rice production and the main actions developed during that period can be summarized in the following way:

- Gathering at a National Meeting of Technical Instruction every year. In this meeting all the directors and technicians of Rice CAI participated. The rice production of the year was analyzed and the results were approved, for generalization in the production.
- The researchers participated in the process of generalization of the results.
- In the extension system, training was carried out directly in the producing units.

Starting from 1991, a deterioration of the established system began, fundamentally due to problems of transportation, and it limited the extension activities. To solve partly the transportation problems, a methodology was implemented consisting of a group on researches and that group held meetings with the producers in each province.

One of main difficulties of the extension system was that the training generally stayed on the level of the directors and technicians of Rice CAI and it comes to the producers very infrequently.

In 1996, the Ministry of Agriculture designated the IIArroz to implement the training and extension systems for the Popular Rice producers. This task motivated a change of mentality in researchers because it was not possible to use the established system since the specialized rice and Popular Rice cultivation takes place in a very different ecosystems from that of specialized rice; furthermore, the extension activities should be directed to every form of production.

As part of the actions, an extension system (Systema de Agrarian Extensionismo) was settled on for the cultivation of rice, which includes both specialized rice and popular rice. In this system, the Experimental Stations and the Universities have a main role, as well as the extension officer of every municipality.

During 2003, three visits were made through all the municipalities of the country, at which multiple training actions were carried out, such as lectures, field days, fairs of diversity and others. These have

contributed to elevate the knowledge of producers and specialists, and an interesting reciprocal exchange of information.

Additionally, more than 150 collections of varieties of rice were distributed to producers in Municipalities and Peoples Committees, as a way of Participative improvement, with the objective that the producers can select the varieties better adapted to their conditions in cultivation. In the same way, the producers received sorghum seed and Sesbania rostrata to develop a culture of agrarian diversification and employment of green manures.

The widespread varieties and their technology were pursued on the part of the responsible investigators. In the present year, the areas sowed with the varieties IACuba 29 and IACuba 30 as a consequence of an arduous process of seed production, have extended considerably, not alone in the Experimental Stations, but also in specific areas of cooperatives. This process was checked by the System of Inspection and Certification of Seeds (SICS).

Among the results reached in the Agrarian Extension of the rice crop during 2003, we could mention the generalization of experiences on transplant, the age of the plant, the system of intensive cultivation of the rice (SICA), new methods of preparation of soils, the use of alternative sustainable of nutrition (worm humus and green manures), the rotation of cultivations with sorghum, the use of alternative biological methods for the control of field plagues, as well as new techniques for the crop and benefit of the rice in the popular sector.

As part of the policy for the technology transfer, the government has established work agreements with international organizations and countries with experience in this crop.

In the project “Support to the program for the popular cultivation of basic grains in the oriental provinces”, encouraged by the UNDP, the following activities were developed:

- Establishment of a production system of seeds with small and medium-scale producers in 29 farms and 3,284 producers were benefited with resources.
- Incorporation of unused areas for the production of seeds and other foods.
- Training actions on qualification such as: Technologies for the production of grains, Technology for the production of seed of grains, post harvest technology, extension activities, specific topics of the cultivation of bean, corn and rice.
- 17 technical materials, were prepared.

In the project “Production of family rice”, developed jointly with Vietnamese specialists, 30 hectares were sowed with Vietnamese technology using small machines for sowing and harvesting.

Although the work of agrarian extension activities has increased in a remarkable way in the last year, it is necessary to recognize that it is still very far from reaching to all the producers of popular rice. Among the main obstacles for the extension system work, the following ones can be mentioned:

- Not enough transportation to develop the extension system in the institute, provinces and the municipalities.
- The universities have not yet have established an effective extension system program in each province.
- All the necessary agreements have not been settled to take the extension system to other organization concerned.

Table 3.6.3 Summary of Training Actions in 2003.

Actions	Planned	Actual	Number of participants
- Workshops	8	10	1,203
- Seminars	5	6	128
- Lectures	100	279	5,926
- Extension activities	235	450	7,000
- Total			**14,257**

3.7 Present Condition of Rice Research Institute

3.7.1 Organization of Rice Research Institute

IIArroz belongs to MINAG and was established in 1969. It has three experimental stations located in the provinces of Sancti Spíritus, Camagüey and Granma.

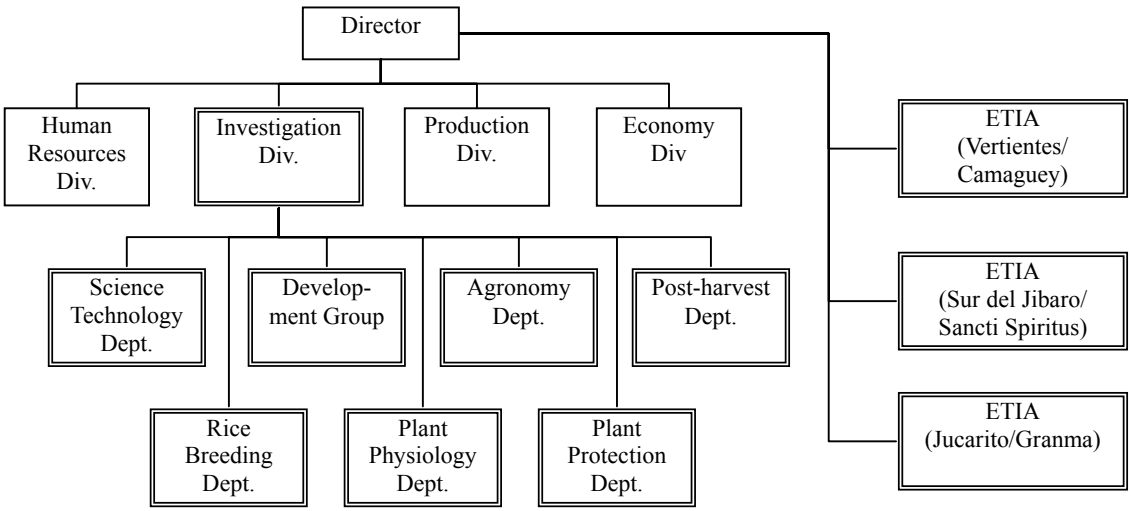


Fig. 3.7.1 Organization of Rice Research Institute

Also, it should be mentioned that there is a rice mill and two Farms for Seed Production in the Havana province, which belong to the institute. These farms are engaged in seed production (registered and certified I). Fig. 3.7.1 shows the summary of the general organizational structure of IIArroz. As it can be observed, there are five departments related to research and two work groups related to Scientific-technical Services and extension and capacitation (capacity building) activities.

The mission of the IIArroz is to develop scientific researches, technology transfer and diffusion, rendering of scientific-technical services, and to obtain genetic materials to cover the demand of rice production system, through Science and Innovation.

The staff of IIArroz consists of approximately 498 persons, among which 278 are working in the institute's headquarters and in the experimental stations. The remaining 220 persons work in the Farms for Seed Production and the Rice Mill. Of the 278 persons working in the institute and the experimental stations, there are approximately 38 researchers and 62 technicians. The remaining personnel work in the administration and in the field as farm workers.

The Rice research Institute (IIArroz) has several strategic objectives, which can be summarized as follows:

- To warrant and to increase the rice genetic variability with high potential in agricultural and industrial yield, providing a better behavior in case of adverse factors, either biotic or abiotic.
- To conceive, adapt and establish technologies leading to sustainable development of national production, considering its economic, social and environmental impact, as well as the protection of the results of science and technological innovation.
- To warrant the rice seed production of high quality in order to cover the demands of national production.
- To produce materials, technologies and to render scientific-technical services of high impact, leading to increase the professional capacity in rice production system to contribute to institutional self-financing.
- To contribute to the development of the national system of rice production through information management, agrarian extension and technological diffusion.

3.7.2 Present Situation of Each Department

The main activities of each research department and work groups are shown below.

Group of Genetic Improvement	• Evaluation and enrichment of the Rice Germplasm Bank and characterization of accessions. • Use of the breeding techniques to obtain new varieties and to increase the productive potential of the breed materials. • Validation and introduction of the varieties in the national rice system. • Production of the breeder and basic seed of all varieties.
Group of Agro -chemistry and Physiology	• Technical recommendations about soil management and the use of fertilizers. • Implementation of methodologies to carry out physiological studies on the rice plant. • Establishment of physiological indicators to select varieties tolerant to different conditions. • Preparation and following-up of the nutrition policy of the rice system.
Group of Plant Protection	• Development of researches to solve problems related to plagues, diseases and weeds. • Contribution to the diagnosis and evaluation of epidemiological and plague problems related to empty grain. • Contribution to the diagnosis of harmful, exotic and/or quarantine agents. • Preparation and following-up of the phyto-sanitarian policy in the rice system.
Group of Post harvest	• Study, evaluation and characterization, both physically and chemically, of the quality of the rice grain, as well as the environmental effect on the varieties. • Establishment of technologies to improve the efficiency of the industrial process and storage of white rice and seed. • Preparation and following-up of policies for the benefit, conservation and storage of rice.
Group of Agronomy and Mechanization	• Implementation of mechanization technologies in rice cultivation • Implementation of technologies for the exploitation of crops in rotation • Coordination of the program of organic cultivation for rice • Establishment of methodologies of water management in the crop • Establishment of the sowing densities of the new varieties, as well as the optimum period for sowing
Group of Scientific Development and Potential	• Control of the fulfillment of scientific programs and developing projects • Control of the development of the individual scientific production • Control and requirement of the fulfillment of individual development plan of the scientific reserve. • Formulation of the program of introduction and generalization of the results • Coordination of activities of professional orientation for the capacitation of new reserves
Group of Scientific-Technical Services	• Extension activities and capacitation using the main results of the research • Preparation of materials for the extension activities, such as booklets, videos, etc. • Library administration • Publicity of information on the results of the researches through the mass media, such as radio, television, etc.

Based on the Problem Analysis in the workshop carried out in each department, in the experimental stations and with members of the direction of the institute, the following problems have been identified as being common to all the departments and limiting the activity of IIArroz:

1) The equipment is obsolete and insufficient, and it restrains the quality of the researches; sometimes researches cannot be done.
2) Laboratories are quite small. In spite of the importance of this activity, some departments do not have any laboratory, for example the Plant Protection Department.
3) The farming machines are quite old and inappropriate for the design of the experimental plots. Consequently, the production of breeder and basic seed cannot be increased, as all farming activities have to done by hand, from transplanting to harvest.
4) There is no equipment for the Meteorological Station.
5) The limitations of transportation restrain the visits to the experimental stations and the extension activities and capacitation (capacity building) of rice producers.
6) Unavailability of the necessary equipment for preparing, editing and diffusing booklets, videos, etc. for the capacitation of producers.

In spite of all difficulties, the Rice Research Institute (IIArroz) keeps working on more than 20 research projects related mainly to the improvement of rice production, and during the recent years, the activities have focused basically on popular rice producers.

CHAPTER 4 DEVELOPMENT POTENTIALS AND CONSTRAINTS

CHAPTER 4: DEVELOPMENT POTENTIALS AND CONSTRAINTS

4.1 General

In order to achieve the objective of increasing the production and improvement of productivity of popular rice, the development potentials and constraints were examined based on the existing conditions in the 5 Central Provinces.

In general, the development potentials and constraints are clarified when the development objectives are set. The development potentials are the positive elements of the external conditions which support the development. The constraints can be classified into problems and causes, and the countermeasures for the causes are studied. The development plan is formulated based on these countermeasures. When it is difficult or impossible to establish any countermeasures for some of causes, such causes should be considered as negative elements of external conditions and development plan should be formulated based on those conditions.

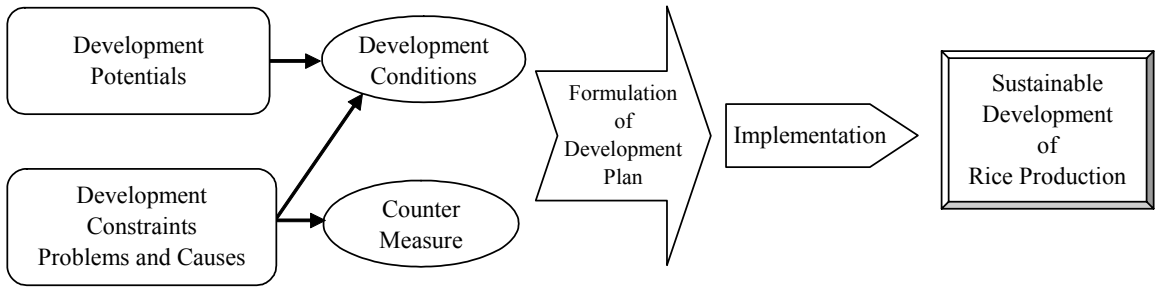


Fig. 4.1.1 Flow of Development

4.2 Development Potentials and Constraints for Increasing of Popular Rice Production

4.2.1 Development Potentials for Increasing of Popular Rice Production

When the development target is set as increasing of popular rice production, the following potentials can be considered:

- Popular rice has been produced naturally from olden times for self consumption and producers have experience of popular rice production.
- The government started the program for increasing popular rice production from 1996 and several measures have been tried to increase popular rice production.
- Research and supporting systems on rice production technique have been developed for national rice and these systems can be applied for popular rice.
- Rental land system for increasing popular rice was started from 2002.
- There are unused lands (including pasture lands) suitable for popular rice production.
- The technical level of popular rice producers is high.

4.2.2 Constraints for Increasing of Popular Rice Production

Most of the popular rice producers recognize that the lack of fertilizers and fuels is one of the biggest problems for increasing of popular rice production that is considered as one of the reasons for

insufficient farm management and low productivity of popular rice. As shown in Fig. 4.2.1, the main causes of low popular rice production are “insufficient sowing area of popular rice” and “deficiencies in post harvest and marketing” as well as “low agricultural productivity”.

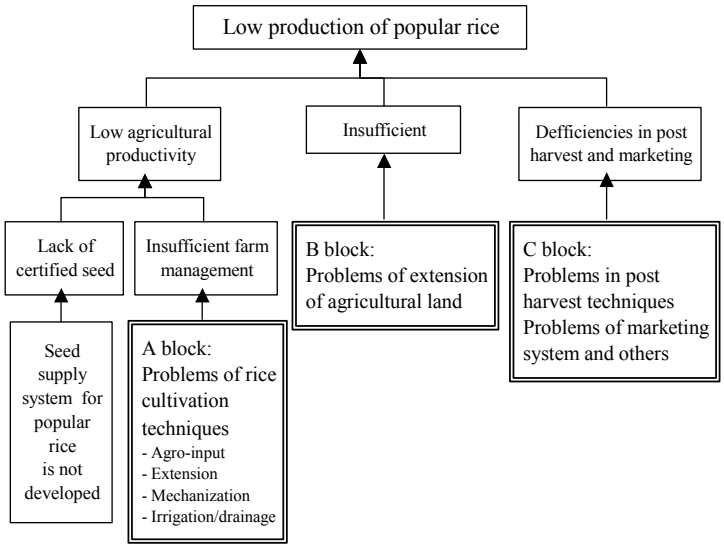


Fig. 4.2.1 Problems of Popular Rice

The main causes for low productivity of popular rice production are “lack of certified seed” and “insufficient farm management”. Also, problems of farm management and post harvest are technical problems at the field level. Problems of certified seed adding with those of extension and research system can be considered as problems of supporting system at the national level. The problems of sowing area of popular rice are problems at the regional level based on conditions in each province.

4.3 Development Potentials and Constraints at the Field Level

4.3.1 Rice Cultivation Techniques

(1) Potentials

The potentials of rice cultivation techniques can be classified into 3 categories: natural resources, human resources and supporting system.

Table 4.3.1 Development Potentials of Rice Cultivation Techniques

Natural resources	Climate	Warm in all seasons, plentiful sunshine	Extended seeding and transplanting period, double rice cropping, increase of rice plant growth
		Optimal precipitation	Keeping irrigation water (many dams & plentiful underground water)
	Soil	Many heavy and light heavy soils	High water holding capacity and nutrient supplying power
Human resources	Labor force	High possibility of labor force	Availability of laborers in farming
	Educated manpower	Educated farmer	Facilitating extension of new technologies
Supporting system	Research institute	Establishment of Research institute and its branches	IIArroz, IIS, INSAV, IIRD, IIMA, others
	Agro-support	Establishment of Supporting system	Technical extension, seed supply, Agro-chemical and organic fertilizer service, plant protection service

(2) Constraints

The causes of insufficient farm management as problems of rice cultivation techniques are “Lack of fertilizer”, “Lack of weeding and insect/pest control”, “Lack of labor force”, “Non-effective use of

agro machine" and "Insufficient irrigation". "Low allotments from Government" caused by "low import amount" due to economical constraints is one of the main causes for "lack of chemical fertilizer" and "lack of agro-chemicals" (there is no allotment except for non-specialized contract). Taking account into that there are few possibility to increase the import of agro-chemicals at present, a group of alternative techniques could be applied, which have been developed by the institutes as shown below:

Table 4.3.2 Expected Alternative Techniques

Problems	Expected alternative techniques
Lack of chemical fertilizer	・ Fertilization of organic matter: Return of top rice straw, Use of fermented excrement, Earthworm compost, Compost of crop residues, etc. ・ Use of biological fertilizers ・ Changing of land use between dry and flood conditions ・ Establishment of supply system of fermented excrement from Animal Husbandry Units ・ Crop rotation in paddy field, especially introduction of green manure.
Lack of agro-chemicals	・ Use of biological control ・ Changing of land use between dry and flood conditions to control weeds. ・ Popularization of rice transplanting method to control weeds. ・ Selection of resistant varieties.

Concerning "lack of labor force", even though there are enough laborers, there are still lack of skilled laborers for popular rice production and insufficient extension activities is one of causes for this situation. "Non-effective use of agricultural machinery" and "Insufficient irrigation" are the direct causes for "insufficient farm management"

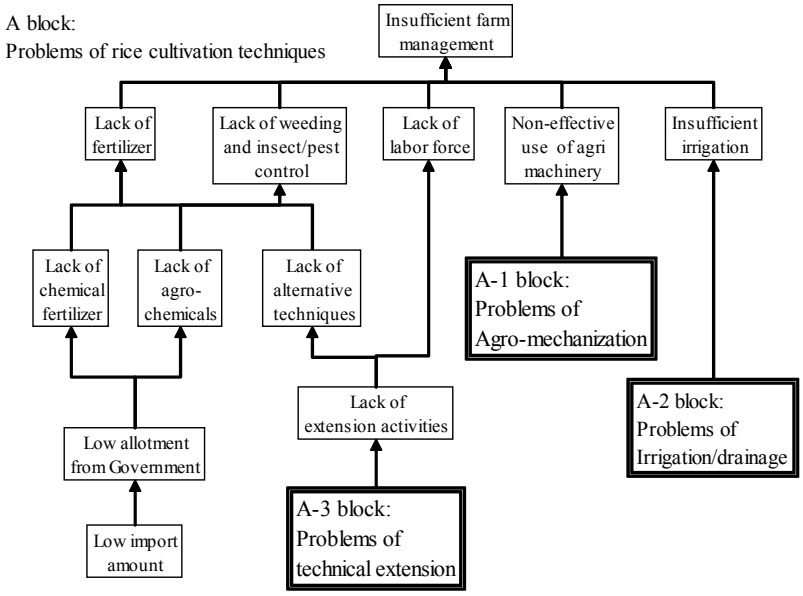


Fig. 4.3.1 Problems of Rice Cultivation Techniques

4.3.2 Agricultural Mechanization

(1) Potentials

1. Producers have experience of mechanization and they are familiar with using of agricultural machinery. Therefore, it is not difficult for them to introduce new types of agricultural machines and follow the system of collective use of agricultural machinery.
2. There is a rental system[1] of agricultural machines among each agricultural organization and each municipality for lending machinery and materials between them.
3. There are repair/maintenance shops in each province and each municipality, and they are providing spare parts and repairing services. These activities of the repair/maintenance shops contribute to long-term use of machineries.

[1] This rental system has an important role for the mechanization development of popular rice production, where there is insufficient machinery supply

4. There are human resources with high knowledge/technology for agriculture machinery.
5. There is a National Institute of Investigation of Agricultural Machinery (IIMA).
6. There are organizations with high technical capacity for designing and manufacturing of agricultural machinery.

(2) Constraints

As shown in Fig. 4.3.2, the main causes of ineffective use of agricultural machinery are "lack of agricultural machinery", "ineffectiveness of agricultural machinery", "high maintenance cost", "insufficient maintenance of agricultural machinery", "lack of fuel" and "lack of information on agricultural machinery".

The main cause of "Lack of agricultural machinery" and "agricultural machinery is too old to use" is the abandonment of old machinery little by little, and it is difficult to import new machines. In the study area, traditionally, large-scale agriculture using large-scale machinery has been carried out and small-scale machinery suitable for small farmland cannot be seen. In regard to fuel, the problem is that the price of fuel is too high to buy in the market and the allotment of fuel from the government is too small.

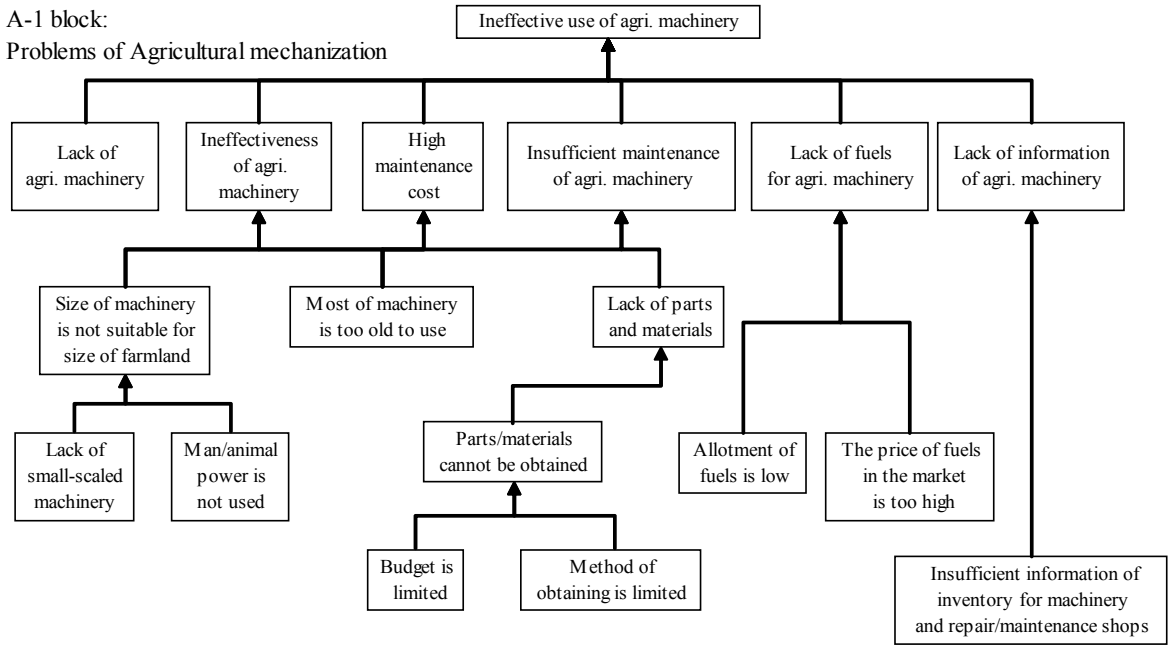


Fig. 4.3.2 Problems of Agricultural mechanization

4.3.3 Irrigation and Drainage

(1) Potentials

- In the selected municipalities, there are abundant available water resources for irrigation of popular rice production. In Aguada de Pasajeros and Santo Domingo, groundwater is used in general. In Chambas, there are abundant water resources from rivers, spring water and groundwater. The majority of individual popular rice producers in Yaguajay rely on the surface water from small streams or drainages canals, even though some of the area have potential of groundwater.
- There are some large scale irrigation systems developed by the government: namely, the

Liberacion Florencia Irrigation System in Chambas, and the Najasa-Los Negros Irrigation System, Jimaguayu-Vertientes Irrigation System and the Congo Conizo Irrigation System in Vertientes. Some of the popular rice producers are able to use those systems.

- In the selected municipalities, many of popular rice producers are using private pumps for irrigation individually and these producers have high awareness of water saving practice in irrigation[2].
- CCS members are familiar with collective use of machinery, equipment and group work in farming practice. It is considered that there is a base for introducing collective use of irrigation system even though they use irrigation system individually at present.
- The electricity cost is lower than diesel cost in Cuba and producers using pumps have high intention for introducing electrification for irrigation. Some areas, which have power lines near the field, are considered to have the potential for electrification of irrigation pumps.

(2) Constraints

In the problems of irrigation and drainage, introducing new irrigation and drainage system will need high investment and it is not considered as a realistic countermeasure. Therefore, improvement of water use of the existing irrigation and drainage system is mainly considered. As shown in Fig. 4.3.3, the main causes of "insufficient of irrigation/drainage" are high irrigation cost due to pumping up of irrigation water, insufficient water resources in some area, non-progress electrification and so on. In addition to these, it is also one of causes that irrigation technology of popular rice at field level is not yet established.

The problems of irrigation for Préstamos are caused by land rental system and it is difficult for Préstamos to invest on the maintenance of irrigation at present (there are same problems in the soil improvement such as using of organic manure).

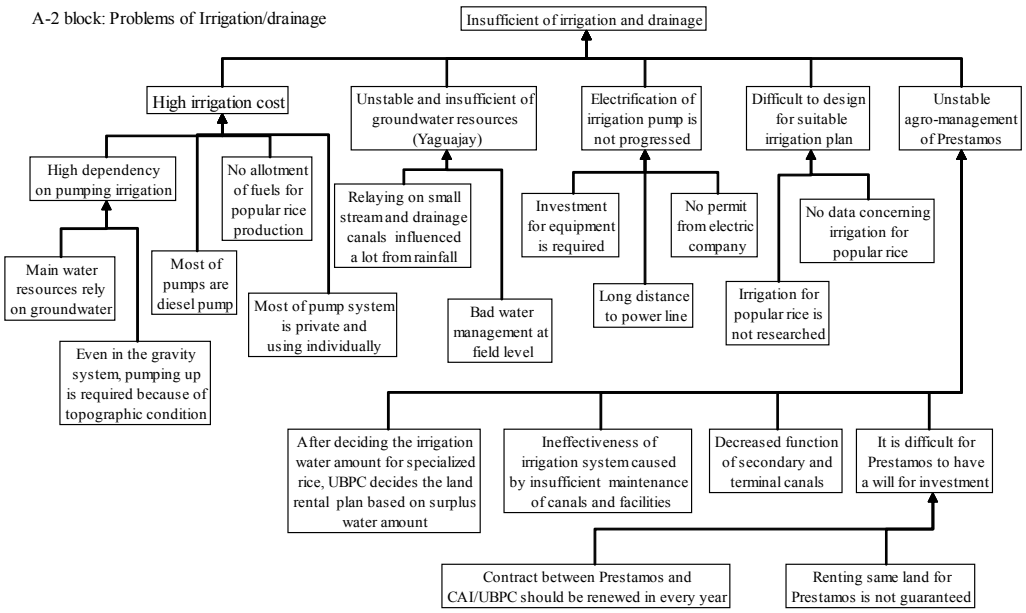


Fig. 4.3.3 Problems of Irrigation/drainage

[2] Due to necessity to reduce diesel consumption, producers have to visit and check the water conditions of paddy fields frequently and control their pump operation plot by plot.

4.3.4 Technical Extension

(1) Potentials

- "Agriculture extension system" department in provincial MINAG supports extension activities through dispatch of staff to municipalities. They are the facilitators for participatory style workshops in collaboration with municipal extension officers.
- Ministry of education established the program called "Extension program of education" at the municipality level in 2002. The program aims at providing opportunities for local people to receive education at the municipality level. It includes extension activities of agriculture with the assignment of persons in charge for executing these activities.
- The rice CAI intends to do extension activities for popular rice producers.
- The number of extension officers in the municipalities will be increased.

(2) Constraints

Main problems of extension activities at the field level are the lack of manpower, lack of transportation, insufficient extension to individual producers, insufficient textbooks concerning popular rice production and no sharing of the information concerning the extension works.

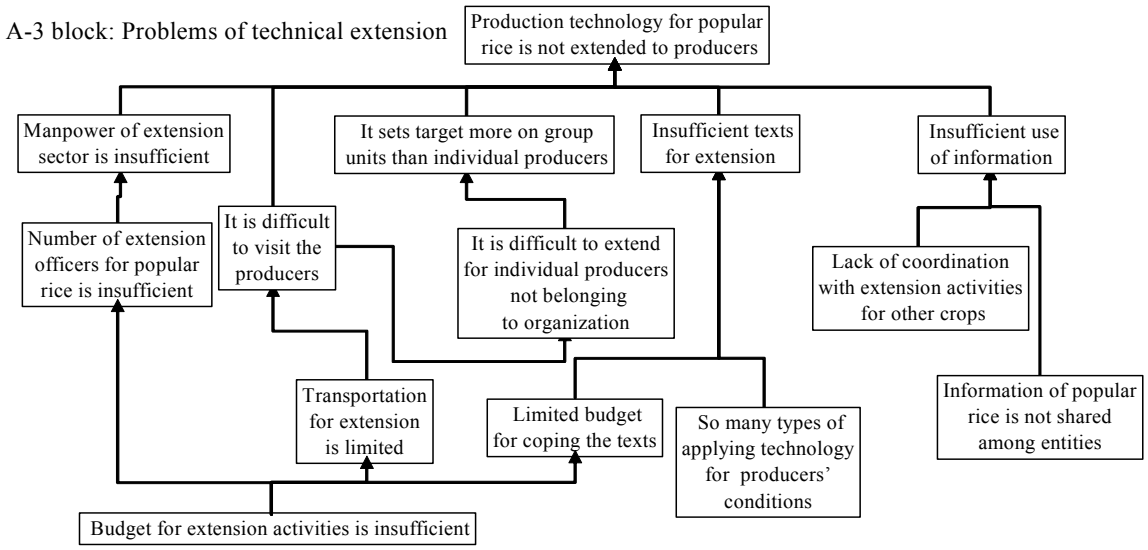


Fig. 4.3.4 Problems of Technical Extension

Since the measures to be applied for improvement of rice cultivation techniques vary based on the management form and land conditions, not only the extension activities, but many other countermeasures are required. This point makes difficulty more for extension activities.

4.3.5 Post Harvesting Practices

(1) Potentials

- As technology and experience of modernized and large-scale post harvesting practice exists, it is possible to develop the suitable technology for small-scale post harvesting practice.
- As producers understand the significance of improvement of post harvest for popular rice, technical extension is not difficult.

(2) Constraints

The main causes of deficiencies of post harvest practice are several technical problems leading to low quality of rice, and since the demand of high quality rice in the market is not high, promoting a new technology becomes difficult.

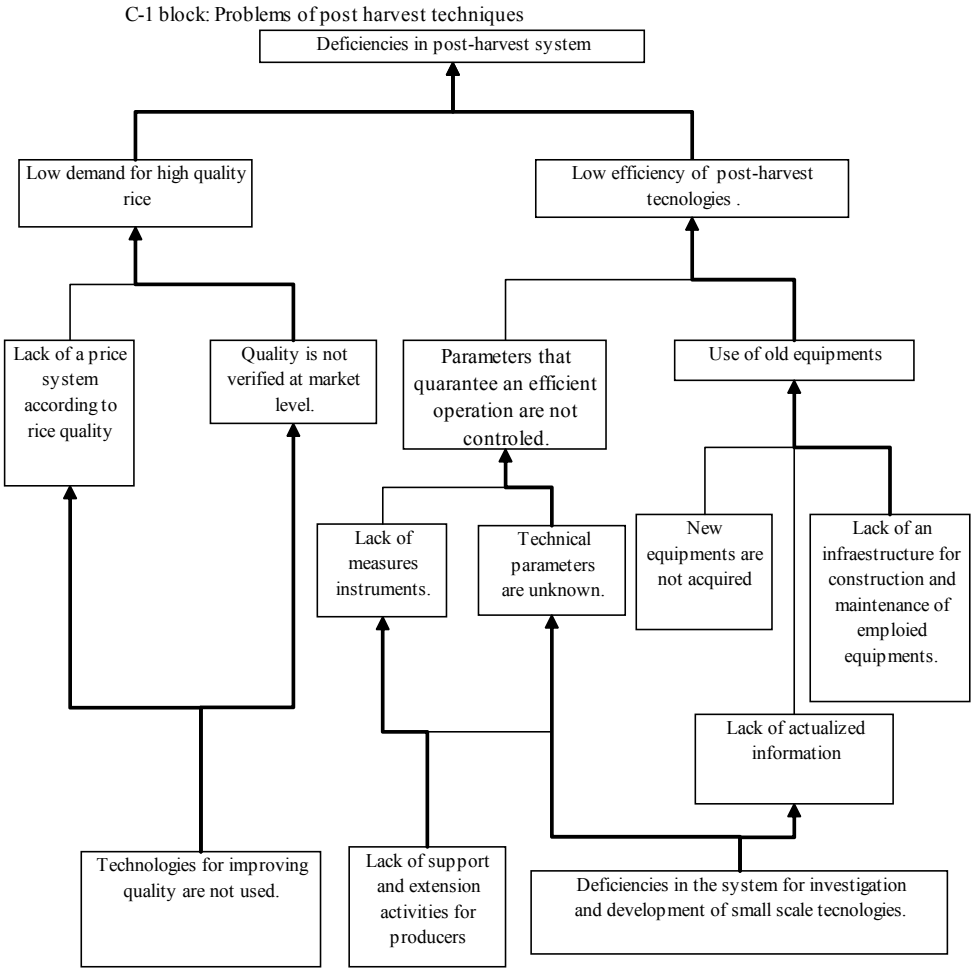


Fig. 4.3.5 Problems of Post Harvest Techniques

4.4 Development Potentials and Constraints at Regional Level

4.4.1 Expansion of Cultivation Area of Popular Rice

(1) Potentials

Although the potentials for expansion of cultivation area of popular rice are different among the Provinces based on the regional conditions, the following potentials are expected in general.

- From the viewpoint of soil conditions, there are many suitable areas for popular rice.
- There also many of areas which can be converted for popular rice production from lands of sugarcane, pasture and non-used areas.
- There are many of non-used areas, which had been specialized for rice previously, and these areas can be rented to Préstamos.
- Rice CAI, sugarcane CAI and other state farms have willingness for converting to popular rice.

(2) Constraints

As shown in Fig. 4.4.1, the basic problems of expansion of agricultural land is that the popular rice has been produced for self-consumption from olden times using small part of farm lands individually and it is difficult to expand the area. On the other hand, even though rice CAI or sugar cane CAI intends to expand the cultivation area of popular rice, it is difficult to convert the land to popular rice since the number of producers with production technology of popular rice is not enough. The system of Préstamos started from 2002 and their area has increased up to around 16,000 ha. However, it is necessary to continuously improve this system for expanding cultivating area for popular rice.

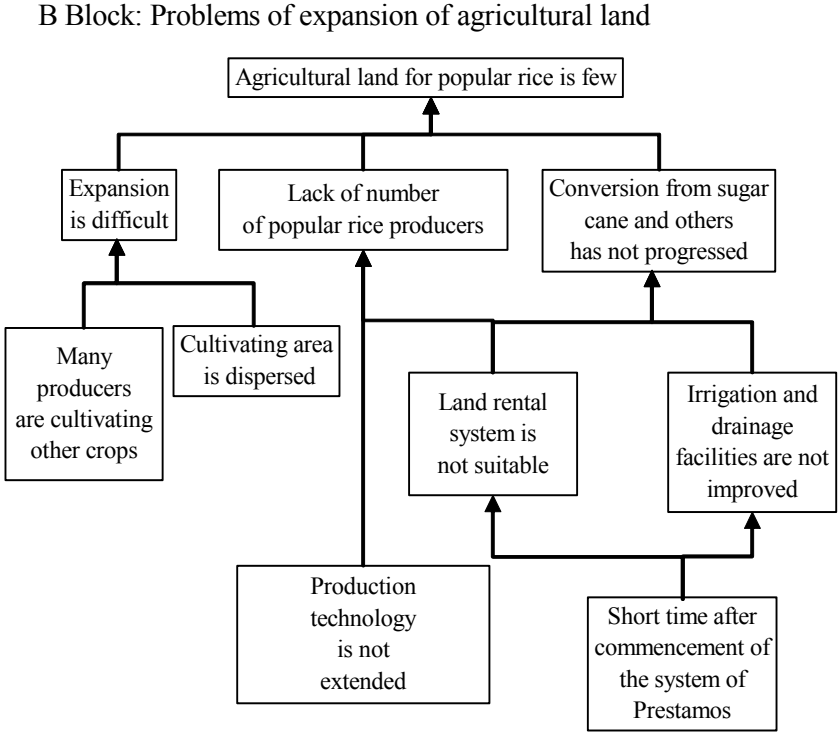


Fig. 4.4.1 Problems of Expansion of Agricultural Land

4.4.2 Marketing of Popular Rice Production

It is observed that many of popular rice producers have willingness to increase the popular rice production, but, the reasons are not always the same. According to interview survey, the reasons are summarized as follows:

- Since they do have not enough rice for self-consumption, they wish to produce more popular rice.
- They wish to supply more rice to the people of other regions, where they do not have enough rice, and to reduce the amount of imported rice.
- They wish to obtain the profit from selling surplus amount of rice.

In this discussion, it is so complicated with conditions of social systems such as ration rice and social rice, and marketing system.

(1) Potentials

Marketing:

- There is possibility to rationalize and improve rice marketing by adequate means under the planned economy.
- Food security is a priority policy of the government and the access to the rice distribution system at lower price is guaranteed by way of ration rice and social rice that occupy the

majority of total consumption.

- The parallel courses of marketing mechanism of planned distribution and free distribution have been well organized, although presently the former is bigger. This is positive to the nation because of its positive effect on the food supply situation.
- The marketing system of popular rice already exists for all Cuba.
- State market and free market are improved, and rice is sold in both markets.

Others

- Rice is one of principle foods in Cuba and demand of rice is high.
- It is known that the country uses part of its finances to import rice, mainly for ration and social use.
- Awareness of contribution to the State with increasing popular rice production.
- Popular rice production system with rental land for Préstamos was prepared and there are people intending to become Préstamos.

(2) Constraints

The top price in the state market affects the producers' and consumers' price, but the prices are not always reflected from marketing rationalism. It is necessary to analyze the suitable price for producers and consumers and the selling price should be decided based on this analysis.

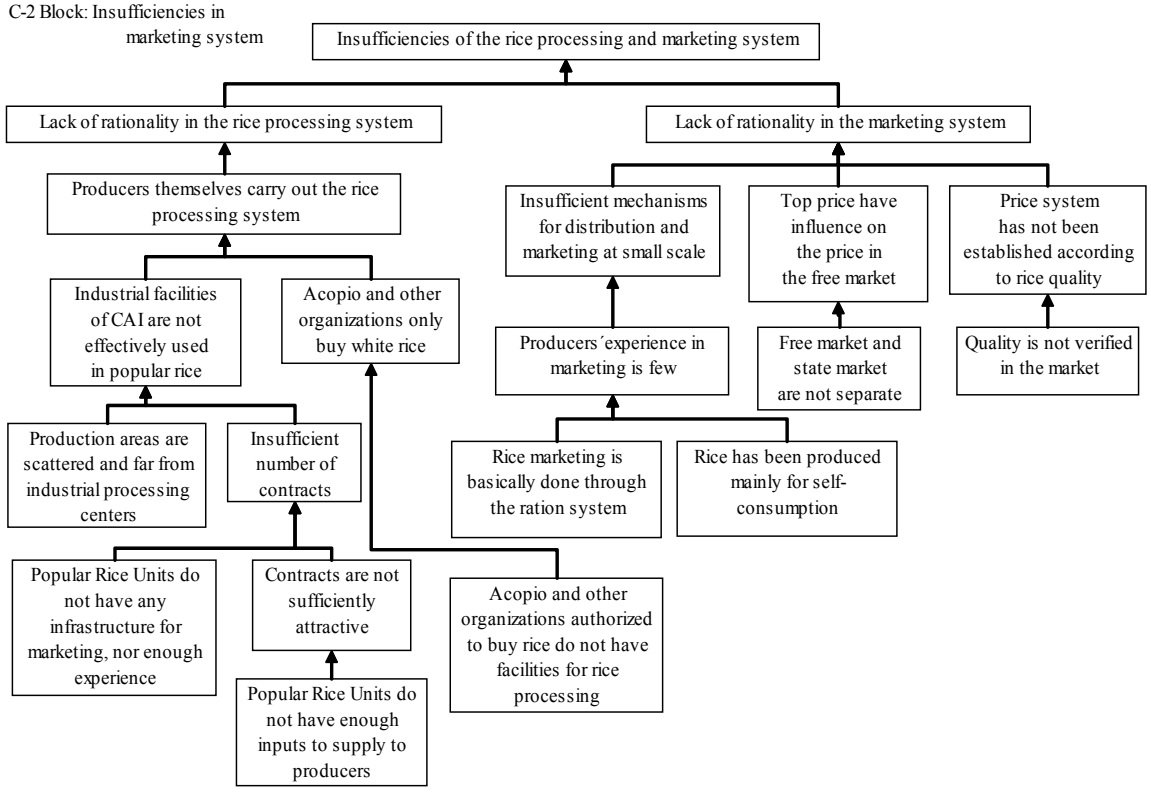


Fig. 4.4.2 Insuffuciencies of Marketing System

In consideration of the willingness for increasing of popular rice production, it is necessary to have further discussion on how to maintain the social systems of ration rice and social rice (at present, it is covered from imported rice) when this rice is supplied from popular rice (at present, most of popular rice producers are using this social systems).

Although the governmental policy is clear for increasing popular rice production, it is necessary to discuss more on the coordination of state rice and popular rice including conditions mentioned above, the supporting activities for private sector, differences between land owners and land renters, etc.

CHAPTER 5 ANALYSIS OF TECHNOLOGY FOR POPULAR RICE PRODUCTION

CHAPTER 5: ANALYSIS OF TECHNOLOGY FOR POPULAR RICE PRODUCTION

5.1 Justification and Priority of Sustainable Technical Development for Rice Cultivation

5.1.1 Justification of Sustainable Technical Development for Popular Rice Production

As discussed in Chapter 4, the issues shown below are recognized as the major constraints to be solved for increasing popular rice production and its productivity:

1) Inadequate rice cultivation technique (materials and inputs, extension, mechanization, irrigation and drainage).
2) Insufficient expansion of rice cultivation area.
3) Inadequate post harvest technology, marketing system, etc.

Also, common problems of popular rice production are pointed out specifically in Section 3.3.2 as shown below:

1) Shortage of farm materials, such as chemical fertilizer, chemicals, certified seeds, etc.
2) Shortage of fuel for pumping up of well and river water, and difficulty of electrification.
3) Broken-down machinery, shortage of machinery and lack of machinery for post harvest.
4) Lack of irrigation-drainage system and large loss of irrigation water in old canals.
5) Low utilization of the rotation crop with rice.
6) Low utilization of the residual crop and other organic manure for soil improvement

As for the potentials to overcome the above constraints and realize an increase of popular rice production, the issues shown below are recognized as the components which have high possibility.

1) Technical improvements in the field (cultivation, agricultural mechanization, irrigation and drainage, extension, post-harvest).
2) Improvement of rice production system (land use, marketing/post-harvest).

In consideration with the position and direction of popular rice production, which was described in Section 2.2.3, it is concluded that the development of technology suitable for popular rice production is important and has high priority to increase popular rice production. It includes the following:

1) Sustainable production and low use of machinery.
2) Production, mainly ecological, based upon the use of varieties adapted to different ecosystems.
3) Maximize use of bio-fertilizers, bio-pesticides organic matter and use of green manure in systems of crop rotation.
4) Design of the production on a small and medium scale; wide utilization of animal power in cultivation.
5) Capacity building for producers.

5.1.2 Direction of Technical Development of Popular Rice Production

(1) Future vision of popular rice production

In order to increase agricultural production, it is necessary to increase agricultural inputs. For the production to be sustainable, the consumption of agro-inputs must also be sustainable. For the popular rice production, the production requires increasing of agricultural input, and improving the management of the limited agricultural inputs used at present. This idea involves the following:

- To improve the productivity by maximum effective use of chemical fertilizer used at present combined with organic manure such as green manure and compost.
- To maximize the productivity by improving the machinery efficiency and combining the animal power and manpower for the effective use of limited fuels at present.
- To increase the productivity by the improvement of cultivation management and irrigation management.
- To improve the suitable varieties of popular rice and to extend and use certified seed in the field.

The purpose of this study is to estimate realistic figures of this idea in a concrete manner with maximum production based on the methods mentioned above. It can be considered as one of the future visions for popular rice production.

(2) Basic concept for development

Increasing popular rice production is based on the improvement of productivity and extension of sowing area.

1. Improvement of productivity

a. Increasing of yield
To increase yield by improvement of rice cultivation technique and post harvesting technique.

b. Effective use of agricultural inputs
To improve the productivity by combining agricultural inputs used at present and new agricultural inputs (organic manure, animal power, etc.)

2. Extension of sowing area

a. Utilize the non-used land and promote diversification from other crops
Non-used land with high potential for popular rice production will be used and conversion will be promoted in the areas of sugarcane and other crops.

b. Increase producers for popular rice
To increase the popular rice producers using the rental land system such as Prestamos

3. Improvement of production environment

The production environment will be improved for promotion of improved productivity and extension of sowing area of popular rice.

a. Promotion of investment for popular rice production
To improve the circumstances for easily investing in infrastructure and soil improvement in the areas of popular rice production. (for instance, improvement of agro-credit and, agro-insurance, extension of rental period, etc.)

b. Strengthening of agricultural supporting system
To strengthen the agricultural supporting system by providing information on popular rice, extension activities, capacity building, etc.

5.2 Suggested Technical Measures

5.2.1 Basic Conditions

(1) Type of farm management

Because of the strict limitation of available resources, (namely, agricultural input, irrigation, machinery, technical support, etc.), their accessibility is considered as a key issue for the promotion of the popular rice production. The condition of accessibility varies widely and it depends on the type of farm management. Popular rice producers could be categorized into the following groups from the view point of accessibility to resources:

- Individual producer without support from state organization
  In the case of producing popular rice without contract with state organization, individual producers such as members of CCS or *Parceleros* do not receive any support of agricultural input such as fertilizer, chemicals, fuel, etc. This group is categorized as having the lowest accessibility of support.

- Individual producer with support from state organization
  In the case of producers having a non-specialized contract with CAI, even individual producers in CCS are able to receive support of agricultural input such as fertilizer, chemicals and fuel as a compensation of the contract. However, it must be mentioned that the amount of supported materials is not sufficient for production. Prestamos who rent land based on the contract with CAI can access to the irrigation system of UBPC.

- Cooperatives such as UBPC and CPA (popular rice production as a part of management)
  The large or mid scale cooperatives such as UBPC and CPA who are not special cooperatives for rice (called as non-rice UBPC or non-rice CPA), produce popular rice for self consumption. In that case, they possess machinery, equipment and facility for their main crops and they can use them for popular rice as well. Furthermore, they can partly divert agricultural input prepared for main crops to popular rice. The accessibility to resources of this group is much higher than above two groups.

In addition to the type of management, the accessibility to input, possible labor force and possible investment are characterized by the position of rice in the farm management.

- Farm management mainly producing rice
  Due to low level of support of agricultural input to popular rice, the accessibility to input is quite low. But there is possibility to concentrate labor force or investment of farms to expanding rice production or introducing new technology or farming practice.

- Farm management mainly producing other crops and partly producing rice
  There is a possibility to divert the agricultural input assigned to the main crops such as tobacco, vegetables and viandas. On the other hand, there is limitation to increase labor force or investment of farms to expanding rice production or introducing new technology or farming practice, because main crops have importance in their farm management.

(2) Agricultural input

Considering the limitation and difficulty of obtaining agricultural input such as chemicals, fertilizer, herbicide, etc. in popular rice production, the alternative measures of improving farming practice

will be examined. In the actual situation, a small amount of agricultural input is applied in the field obtained as assignment of non-specialized contract of rice or diverted from assignment for other crops. Thus, it is assumed that the use of agricultural input which is difficult to obtain such as fertilizer, chemicals, herbicide, etc. will be maintained in the present level.

With regard to high quality seed, the ratio of application in the field is low now due to insufficient certified seed and its ineffective distribution system. Since expansion of applying certified seed is indispensable to improve popular rice production, it is necessary to examine the measures to increase certified seed by development of suitable variety and strengthen the production and distribution system of certified seed.

(3) Fuel

It is possible to purchase fuel for agricultural machinery, irrigation pumps, etc. in the market even though it is much more expensive than that obtained as assignment for crops, but producers face difficulty to purchase it due to its price. On the other hand, it is possible to purchase fuel for assignment at low price; however the amount is limited and insufficient. Especially for popular rice, producers do not have fuel assignment except for non-specialized contract. That is to say, producers can purchase the necessary fuel, but they have difficulty in obtaining low priced fuel. Thus, the promotion of popular rice shall be examined with the condition that the level of fuel consumption will be kept at the current level without significant increase. The effective fuel use through improvement of efficiency should be examined.

(4) Agricultural mechanization

Improving the efficiency of machinery and effective use of fuel will be examined for mechanization in popular rice production as well as considering possible alternative measures. The following issues shall be considered in the examination of mechanization:

- Soil conditions (possibility of alternate use of animal traction power)
- Labor force (possibility of provision or procurement)
- Accessibility to machinery (lease of machinery, commission base service)

(5) Irrigation use

It is considered to be unfeasible to develop new water resources and large-scale irrigation systems for popular rice in consideration of possible high investment for both by the government and producers. Thus it is important to use the existing water resources and facilities appropriately and effectively. At present, most of the irrigation systems used by medium and small scale individual producers are pump system with small diesel engine, and the securing of fuel is a major problem for producers. Since pump irrigation is indispensable in the area using groundwater or small rivers as water resources, it is necessary to examine ways to promote irrigation positively through improving water use efficiency, saving fuel, introducing alternative power source, etc.

(6) Labor force

The possibility of securing labor force shall be considered from the viewpoints of family labor of producers, providing labor from cooperatives, and employment of labor from outside of cooperatives. It is necessary to consider training and organizing skilled workers for transplanting in cooperation with improvement of farming practice. Farming practice should be carried out more

effectively in order to realize high productivity of rice with low input, which will cause the increase of farming work at the field level. It is necessary to examine the possible increase of farming work and available labor force in the farm management by types of management to cope with the change of farming practice.

(7) Adoptability of proposed farming practice by producers

Popular rice is produced by the producer's own decision under the limitation of accessible resources. Thus, it is most important in the promotion of popular rice production that the proposed technology and farming practice will be spontaneously adopted by producers. The adoptability of proposed farming practice by producers will be examined from the following viewpoints:

- Incentive to producers
- Motivation of producers
- Technical level of proposed farming practice
- Customs and social structure around producers
- Farming work
- Possibility of investment

5.2.2 Improvement of Farming Practice

In order to solve problems concerning popular rice production, it is necessary to consider two different aspects, one is aspect of farming activity of producers and another is aspect of institute and organization supporting farming activity of producers. The improvement measures of the rice farming technology can be divided into two types: one is focused on the shortage of the agricultural inputs and machines, the other is focused on the fields where the rice is grown.

Rice cultivation in Cuba has been carried out by various methods such as direct seeding system of the row seeding by manpower and/or seeding machine and the broadcast seeding by airplane.

When producers have been cultivating rice for self-consumption by small scale, they have practiced direct seeding with hoe weeding under rainfed condition. After the free sale of popular rice production was admitted, they took the cultivation system carried out at CAI Arrocero near their farms. But the yield at CAI Arrocero was not necessarily high due to many missing hills caused by bad irrigation water management, poor puddling and bad leveling which cause puddles (lagunas, charcos) in the paddy fields affecting rice population and a large amount of weeds.

Moreover, it was difficult for producers to obtain the herbicides which were indispensable to the cultivation system similar to CAI Arrocero. Hence, the transplanting system with puddling and leveling, which can control the weed growth by the depth of the irrigation water immediately after planting and hardly causes the missing hills, has been rapidly widespread in these 5-6 years. As a result, the yield of the transplanting system is higher than that of the direct seeding system by about one ton/ha. However, there is much difference in the yield between the transplanting system and the direct seeding system. The yield of the transplanting system is higher than that of the direct seeding system, because the transplanting system has the advantage to produce the rice under good conditions without missing hills and without the competition with the weeds.

At present, chemical fertilizer is hardly applied for either the transplanting system or direct seeding system by the popular rice producer, because of the difficulty to obtain it; organic fertilizer is also

hardly applied in both cultivation systems. Therefore, fertilization is indispensable to attempt to increase the popular rice production in the future.

The basic concepts of the sustainable rice cultivation systems which are necessary to increase the popular rice production are described as below.

(1) Improvement measures of rice farming technology

1) Weed control by agronomic management

The cultivation of crops is always a fight against weeds. Weed control carried out by conventional methods is important in order to increase the yield of Popular Rice, especially if it takes into consideration that herbicides are unavailable.

Conditions	Technical measures
The fuels for agricultural machine are available to the popular rice producers.	The series of the incorporation of weeds into the soil. At first, plowing is done at the beginning of the rainy season. After germination and growing of weeds, harrowing is done to incorporate them. After the weeds grow once again, puddling is done to incorporate them and to level the paddy field.
The work cows and manpower are available to the popular rice producers.	Preparation of paddy field with cattle. If one paddy field is too large to level at once, it is divided into smaller areas of 0.1 – 0.2 ha for better leveling. This practice is carried out before rice plant cultivation. Temporal levees are prepared by cattle to level the paddy field and to manage the irrigation water easily. The puddling is carried out not by tractor but by cattle. The places that are higher than the surrounding ones are identified and the soil is moved to puddles caused at the lower levels.

2) Incorporation of organic matter into the paddy field

Since chemical fertilizers are not available to the popular rice producers, the application of organic materials and organic fertilizers are indispensable not only for the mineral nutrients for rice growth, but also for the improvement of the physical conditions of the paddy fields.

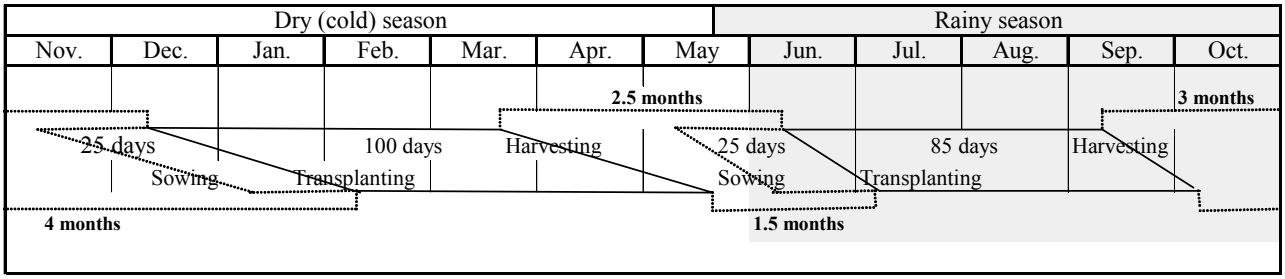
Organic materials and organic manures such as the rice straw and Sesbania are used as unprocessed materials, but pre-treatment is needed before incorporating them into the paddy field.

Conditions	Technical measures
Portable fodder cutting machine is available to the popular rice producers	Pretreatment of rice straw. The rice straw after threshing is cut into pieces and is kept for about 20 days to dry, and then it is incorporated during the plowing.
Sesbania seeds are available to the popular rice producers	Use of Sesbania rostrata; Sesbania is one of the nitrogen fixing crops and can be grown under submerged condition. About 65 kg/ha of nitrogen is supplied by Sesbania grown in 45 days. The incorporation of Sesbania is recommended to be done every two years.
Fermented excrement of dairy cattle is available to the popular rice producers.	Incorporation of fermented excrement. The excrement of dairy cattle is one of the best organic fertilizers, but it contains many weeds seeds. Therefore the process of fermentation is indispensable before it is applied in the field.
Earthworm compost is available to the popular rice producers.	Incorporation of earthworm compost. Earthworm compost is mixed with the excrement of dairy cattle and it is more efficient than cow manure. One ton of earthworm compost is the same as 10 tons of cow manure (about 10% in weight of the raw materials) and it is easier to transport and apply to the paddy field.
Drying of soil at maximum tillering stage	Interruption of irrigation to dry the paddy soils. The available nitrogen, phosphorous and potassium originating from the organic matter in the soil is generated by microorganism after the drying and wetting process of the paddy field. This nitrogen is used during the flowering period of rice. Irrigation water in the paddy field is drained at maximum tillering stage, 55 days after germination at dry season, 50 days after germination at wet season, for 10 - 12 days and then immediately irrigated again.

When using Sesbania as organic matter, it is necessary to take the adequate control measures so that the plant and its seeds are not disseminated freely in the field after being incorporated in the paddy field to later on turn into a weed problem. Many seeds remain latent in the soil, without germinating and they eventually germinate when the rice crop is established.

Necessary considerations

The growth period of Sesbania is short, 45 days after germination, and the optimal sowing period is March to July. Double rice cropping should be carried out according to plan of cropping season as shown in the chart below.



Note: 1) Variety: Reforma (early maturing variety). 2) Period of raising of seedling: 25 days.
3) Period of rice growth in field: 100 days in dry season and 85 days in wet season.

Fig. 5.2.1 Expected Growth Periods of Rice in Double Rice Cropping

In Cuba, sowing and transplanting of rice cultivation can be carried out all year round, except September and October. Moreover, if suitable varieties are selected for each month, sowing and transplanting can be carried out during ten months without decrease of yield.

The accumulation of the organic acid happens under the low temperature by incorporating the straw, and it is harmful for the roots of the rice plant. But it is few that the roots are affected by the organic acid at the high temperature, because the decomposition of the straw progresses promptly. However, it is desirable to cut them into pieces to promote the decomposition of the straw.

3) The improvement of germination and seedling growth by selection of seeds and the use of certificated seeds

It is difficult for the popular rice producers to get the certificated seeds for the producers at present. And this difficulty causes the low percentage of seedling establishment at the nursery and the paddy field seeded by direct seeding, the contamination with other varieties and red rice. The certificated seeds are used to avoid the contamination with other varieties and red rice. The seed selection by specific gravity to exclude immature seeds before sowing is carried out to establish the good seedling establishment.

Conditions	Technical measure
The certificated seed are available to the popular rice producers Calper (Calcium peroxide) is available to the farmers	Use of certified seed. The renovation of the certificated seeds is carried out every 3 years. The seed selection is done by gravity with salt water. The germination test is carried out before preparing for seeding. The rice seeds for the next planting are attained from the pest/disease free area in the paddy field. The pre-germinated seeds are used. The Calper is mixed with rice before direct seeding (in case of direct sowing).

4) Introduction of regular planting and row seeding system

Random planting is the cultivation method that has been spread to the Popular Rice Producers, since the seedlings have grown enough to be able to avoid competition with weeds in the initial growing stage and to reduce missing hills caused by poor leveling degree. However, since random planting also has problems such as lack of skilled workers for transplanting and too high wage for them, broadcast sowing still is being carried out in some regions in the study area; also herbicides obtained by contract with CAI are used by some producers, but hand weeding which is difficult in random planting field has been carried out by the majority of producers. Moreover, as the workers who carried out the random planting now transplant in a rough way, the number of plants per hill is not constant and there are a lot of missing hills and floating seedlings.

Therefore, regular planting will be introduced to increase the yield by increasing plant numbers per hill, and reducing floating seedlings and supplementary planting. At the same time, combining manual rotary weeder with regular planting will be introduced. For regular planting, since the weeds in the furrow and the interhill space are able to be controlled by manual rotary weeder, the need of hand weeding becomes lower.

The important condition to decide the cultivation style (i.e. transplanting or direct seeding) is the management scale of the producer. A lot of manpower is needed for the transplanting. Therefore, even if the wage is low, when it is difficult to assemble a lot of laborers at one time, direct seeding should be selected.

When it is difficult to introduce regular planting by the management scale and social conditions, row seeding by drum seeder will be introduced. For row seeding, the weeds in the furrow are able to be controlled by manual rotary weeder, and in interhill space, by hand weeding.

Furthermore, the technology (which is used at present to suppress generations of upland weeds, red rice, and the rice grown from seeds dropped in the previous cropping season) by maintaining the flooding condition through the growing period should be continued.

Conditions	Technical measure
The manpower for the transplanting can be secured.	Regular planting and manual rotary weeder will be introduced.
The manpower for the transplant cannot be secured.	Row seeding by drum seeder and manual rotary weeder will be introduced.

5) The use of biological insecticide

There are biological insecticides to control the principal insects of rice plant, such as plant hopper, rice bug, water weevil, moths and mites. But the biopesticides are not produced the necessary amount to supply to the popular rice producers. Therefore, it is necessary to increase the production levels of the biopesticide, especially the production of Metarhizium to control the rice bugs (Obebalus insularis Stal).

Conditions	Countermeasure
Biological insecticides are available to the popular rice producers.	Control of insects is carried out by means of biological insecticides by the popular rice producers.

(2) Development of better circumstances for popular rice cultivation

1) Establishment of new production and distribution system for certificated popular rice seeds

It is most urgent that integrated techniques of certificated rice seeds production are standardized for seed produced farmers, and are transferred to all seed produced farmers. This can be achieved by strengthening with specialized technicians, the present extension unit for rice, and SICS in the municipalities.

2) Promotion of electrification of pumping up of irrigation water from well and river

To promote the rice cultivation in dry season, for which the management practices are easy and rice yield is high and for double rice cropping, it is necessary to distribute irrigation water pumps and to electrify them.

3) Establishment of supply system of earthworm manure and fermented animal excrement from animal husbandry units to rice cultivation units

In the surveyed five municipalities, there are 39 animal husbandry units as follows.

Municipality	Production unit	Total
Aguada de Pasajeros	2 UBPC, 1 CCS	3
Santo Domingo	2 CPA, 1 CCS	3
Yaguajay	10 UBPC, 3 CCS, 1 EMPRESA	14
Chambas	4 UBPC, 1 EMPRESA, 2 GENT	7
Vertientes	2 UBPC, 2 CPA, 6 CCS, 1 EMPRESA, 1 GENT	12
Total		39

Almost all of the animal husbandry units are familiar about handling and use of animal excrement. On the other hand, many units and farmers have problems of shortage of chemical fertilizer. Hence, the supply system of fermented excrements from animal husbandry units to crop cultivation units should be established.

Total area of rice cultivation is about 6,000 ha in Vertientes and 2,500 to 3,500 ha in the other surveyed municipalities. If the quantity of nitrogen required for whole rice growth is 150 kg/ha, and all the rice straw is returned and one third of the required nitrogen is applied with fermented excrement, it is estimated that the quantity of fermented excrement, that is excreted by two adult cattle during one year, is necessary to be applied to rice cultivation in one ha. Therefore, the required number of cattle for the use of fermented excrement for rice cultivation is 12,000 heads in Vertientes, and 5,000 to 7,000 heads in other municipalities.

Especially, for the earthworm manure, as the earthworm compost is widely used in the urban agriculture in Cuba and the engineer in charge is engaged in the earthworm compost production in each county in cooperation with animal husbandry units, the production technology on the earthworm production will be spread easily among the producers. Moreover the earthworm manure are transported and scattered easily, because it is dry by 1/10 of the weights of raw material and coarse powder in shape.

By establishing a supply system of fermented excrement, the problems of shortage of chemical fertilizer and environmental pollution by animal excrement are resolved.

4) Establishment of social supply system of trained labors for rice transplanting

The farmers in Vertientes cannot introduce rice transplanting due to larger acreage of paddy field per farm household and shortage of labor. In other municipalities, many farmers, who have large scale paddy fields have a problem of shortage of labors for transplanting too. Therefore, it is necessary to establish groups of laborers who are trained in rice transplanting techniques.

5) Strengthening of activity circumstance of extension workers

The extension staff of popular rice should be increased to at least two staff: one, to be in charge of popular rice production, and the other to be in charge of certificated seed production. In addition, required vehicles and personal computers should be supplied for extension activities.

6) Increase of training for farmers and extension staff

It is necessary to increase training for farmers, extension workers and various units related to the popular rice production. The farmers also have desire to receive training on popular rice production.

(3) Integration of improvement model of rice cultivation techniques in the field

1) Integrated improvement model of rice cultivation (Cultivation type)

The optimum farm management and necessary improvement for each producer is to be decided as an integrated improvement model of rice cultivation based on the detail analysis of the conditions of cultivation and management. Even though there is a very wide variety of the condition of farm management of rice cultivation, the following are major issues to be considered to set up an integrated improvement model of rice cultivation.

a. Water use

For possibility of securing irrigation water in the dry season, the cost of pump operation is to be considered in case of pump irrigation, in addition to physical availability of water.

b. Management scale and available labor force

In addition to the analysis on physical possibility of securing labor force based on management scale (scale of rice cultivation area), the possibility of burdening labors cost for transplanting is to be considered.

c. Possibility of introducing economic crop as a secondary crop

For possibility of introducing economic crop as a secondary crop, The possibility of contract farming of which support on agricultural input such as fuel, fertilizer and pesticide is expected is considered as a very important factor.

Table 5.2.1 Outline of Integrated Improvement Model of Rice Cultivation

Culti-Vation Type	Major issues of farm management			Proposed integrated improvement model of rice cultivation (Cultivation type)
	Water use: Irrigation water is available in dry season.	**Management scale and labor force:** Labor force and funds for transplanting are possible to be secured.	**Economic crop:** Economic crop as a secondary crop is expected to be introduced.	
1	O	O	O	Rice in rainy season – Transplanting – Economic crop
2	O	O	---	Double rice cropping – Transplanting
3	O	X	---	Double rice cropping – Direct sowing
4	X	O	X	Rice in rainy season – Transplanting – Soil maintaining crop
5	X	X	X	Rice in rainy season – Direct sowing – Soil maintaining crop

The outline of each improvement model of rice cultivation is described below:

Cultivation Type 1 Rice in rainy season – Transplanting – Economic crop

This type is a high profit model which aims high profitability by double cropping of the combination of rice in the rainy season and economic crop in the dry season. In order to obtain stable irrigation water both for rice in the rainy season and economic crop in the dry season, a stable water resource such as ground water is required. Contract farming of vegetable or root crops which can expect a support of necessary input such as fuel, fertilizer, chemicals, etc. is expected as a secondary crop.

Cultivation Type 2 Double rice cropping – Transplanting

This type is a high yield model of rice cultivation with double cropping of rice, which aims to obtain high yield by transplanting technology and double cropping of rice in the field even under the limited inputs.

Cultivation Type 3 Double rice cropping – Direct sowing

This type is a low input double cropping model of rice cultivation. Direct sowing using drum seeder is introduced as to reduce labor force in seeding process as well as double cropping of rice is proposed to make high production. This type aims a labor saving farm management as well as aims a relatively high yield even its level is lower than the cultivation type 2.

Cultivation Type 4 Rice in rainy season – Transplanting – Soil maintaining crop

This type is a labor saving rice cultivation model, of which the main production is rice in the rainy season. It is proposed to cultivate crops for green manure or which will contribute to maintaining soil fertility and structure by returning crop residue in order to realize sustainable crop cultivation under the condition of limited inputs. Regular planting technology is also proposed into the cultivation in the rainy season, which will contribute to get relatively high yield.

Cultivation Type 5 Rice in rainy season – Direct sowing – Soil maintaining crop

This type is a sustainable and labor saving rice cultivation model, of which the main production is rice in the rainy season. It is proposed to cultivate crops for green manure or which will contribute to maintaining soil fertility and structure by returning crop residue in order to realize sustainable crop cultivation under the condition of limited inputs. Technology of stripe/hill direct

seeding by drum seeder is proposed into the cultivation in the rainy season, which will contribute to reduce labor and cost in the seeding stage.

The outline of the improvement model of rice farming practice is shown in Table 5.2.2.

2) Cropping system

Rice as a basic crop is possible to combine with various crops (secondary crop) including rice (double cropping) according to the length of the rainy season, the drainage situation of the paddy field, the volume of water that can be irrigated, and the market price of various crops. Considering the current situation of Cuba, vegetables, root crops, and sorghum which are able to maintain the soil fertility are pointed out as candidates of off-season crops as economic crops.

Vegetables and root crops-

State Procurement and Distribution Agency (ACOPIO) has consigned the production of the vegetables (onion, tomato, pumpkin, sweet potato, green pepper, and cucumber, etc.) with farmers. The vegetables are grown in dry season when the pests are few. The seed, the fertilizer, and agricultural chemicals for vegetables are granted by the contract with ACOPIO, and the produced vegetables are purchased by ACOPIO; in addition, the insurance regime that exempts the repayment of materials granted when it is not possible to harvest due to the disaster has been installed. The residual effects of the fertilizers applied to vegetables can be expected to improve the rice cultivation in the rainy season.

Moreover, individual farmers can privately grow the field bean and garlic, etc., and the farm surplus can be sold in local markets.

Sorghum

The grain sorghum is used as pig and chicken fodder. Therefore, it can be used for private domestic animal fodder; there is also livestock raising demand. The sorghum is sown in the field where drainage is good and the field that doesn't get excessive moisture. The sowing machine for sorghum that is used for row seeding of the rice plant can be used. Irrigation can be held to the extent that is there is no flooding if necessary, and then as a rule, the grain is harvested. As the sorghum can be harvested by the combine that used for rice, and the stem and pieces after cutting are incorporated directly into the soil.

When there is no combine, the ear reaping will be done and the stem and leaf are dried in a stand to use for livestock feed or to incorporated directly into the soil after cutting to pieces. As the sorghum is harvested as grain, two tons of the earthworm manure is applied at plowing of sorghum and two tons of the earthworm manure is applied to the rice.

Table 5.2.2 Outline of the Technological Improvement at Rice Farming Technology and the Models for Technological Improvement for the Popular Rice Production Areas.

Proposal technology	Objects of the proposal technology	Rice in rainy season cropping - regular planting - crop rotation with cash crop	Double cropping - regular planting	Double cropping - row seeding	Rice in rainy-season cropping – regular planting - crops for maintenance of the soil fertility by crop rotation	Rice at rainy-season cropping – row seeding - crops for maintenance of the soil fertility by crop rotation
Weed control by the agronomic management	At first, plowing is done at the beginning of the rainy season. After germination and growing of weeds, harrowing is done to incorporate them. After the weeds grow once again, the puddling is done to incorporate them and to level the paddy field.	○	○	○	○	○
Leveling of the paddy field by animal	The leveling of the paddy field for the improvement of the seedling is carried out well by animal.			○		○
Use of the Certificated seed	To be used to avoid the contamination with other varieties and red rice. and to decrease the amount of the agricultural chemicals.	○	○	○	○	○
Seed selection by specific gravity	To exclude immature seeds before sowing is carried out to establish the good seedling establishment and to reduce the amount of the seed.	○	○	○	○	○
Planting pattern	To weed by the manual rotary weeder.	Regular planting	Regular planting	Row seeding	Regular planting	Row seeding
Manual rotary weeder	To control weeds which reduced the yield without haebicide and supply oxgen to the roots and remove toxic gas from from anaerobic degradation of the organic matters.	The rotary weeder is passed in the furrow and the interhill space	The rotary weeder is passed in the furrow and the interhill space	The rotary weeder is passed only in the furrow space	The rotary weeder is passed in the furrow and the interhill space	The rotary weeder is passed only in the furrow space
Hand weeding	To weed the red rice and the rice grown from the seed dropped at the previous cropping season on the hill spaces which could not controled by the manual rotary weedre.			○		○
Weed control by maintenance of the flooding condition of the paddy field	To depress of the germination of the red rice and the rice grown from the seed dropped at the previous cropping season	○	○		○	
Application of the eartworm manure	To reduce runoff of the mineral nutrient by the irrigation water and to last its fertilizer response, although earthworm manure is not readily available fertilizes such as chemical fertilizers.	○	○	○	○	○
The use of a biocide	Biocides which are produced by CREE which established in each municipality are used to reduced the pesticide pollution of the paddy field and irrigation water and production cost, to maintain natural enemies.	○	○	○	○	○
Midseason drainage at maximum tiller number stage	To promote the minaralization of the the mineralization of organic nitrogen, phosphate and potassium and improve the root spread.	○	○	○	○	○
Improvement of soil physics and chemistry, Weed control by crop rotation	To Improve the physicochemical fertility of the paddy soil by incorporating the residual effect of the fertilizer to the cash crops and to change uplnad condition from the paddy field	○				
	To Improve the physicochemical fertility of the paddy soil by incorporating the sorgum forage and to change uplnad condition from the paddy field				○	○
Incorporation of the rice straw	To improve the soil physicochemical fertility of the paddy soil	○	○	○	○	○

The proposed technology for the improvement model of rice farming practice above is executed in the field by using the rotation system combined with the crops shown in Figure 5.2.2.

The cropping system will be repeated every year. The field where the popular rice has been grown for many years with the amount of applied nutrient seems to be used below the standard application rate of fertilizer to rice. To recover the fertility of the paddy field, 4 – 6 ton/ha earthworm manure is applied at plowing time of dry season for double cropping. For the rice combined with secondary crop, 2 ton/ha earthworm manure is applied for the secondary crop in dry season and 2 ton/ha for the rice in rainy season. The earthworm manure cannot be expected to be rapidly available fertilizer but the runoff of the nutrients such as the chemical fertilizer are few and the fertilizer response continues for a long time. Moreover, it differs from chemical fertilizer and the excess damage of fertilizer hardly appears; the response of fertilizer can be expected to work like topdressing in late growth stage. It is preferable to increase and decrease the amount of application of the earthworm manure according to the leaf color at the flowering time.

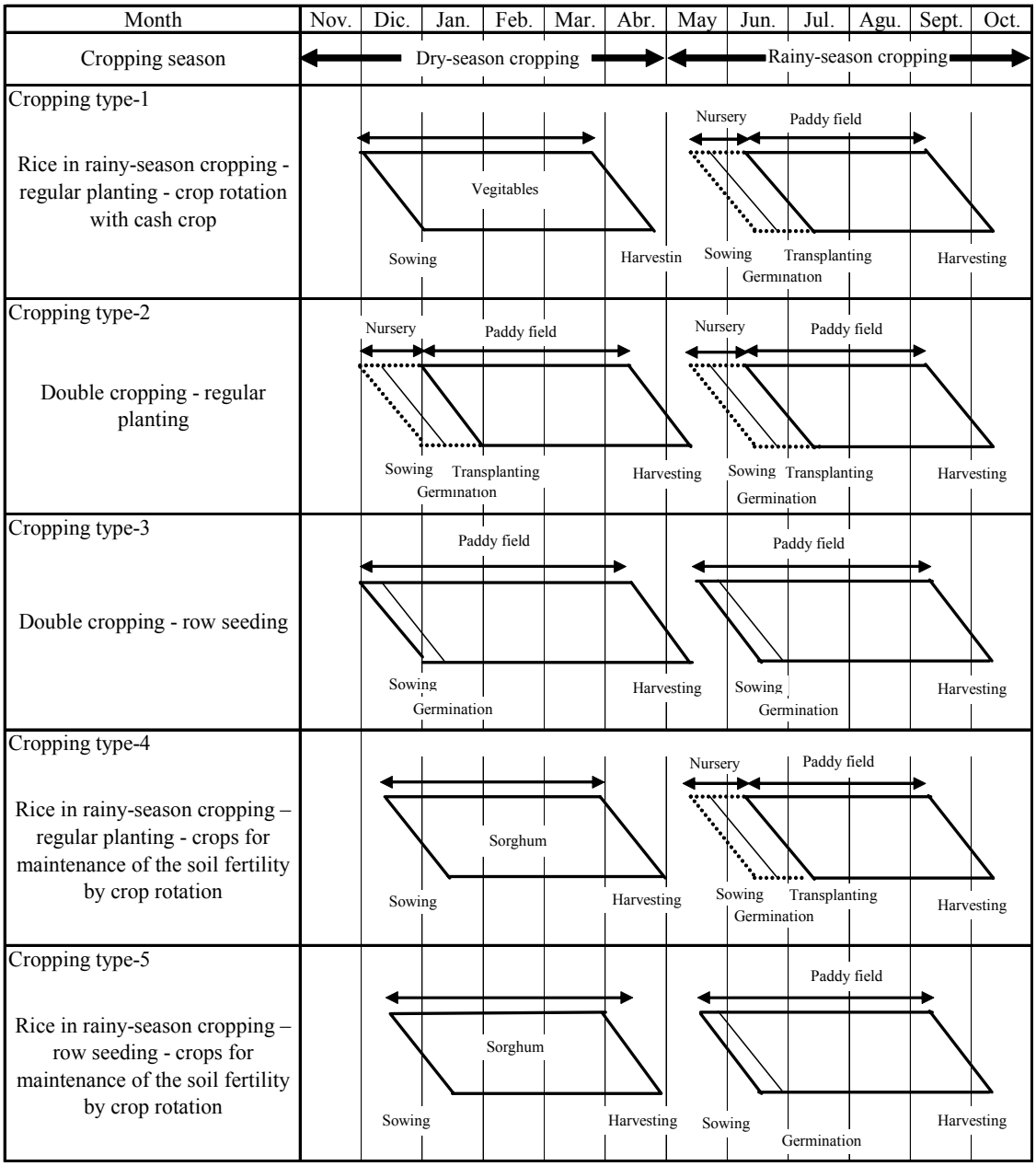
The yield is influenced strongly by the soil fertility; moreover, amount of precipitation and the influence of pest damage etc. The estimated yield shown here is based on the farmer interviews, the statistics of GAIPA, etc. It is seems that the yield will increase at least by 10% of the previous yield for several years, though the yield is influenced by fertility degree of the field where rice is grown.

The control measures of the weeds and red rice and the rice grown from the seed dropped in the previous cropping season that becomes a serious trouble for popular rice production increase in Cuba are possible by the combination of row seeding or regular planting with manual rotary weeder.

The weed, red rice and the rice grown from the seed dropped at the previous cropping season can be controlled well by manual rotary weeder combined with the regular planting. However, when rice plants are planted as row seeding, it is necessary to control them in the inter-hill space by manpower, although those in the furrow can be controlled by the manual rotary weeder.

Since the red rice and the rice grown from the seed dropped at the previous cropping season have the same spacing as rice, it is difficult to control them by herbicides at the rice is grown. The growth of red rice and the rice grown from the seed dropped at the previous cropping season depend on the management of the paddy field. The only method to suppress the germination of them is that the paddy field should be kept in flood condition immediately after puddling and leveling.

It is necessary to avoid row seeding when popular rice is produced in the field where red rice and rice grown from the seed dropped at the previous cropping season are prevalent and the regular planting should be introduced their paddy field.



Variety: ICACuba 31 (Dry season: 120 days、Rainy season: days)、Nursery period: 20 days

Fig. 5.2.2 Example of Cropping System to be Introduced

3) Production cost and benefit

The production cost of the plan was calculated based on the assumption that red rice and the rice grown from the seed dropped at the previous cropping season are not so prevalent as shown in the direct seeding field of the verification study.

The production cost and the benefit of the each cropping system are shown in Table 5.2.3.

Table 5.2.3 Production Cost and Income of Each Rice Cropping type

Rice cropping type		Assumed irrigation method	Assumed yield, wet paddy (t/ha)		Plan production cost		Gross income		Net income		
			Dry season cropping	Rainy season cropping	Dry season cropping	Rainy season cropping	Dry season cropping	Rainy season cropping	Dry season cropping	Rainy season cropping	Dryseason cropping + Rainy season cropping
						Present condition					
Type-1	Rondom planting	Ground water + pump		4,000		8,498		10,560		2,063	2,063
Type-2	Rondom planting	Ground water + pump	4,500	4,000	9,160	8,498	11,880	10,560	2,721	2,063	4,783
Type-3	Broadcast seedong	Ground water + pump	4,000	3,000	7,775	6,966	10,560	7,920	2,785	954	3,739
Type-4	Rondom planting	Surface water + Pump		4,000		8,498		10,560		2,063	2,063
Type-5	Broadcast seedong	Surface water + Pump		3,000		6,966		7,920		954	954
						Plan					
Type-1	Regular planting	Ground water + pump		5,500		10,208		14,520		4,312	4,312
Type-2	Regular planting	Ground water + pump	5,500	5,000	11,024	9,738	14,520	13,200	3,496	3,462	6,958
Type-3	Row seeding	Ground water + pump	5,000	4,500	9,451	8,222	13,200	11,880	3,750	3,659	7,408
Type-4	Regular planting	Surface water + Pump		5,000		10,046		13,200		3,154	3,154
Type-5	Row seeding	Surface water + Pump		4,500		8,773		11,880		3,107	3,107
						Increase or decrease (Plan - Present condition)					
Type-1				1,500		1,711		3,960		2,250	2,250
Type-2			1,000	1,000	1,865	1,241	2,640	2,640	776	1,400	2,175
Type-3			1,000	1,500	1,676	1,256	2,640	3,960	964	2,704	3,669
Type-4				1,000		1,549		2,640		1,092	1,092
Type-5				1,500		1,807		3,960		2,153	2,153

5.2.3 Improvement of Post-harvest

(1) Conditions for technical measures for post harvest

1) Forms of product by producers

Forms of product by popular rice producers vary depending on the circumstances of wet paddy, dry paddy and milled rice.

2) Scope of post harvest practices

Scope of post harvest generally involves a wide range of practices from reaping in a field until reaching the consumer. Post harvest practices by popular rice producers normally includes all practices such as reaping, threshing, paddy drying, cleaning, paddy storage, husking, milling, milled rice storage, selling, but sometimes the practices after drying are consigned to others like CAI when its facility is accessible.

Special processes such as parboiling, brown rice production, rice flour making, at the stage of distribution are out of the scope of Popular Rice producers.

3) Tools and equipment for post harvest practices

Post harvest practices for Popular Rice slightly vary depending on areas and producers in the study area, but include hand reaping by a sickle or harvesting by a combine-harvester, threshing by Maccogil, sun-drying (partly mechanical drying), milling by Engelberg are predominant tools and equipment. Combine-harvesters are normally superannuated, and Maccogil and Engelberg are normally old type and home-built.

4) Scale of practices

Popular rice producers assume post harvest practices under small-medium scale (less than several hundreds tons) depending on farming scale. The future production increase of Popular Rice has possibilities to rely on large-scale milling process by an enterprise such as CAI, after the popular rice producers deliver their products.

5) Post harvest losses

It is said that large quantitative and qualitative losses are generated during post harvest practices, but no survey on loss assessment has been conducted yet. The verification study involves some loss survey data.

(2) Improvement of post harvest technology

1) Direction of technology improvement

The directions of technology improvements are:

- To indicate the appropriate technology to popular rice producers with different level of technology.
- The recommended improvements shall be acceptable, sustainable and extended among popular rice producers.
- The technology improvements are based on the current marketing conditions.

2) Items of improvement for each practice

a. Reaping

Appropriate timing for reaping is quite important to prevent shattering and generating cracked grains. The efficiency of large-scale combine-harvester is low in a small field, but producers appreciate the simultaneous processes of reaping and threshing because it avoids worry about thresher rental and rainfall after reaping. The following phased options assume the condition that the producers require to upgrade their working efficiency at lower costs.

Step	Present	Description
Present 1	Hand reaping by sickle	No bundling, no field drying.
Present 2	Large combine harvester, reel type	Low cleaning efficiency because of reaping and threshing continuously. Low working efficiency in a small plot.

⇩

Step	Conditions	Improvement
Option 1	For transplanted field	Improved sickle for transplanted rice
Option 2	Row transplanting, well drained fields, and procurement of equipment	Walking type reaper, clipper type
Option 3	Equipment procured	Small combine harvester, reel type
Option 3	Bottom cutting and uniform panicles, row transplanting, well drained fields and procurement of equipment	Riding type combine, clipper type, panicle threshing

Final mechanization of reaping and threshing may be directed to a small combine-harvester or a riding type combine with clipper for reaping and threshing panicles (Japanese type).

b. Threshing

Threshing machines are more adaptable, because the big Maccogil type threshers, which are being used presently, have less efficiency. Improved IRRI type threshers are planned to be introduced and made locally. Japanese type of panicle ear threshers have high power efficiency, but they require the bottom cutting and uniformity of ear height. On the other hand, it is necessary to further elaborate the reason why producers have no custom of field drying of paddy between reaping and threshing. Raw straw or dry straw is a key point for improving the threshing efficiency.

Step	Present	Description
Present 1	Dashing down	Manpower
Present 2	Maccogil type thresher, throw in type	Low power efficiency due to large size of the machine
Present 3	Large combine harvester, reel type	Low cleaning efficiency because of continuous reaping and threshing. Low working efficiency in a small plot.

⇩

Step	Conditions	Improvement
Option 1	Middle/high reaping, field drying after reaping, procurement of equipment	Improved IRRI thresher, axial flow type
Option 2	Row transplanted, well drained, bottom cutting and uniform panicles, procurement of equipment.	Riding type thresher, panicle ear threshing type

c. Drying and cleaning

Field drying is recommended after loss assessment even if it is not presently implemented, because field drying is expected to considerably solve the drying problem. At the same time the construction of improved drying yards can be useful for finishing drying process. Alternative fuel for mechanical dryer is required because of current shortage of fuel. Possibility of normal

air for mechanical drying is based on the study of relative humidity. The difficulty of drying in rainy season harvest causes deterioration of rice quality.

Cleaning process during paddy drying is recommended because paddy with a moisture content of less than 17~18% can be cleaned by a winnower and sieves.

Step	Present	Description
Present 1	Sun drying on roof	Low cost, but dangerous and limited space
Present 2	Sun drying on road	Low cost, but impurities are mixed, dangerous and traffic hindrance
Present 3	Partly consigned mechanical drying	A few available facilities, far away, and shortage of fuel

Step	Conditions	Improvement
Option 1	Preliminary drying (MC17~18%), less shattering, no rainfall	Field drying after reaping (2~3days)
Option 2	Sheet, concrete floor and equipment procured	Improved sun drying and cleaning
Option 3	Require low relative humidity, equipment procured	Box type dryer with normal air ventilation
Option 4	Alternative source of fuel, power source procured	Box type dryer, heated air by electricity/ biomass
Option 5	Fuel, equipment, power source procured	Box type dryer, heated air by fuel combustion
Option 6	Fuel, equipment, power source procured	Circulation type dryer, heated air by fuel combustion

d. Rice milling

Engelberg type is presently the main milling machine for popular rice used for self-consumption. The following measures are taken to improve broken rice ratio and recovery.

1) Set of additional Engelberg is used with an existing machine to separate husking and milling.
2) Introduction of an improved prototype of Engelberg solves the performance fluctuations among machines that are normally homemade.
3) The combination of rubber roller husker and Engelberg shares the functions of husking and milling. Domestic production of rubber roller still is not available.
4) Milling technology for self-consumption finally uses an integrated equipment, consisting of cleaner, rubber roller husker, paddy separator, milling machine, broken rice separator, 0.5-1.0 MT capacity/hour on paddy rice.

Step	Improvement	Description
Present 1	Engelberg, 1 set	Husking and milling by 1 machine (one-pass)
Present 2	Engelberg, 2 sets	Husking by 1st machine, milling by 2nd machine (2-passes)

Step	Conditions	Improvement
Option 1	Prototype and drawings procured	Improved Engelberg type, prototype
Option 2	Combination of existing Engelberg, equipment procured	Rubber roller husker
Option 3	Separation of husking and milling process, equipment procured	Improved sieves
Option 4	Equipment procured	Solid type husking and milling machine, one-pass
Option 5	Broken rice separation, incentive to improve recovery and broken rice, equipment procured	Integrated milling equipment, 0.5-1.0t/hr, length separator included

(3) Improvement of marketing at the field level

It is considered that in the future much more rice will be circulating in the market compared with the present situation. A fixed consumption ratio per capita is also considered. Farmers should not

sell rice for self-consumption once and buy it back later.

Producer	Present (Production 270,000 ton in 2003)	Future (Surplus is increased by production
For self consumption	・ Producers need milling practice.	・ Producers need milling practice.
For marketing surplus	・ Producers/production units sell wet or dry paddy, or milled rice. ・ Collection and processing by producers/ production units. ・ CAI/Popular Rice Unit collect and processing a part of Popular Rice.	・ Producers/production units sell wet paddy at a cooperative drying center. ・ Collection and processing of dry paddy by CAI/Popular Rice Unit.

(4) From individual to centralized collection/ processing

Marketing improvement at the field level means that reasonable post harvest practices are carried out by popular rice producers. Incorporation of small-scale production of popular rice and the economic rationality of centralized collection/ processing becomes an effective improvement. It means that there should be a rational separation of practices between production stage and marketing stage.

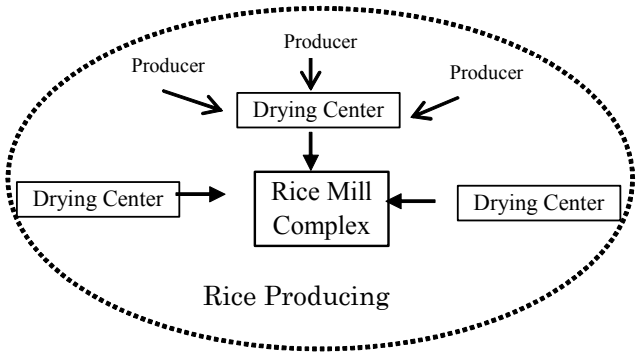


Fig. 5.2.3 Concentrating Treatment of Rice

Popular rice producers take the responsibility until preparing cleaned dry paddy; the tasks of dry paddy transportation and processing (reduction of processing cost and quality improvement) is taken care of in the marketing stage. Nowadays in some provinces, CAI operates centralized collection/ processing.

Fig. 5.2.3 illustrates the installation of a centralized processing complex in the center of a rice production area, with several drying centers, to which producers bring their paddy by themselves, as satellites surrounding it. Drying centers belong to production units such as CCS or any enterprises that renders drying service. CAI/Popular Rice Unit may operate a centralized rice milling complex.

5.2.4 Improvement of Agro-mechanization

In the agro-mechanization sector, considering the present economical conditions in Cuba, the technical improvement at field level should be studied avoiding the plan requiring foreign currency, and studying the possibility of introducing the new machineries and achieving sustainable technology.

The basic models to improve mechanization of agriculture are based on the strengths and weaknesses for development appearing in Chapter 4 and the following points.

(1) Improvement of agro-mechanization

1) Introduction of row seeding and transplanting

At present, many popular rice producers use broadcast seeding and transplanting without caring about rows. Since rice planting density is very high, it has problems of insufficient ripening and damages from insects and diseases caused by lack of sunshine and aeration. By improving hill

condition, the problem of high plant density can be solved. Thus, healthy rice crop will be possible and rice production will increase by growing a larger number of grains in each panicle and increasing the ripening yield. In addition, rice cultivation in rows will enable weed control by the use of machinery and without the use of herbicides.

Conditions	Technical measures
Transplanting is extended There is enough labor force Introducing of transplanting machine is difficult	Introduction of manual row transplanting Introducing of inter-tillage/weeding using manual weeder
Transplanting is extended Transplanting machine can be procured	Introduction of transplanting machine Introducing of inter-tillage/weeding using manual weeder
Direct seeding There is enough labor force Introducing small seeder is difficult	Manual row direct seeding Introducing of inter-tillage/weeding using manual weeder
Direct seeding Small seeder can be procured	Introducing manual or animal power small seeder Introducing of inter-tillage/weeding using manual weeder

2) Promoting the use of manual and animal power machines

As the amount of fuel allotted by the Government for popular rice is very small, and producers must buy it at high price in the free market (CUPET). Small popular rice producers, such as Parceleros or CCS members, can reduce the production cost and exploit the resources efficiently by using manual and animal power machines.

Conditions	Technical measures
Small scale Difficult to use tractor Difficult to obtain fuels	Promotion of manual and animal power machines
Demand of animal power machine is high Enough budget/staff of IIMA	Exploitation and extension of animal power machines by IIMA
Demand of animal power machine is high Improvement of machinery production system Improvement of marketing	Making and selling animal power machines in the workshops related to MINAG

3) Introduction of small machines

Most of the agro-machines, which have been used since many years ago for popular rice production, have been transferred from previous large state farms. These big machines are not suitable for popular rice plots, and they require a high amount of fuel. Therefore, these machines are not appropriate for popular rice cultivation. It is necessary to introduce small collective machines suitable for popular rice production scale and the use of animal power, to achieve high workability in the field and efficient use of fuel.

Conditions	Technical measures
Small or medium farm-scale New machine can be procured Fuels can be obtained	Introduction of small machines, such as walking tractor or 4WD tractor (about 25HP), combine and transplanting machine
Cooperative use system of machinery New machines can be procured Fuels and electricity can be obtained	Introduction of small machines for post harvesting, such as thresher, husker, polisher and dryer

(2) Improvement of the situation by using agricultural mechanization

The following countermeasures are suggested for regional level and it is necessary to improve the supporting environment for promoting use of agricultural machinery and sustainable technology.

1) Establishing of inventory system for mechanization

For the formulation of the mechanization plan in the future, it is necessary to establish an inventory of machines and workshops in each area. In the Study area, there is a rental system of mechanization among the agricultural organizations in each municipality. This rental system plays an important role in developing mechanization for popular rice production, under the difficult condition of machine supply, although some differences exist among the areas and organizations. To achieve a more efficient use of the rental system in the future, establishing the inventory of mechanization is quite important.

2) Improvement of the operation and maintenance system of agricultural mechanization

To improve the operation and maintenance system, it is necessary to establish an agro-mechanization center in each municipality. At present, there are workshops providing services for repairing the machines in each province and municipality of the study area. The activities carried out by these workshops contribute to extending the useful life of the machines. Among those, some workshops can be selected as the center of operation and maintenance of agro-machines in each municipality. The center would hold the machines for providing services to producers, the workshop for repairing and maintenance, and the specialized technicians. The center would cover the use of machines in the area, services for the producers requesting it, and repairing and maintenance of agro-machines in the municipality.

3) Securing of necessary machines

Considering the present economic condition in Cuba, it is very difficult to introduce new machines for individual producers. Most of the machines used at present are very old; therefore, introducing new technologies will be required in the near future. This renewal will be introduced and collectively used through the agro-mechanization center supported by the MINAG.

4) Securing of fuel

At present, the majority of popular rice is produced without contract. In this case, producers cannot secure the fuel through MINAG's assignation, and they must buy it in the free market in dollars. The price of diesel in the free market is very high and its accessibility is difficult. Diesel assigned to the producers is not enough to cover the needs of popular rice production. In addition, it is necessary to organize the fuels and lubricants supplied by the MINAG, in return for a certain amount of agricultural products sold in every municipality.

5.2.5 Improvement of Irrigation and Drainage

(1) Improvement of water management in the field

The improvement of water management in the field consists of two aspects: (a) to contribute to improve farming practice through enabling adequate water management in the field, and (b) to increase efficiency of irrigation water use so as to reduce water consumption, which will contribute to reduce cost as well, and to increase available water for cultivating rice.

1) Water management for improving farming practice

The basic concept for water management to improve farming practices is the following:

- To realize uniform ponding in the field to achieve uniform growth of crop and to enable

effective weed control.

- To enable accurate control of ponding depth in plot to prepare optimum moisture condition to crop corresponding to its growth.
- To enable water control such as release and re-supply of ponding water at the adequate moment during cultivation period.
- To facilitate water control by shortening necessary time for release and re-supply of ponding water.

To achieve the above targets, the following activities are required at the field level.

- Land leveling
- Improvement of shape of plot and improvement of dyke and levee
- Preparation of irrigation and drainage facilities in and around the plot such as distribution system connected to each plot, improvement of field drainage, and preparing simple watergates at intake and outlet of plot, which enable water management by plot.

In addition, to realize the improvement of water management in the field, it is necessary to prepare the circumstance for irrigation and drainage in the area which will enable several activities in the field as well as to improve farming practice of producers in the field regarding water management.

Land leveling is considered as the most basic item to improve the condition of water management in the field, and the possible achievement of land leveling varies by producers because accurate land leveling requires adequate machinery and fuel and these are difficult to obtain for some producers of popular rice. Thus, the level of introduced water management and related facilities should be defined by the expected level of land leveling.

Conditions	Water management
Accurate land leveling is expected	Introduce terminal facilities of irrigation and drainage for ponding water depth control corresponding to crop growth
Configuration is remained	Introduce terminal facilities of irrigation and drainage which are necessary to enable adequate release and re-supply of ponding water.

2) Water management practice in the field

a. Water management for popular rice in flooding conditions

In the germination stage, irrigation water is of vital importance for seeds. After seeding, it is necessary to irrigate with enough water and at short intervals. In case of transplanting, suitable land leveling is required so that water level above the height of the rice plant at some parts of the field can be avoided.

During the tillering stage, flooding condition depends on the height of the rice plants. On the other hand, flooding period should be 25 days after germination for sowing in the dry season, 20 days after the germination for sowing in March – April, and 15 days after germination for sowing from May. In this stage, it is recommended to dry up the field temporarily. This technique consists of canceling the water supply in the paddy field until the soil becomes dry and to keep this condition of water stress in the soil during 7 to 10 days depending on water level in the field.

From the maximum tillering stage, until 50% of the panicle formation it is suggested to flood

the paddy field, and the water level will be adjusted considering the topography and leveling conditions, for the efficient harvesting.

b. Water management in the upland

The cultivation of the rice in upland depends on the precipitation during the whole cycle. The upland rice demands an approximate average of 200 mm of rainfall per month and the frequency of the rain is as important as the quantity of rain. For that reason, it is necessary to know the pattern of rains in each region for selecting the most appropriate time for seeding. It is also very important to apply organic matter and/or green manure to retain more quantity of the soil moisture, as well as to construct small dikes for retaining water from the rain. It is also required to introduce drought resistant varieties with high efficiency for the use of the nutrients. On the other hand, it is vital to know that, during the growing period of the rice, the most susceptible periods to the lack of water are: the germination stage, 20 to 25 days before the panicle formation, and at 5 to 15 days after initial panicle formation.

3) Water management for improving efficiency of water use

Saving water through improving efficiency of water use in the field is expected to expand irrigation area by reducing irrigation cost and generating extra water resources. The basic concept of the water management for improving efficiency of water use is:

- To increase efficiency of water use through adequate water management in the field.
- To reduce water loss in the field by reducing water leakage and percolation.

These concepts are realized by the following activities in the field.

- To reduce wasteful discharge of irrigation water caused by spillway irrigation practice by introducing simple water gate at inlet and outlet of plot.
- To enable water control of plot by preparing distribution channel system connected to each plot
- To avoid excessive deep ponding through improving land leveling of plot
- To reduce horizontal percolation by improving shape of dyke and levee and introducing levee coating practice.
- To reduce vertical percolation by introducing adequate puddling practice.
- To introduce irrigation practice contributing to increase water use efficiency such as intermittent irrigation and circulating irrigation method.

Major targets of improving water efficiency are different due to the situation of irrigation. Some typical situations and their major targets are shown below.

Irrigation conditions	Major targets of improving water efficiency
Individual (private) irrigation by pump	The major target is placed to reduce water use and reduce fuel consumption.
Individual or small group irrigation relying on unstable water resources such as small river, drainage and small pond	The major target of this case is placed to realize effective and efficient use of limited and unstable water resource.
Beneficiary of large scale irrigation system	The major target will be placed on contributing to generate extra water resources by reducing water use in the existing beneficiary area.

(2) Improvement of irrigation and drainage in the system

Besides the improvement of the water management practice in the field, the irrigation and drainage system is to be improved in the system. The objectives of the improvement of the system are placed on: (a) saving water in the system, which will generate extra water resources, and (b) providing the circumstance for producers to introduce adequate water management in the field.

1) Effective use of existing water resources (Yaguajay Municipality, etc.)

In Yaguajay Municipality, many irrigation users rely on unstable and insufficient surface water resources of small rivers or small ponds. Since it is difficult to develop new water resources with a large facility, effective use of the existing water resource is a major objective.

- To confirm availability of existing water resources such as groundwater or spring water.
- To rehabilitate water resources and irrigation system which are superannuated or degraded.
- To improve efficiency of water use in both system and field.
- To strengthen the function of users group from the following aspects:
  - To strengthen maintenance work of irrigation canal by users so as to reduce conveyance loss in the system.
  - To strengthen coordination of water use in drought season and to introduce circulating irrigation system.

2) Increase of efficiency of the existing irrigation system

a. Large scale irrigation system (Liberación de Florencia Irrigation System, Chambas Municipality, etc.)

- By increasing efficiency of water use, it is expected to save water and to expand irrigation area.
- To reduce water consumption by improving water management practice in the field.
- To reduce wasteful discharge in the system by introducing effective coordination within water users and between users and suppliers.

b. Communal irrigation system of CCS

- To reduce conveyance loss by rehabilitation or adequate maintenance work of irrigation canal.
- To reduce peak of water demand by introducing circulating irrigation system, in case when there is a limitation of capacity of irrigation system.
- To improve efficiency of pump equipment by:
  - Repairing or replacement of superannuated equipment
  - Integration of pump system
  - Electrification of pump
- To strengthen operation and maintenance of the system by strengthening users organization.

c. Individual and small group pump irrigation (Santo Domingo Municipality, etc.)

- To reduce water consumption by improving water management in the field.
- To increase efficiency by repair and replacement of superannuated equipment.

- To increase efficiency of the system by integration of pump and irrigation facilities.
- To reduce irrigation cost by pump electrification.

d. Prestamos (Vertientes Municipality,etc.)

- To secure water supply to paddy field of Prestamos through improving the irrigation system of CAI/UBPC by reducing conveyance loss, reducing wasteful discharge, and securing water distribution.
- To strengthen maintenance of secondary and terminal irrigation canal by users.
- To prepare a circumstance so that Prestamos shall have the intention to invest for maintaining and improving irrigation and drainage facilities by themselves, by fixing renting land, extend the renting contract, supply irrigation water stability, etc.

e. Parceleros

Because of their small farming scale, the communal use including group work of maintaining and improving irrigation and drainage facilities is important for Parceleros in particular. Thus, it is necessary to organize group of Parceleros to promote group work and joint investment of irrigation facilities.

3) Electrification of pump

Electrification of pump is the most effective measure to reduce irrigation cost in the area using pump irrigation. Because it will take high initial cost to introduce electrification in general, it is necessary to promote pump electrification for the area which has an advantage in saving initial investment. The priority of electrification will be given to the following areas:

- Rehabilitation of existing electrified pump which is necessary to be repaired or renovated due to superannuated equipment.
- The area possible to use transmission line and transformer for other facilities such as existing pump system.
- The area close to existing power transmission line and easy to install electricity to the field.

In the case that the paddy field of producers group is concentrated and have water resources with enough capacity:

- To integrate individual pumps of private or small group producers and to develop communal irrigation system, to reduce the initial, running and maintenance cost of facility.
- To develop canal system of the communal irrigation system by full use of existing canals as much as possible to avoid big investment.
- To introduce circulating irrigation, which can reduce the size or scale of the canal system.
- Strengthening users organization for water management and maintenance work of the system.

In the case that paddy field of concerning producers are scattered by small clusters or the water resource has a limitation in the capacity:

- Electrification of pump by private or small group producers individually.
- To consider use of pump by combination of target crops including rice, vegetables, tobacco, viandas, etc.

4) Increase of operation and maintenance capacity by strengthening water users' organization

In order to improve the operation and maintenance of irrigation and drainage facility, the activity of water users is important in large scale irrigation system as well as communal system. The expected roles of water users organization are:

- Integration and development collective irrigation and drainage system
- Participation to operation and maintaining of the system
- Consultation and coordination of water use in the system, within users and with water management organization

5) Others

- Measures for paddy fields suffering problems of salt damage
- Improvement of paddy fields with drainage problems

5.2.6 Improvement of Extension Activities

Main problems of extension activities at the field level are the lack of manpower, lack of transportation, insufficient extension to individual producers, insufficient textbooks concerning popular rice production and no sharing of the information concerning the extension.

(1) Improvement of lack of manpower

At present there is only one extension officer in each municipality covering extension activities for popular rice. As these officers are quite busy organizing information concerning popular rice production and buying popular rice including non-specialized contract, they cannot provide enough extension activities. Each Province has a plan to increase the number of extension officers up to 3 to 5 for each municipality and intends to use extension officers only for extension activities. Technical measures for extension activities at field level are considered as shown below.

Condition:	Measure
Enough budget and human resources	Increasing the number of extension officers
Lack of human resources	Strengthening of human resources
Lack of budget	Effective use of multimedia (radio, etc.)

(2) Improvement of transportation void conditions

In addition to insufficient number of vehicles, difficulty for getting fuels is also one of serious problems of transportation for extension activities. Therefore, using transportation without using fuels (such as bicycles) is considered as an alternative.

Condition:	Measure
Enough budget, procurement	Use of bicycles

(3) Improvement of extension concerning individual producers

It is impossible to carry out extension activities targeting thousands of individual producers irrespective of manpower and transportation. Organizing the producers and carrying out extension activities for each organization is a basic countermeasures for this problem. There is no problem for present producer organizations (UBPC, CPA, and CCS). For Parceleros, this will be solved by organizing new CCS, which consists of parceleros and is establishing. For Prestamos, it is

necessary to consider organizing them and carrying out extension activities.

Condition:	Measure
Improvement of system of Prestamos	Extension system for each organization

(4) Improvement of texts for popular rice production techniques

There are many variations of popular rice production techniques based on land conditions and management form; hence it is necessary to consider different technical measures for different conditions. Since it is impossible for extension officers to know well about all techniques concerning every condition, texts (manuals) showing comprehensive rice production techniques will be required. With such texts, extension officers can discuss specific rice production techniques based on each condition of producers, and producers can try combinations of techniques by themselves. In this sense, the easy access system to IIArroz for producers (or extension officers) will be also required.

Condition:	Measure
Improvement of budget and communication system	Preparation and distribution of texts (manuals) on comprehensive production techniques

(5) Sharing of information

At present, information concerning extension is not unified. An extension officers know very well the information of his municipality, but he does not have any idea for the areas outside of his municipality. Furthermore, it is difficult to collect information at municipal level for provincial level extension officers and this situation is one of the constraints for systematic coordinated extension activities. Under the present conditions, it is quite difficult for an extension officer to even make one copy of only one sheet; thus, establishment of a system for sharing information is required.

Condition:	Measure
Improvement of budget and communication system	Establishment of information sharing system

(6) Other measures

In addition to measures mentioned above, the following activities also will be considered for promotion of extension of popular rice production techniques.

- Encouraging leaders for popular rice producers who take the lead in improvement of popular rice production in the area
- Establishing demonstration farm using the paddy field of leaders for producers
- Coordination of extension activities and institutes concerned
- Others

5.2.7 Improvement of Supporting System

Improvement plan at national level will be required in order to achieve the improvement of popular rice production at the field level.

- Strengthening of seed supply system
- Supporting system for fertilizers (chemicals, organics, biological)
- Strengthening of IIArroz and its branches
  IIArroz and its branches have quite important roles for popular rice such as basic development

of popular rice, seed supply, etc. It is necessary to strengthen the activities of these institutes.

- Strengthening of popular rice units
  Popular rice units will take main roles of action plan such as extension of production techniques for popular rice, buying and selling for stabilizing the marketing price of popular rice, coordination of producers and governmental institutions, etc. It is necessary to strengthen the function of popular rice units.
- Others
  To increase popular rice production, improvement of governmental service concerned, improvement of post harvesting and marketing system, land rental system, etc. are required.

5.2.8 Strengthening of Certified Seed Supply System

In 2003, the amount of certified seed II used for popular rice is estimated as more or less 3,000 ton/year and the demand of seed for popular rice is estimated as approximately 11,000 ton/year. As the demand of seed for popular rice in 2015 is also estimated as 16,000 ton/year, it is necessary to strengthen the seed supply system.

The Certified Seed Production System in Cuba has been functioning according to the needs of the specialized rice production. Popular rice producers use non-certified seeds and sometimes they get the certified seeds from the varieties produced by Rice CAI, which in general are not so suitable for popular rice production.

Seed categories in Cuba are shown below:

1. Original seed
2. Basic seed
3. Registered seed
4. Certified seed I
5. Certified seed II

The Seed Production System established for rice cultivation (Fig.5.2.4) covers the production of basic seed only in the headquarters of IIArroz, while basic seed is produced by IIArroz itself and also by the experimental stations located in the provinces of Sancti Spiritus, Camaguey and Granma. Registered seed and certified seed I are produced by two farms belonging to IIArroz that are located in Havana. The farms for seed production located in the Rice CAI produce Certified seed II.

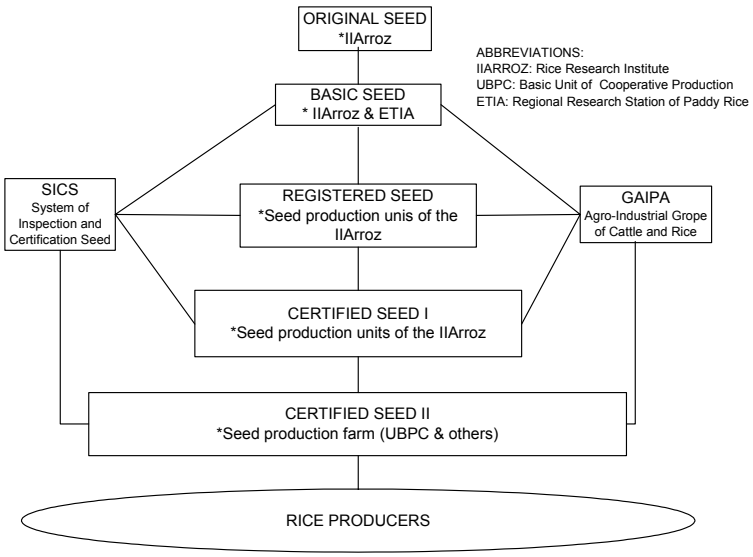


Fig 5.2.4 Present System of Seed Production in Cuba

Considering that popular rice production is increasing annually and that popular rice areas are mainly cultivated using non-certified seed, it is necessary to establish a new system for certified seed production to cover the demand of popular rice producers. Fig.5.2.5 shows the proposal for a new system of certified seed production aiming to cover the needs of both specialized rice and popular rice. To formulating this syste, participation of concerned institutions is expected, i.e., IIArroz, ETIAs, seed producution farms, Rice Experimental Station in Los Palacios, the System of Inspection and Certification of Seeds (SICS) at both provincial and municipal level, the National Group of Popular Rice (belonging to GAIPA) and the Provincial Units of Popular Rice.

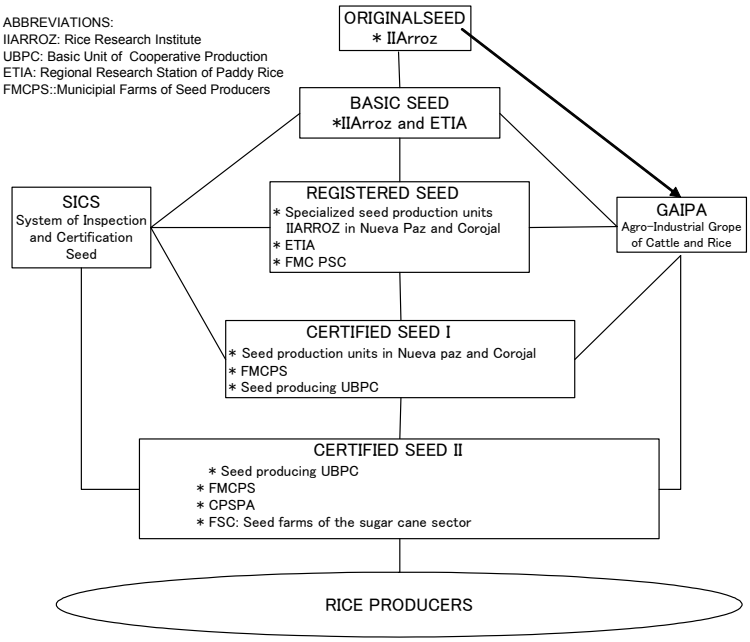


Fig. 5.2.5 Idea of Seed Production System

Specialized rice	GAIPA's projection concerning specialized rice is to achieve progressively the cultivation of 5,900 cab (approximately 80000 ha). For this purpose, considering that the sowing density shall be 120 kg of seed/ha by direct seeding in the whole area, it is necessary to use 9600 tons of seed.
Popular rice	Approximately 161,000 ha were cultivated in 2003 and it is expected that the area shall increase up to 250,000 ha in 2015. Considering that the transplanting technique was carried out on 46% of the area in 2003, it is expected that in 2015 transplanting will be used on 60% of the area. Seed requirements for both sowing technologies are as follows: Direct seeding: If direct seeding will be used on 40% of the area, then its equivalent is 100,000 ha. Considering that sowing density will be same as that of specialized rice (120 kg of seed /ha), it is necessary to use approximately 12,000 tons of seed. Transplanting: If transplanting will be used on 60% of the area, then its equivalent is 150,000 ha. Considering that sowing density will be 15 kg of seed/ ha in the seedbeds, it is necessary to use approximately 3,750 tons of seed.

Taking into account of the needs of both specialized rice and popular rice in 2015, the necessary amount of certified seed II is approximately 25,500 tons. In order to cover above demand of certified seed II, it is necessary to produce each year the following amount of other categories:

1. Certified seed I 1,300 tons
2. Registered seed 65 tons
3. Basic seed 26 tons
4. Original seed 2,100 kg

The projection for 2015 should be to produce approximately 26,000 tons of seeds of different categories. Based on these conditions the strengthening plan will be studied.

5.2.9 Marketing System for Popular Rice

Popular rice producers consume the majority of their production for their own consumption, thus only the surplus circulates in the market. Market mechanism forms current prices in the free-markets for

popular rice in a company of some influence of top-price in the state-markets. But the sales volume in free markets is only a part of the total quantity of consumption. While, the market prices evaluate rice quality on some level, but it doesn't reflect grading standards. The establishment of rice standards is a future task for the government.

It is necessary to set the market price by an evaluation on the basis of rice grading standards in future. For the implementation of this, the establishment of grading standards and market information system are required.

Rice grading standards are essential for fair trading for rice producers, traders and consumers. This means that the rice standard is somehow a kind of target of quality improvement by producers, and rice quality should be assured when the consumers want to get rice at the markets, which is a form of consumer protection.

Even considering the importance of this issue, the marketing system for popular rice will not be examined to propose concrete countermeasures or improvement plan in the Study, because the marketing system is closely related to the national policy and such problems are to be solved as a whole system at the national level and not by individual technology.

5.3 Necessity and Purpose of Verification Study

In order to achieve the increase of popular rice production, it is necessary to realize the technical improvement in each step of rice production. It is indispensable to confirm the propriety and adoptability of suggested technical improvement prior to examining the future development plan. Hence, the verification study has been implemented to verify the level of actual implementation of the improvement technologies and methodologies in the field of cultivation, post-harvest, extension and supporting system, etc. Since it might be quite difficult to include all suggested technical improvements due to limited period and input of the Study, the technical improvement concerning the present constraints directly and ones expected to have significant impact and to be accepted by producers are selected and applied to the Verification Study. The results of the Verification Study will be used as a technical background in the formulation of the Development Plan. The effect of spreading improvement technology by demonstration function at the verification site is also expected as a major impact of the Verification Study. In addition, the experience of the Verification Study is expected to contribute to accelerate the similar study implemented by Cuban side in the future.

5.4 Contents of Verification Study

The Verification Study consists of two components: one is the strengthening of activity of IIArroz which aims to contribute to the improvement of supporting system for popular rice production; the other is the Verification Study in the Field which aims to verify and modify the suggested technical improvement of popular rice production. The strengthening of IIArroz will focus on improving the seed production technique of IIArroz, in order to contribute to the improvement of the seed supply system. In the Verification Study in the Field, the suggested technical improvement will be combined into a package of farming practice and it will be applied in the field with participation of producers. The impact, adoptability and acceptability of the technical measures will be verified through the Study.

5.4.1 Outline of Strengthening of IIArroz

The verification study of the Strengthening of IIArroz focuses on the improvement of seed production techniques, productivity and quality, by implementing several mechanized activities, such as

transplanting, harvest and drying, which are carried out manually at present, and by improving seed drying and grading process and strengthening function of evaluation and quality control. Necessary equipment is procured in the verification study as well as improving the irrigation and drainage system at the paddy fields for breeder and basic seed production.

(1) Target of Verification Study in IIArroz

The target of the verification study in IIArroz is set to contribute to increase of popular rice production through improvement of original and basic seed production techniques of IIArroz.

(2) Expected Impact

This Verification Study should have the following impacts:

- To increase the number of varieties in basic seed production, from present 2 to 4 varieties each year.
- To increase the amount of basic seed production from 2.0 to 3.5 tons per variety.
- To increase the seed quality by obtaining a higher germination capacity.
- To reduce the manual works of the researchers in transplanting and seed harvest.
- To develop work conditions and abilities to increase the productivity in the seed areas (around 10 ha) by developing the infrastructure of irrigation and drainage.

(3) Activities of Verification Study in IIArroz

1) Improvement of workability and productivity by improving infrastructure of the seed area

- Maintenance of the irrigation system in the seed areas of around 10 ha (repairing damaged valves, pipes and pimp).
- Maintenance of the drainage system in the seed areas of around 10 ha, including the collecting channel, secondary channels and buried drainage in the plots.

2) Improvement of cultivation technique of seed production by introducing field machinery

- Improvement of soil preparation.
- Selection the sowing season according to the characteristics of the varieties.
- Transplanting using the new technology. (Introducing motor type transplanter. Experimental introduction of manual type transplanter.)
- Irrigation management including water stress during the tillering stage.
- Plant protection by applying insecticides and fungicides.
- Seed harvesting using small reaper and thresher. .

3) Improvement of seed quality by introducing seed grader and mechanical dryer

- Seed drying by mechanical dryers suitable for seed production.
- Appropriate seed cleaning and grading.
- Seed conservation in bins.
- Seed analysis in the laboratory.

5.4.2 Outline of Verification Study at the Field

(1) Objectives and selection of verification activities

The objective of verification study at the field is verifying of impacts of improvement of farming practice suggested in the development plan, as well as contributing to technical extension through demonstrating activities in the verification field.

The verification sites from the Mayajigua Area of Yaguajay Municipality and from the Mabuya Area of Chambas Municipality have been selected. In addition, a site from El Rio Area of Yaguajay Municipality has been adopted as a supplementary data collection.

Table 5.4.1 Selected Sites for Verification Study in the Field

Province / Municipality	Site	Producer	Organization	Water resources	Remarks
Sancti Spiritus / Yaguajay	Mayajigua Site	Ruben Cuadrado	CCSF Frank Pais	Surface water (small river) Individual system by gravity	Verification of farming practice with direct seeding technology
	El Rio Site	Irenio Perez	CCSF Savino Hernandez	Surface water (Jatibonico del Norte River) Individual system by pump	Supplementary data collection for verification of farming practice with transplant technology
Ciego de Avila / Chambas	Mabuya Site	Pastor Gonzalez	CCSF Maximo Gomez	Surface water (Jatibonico del Norte River) Communal system by pump	Verification of farming practice with transplant technology

The applied verification theme of each site is outlined as shown below. The verification on cultivation technique was conducted in three sites and the verification on post harvest technology was conducted at the Yaguajay-Mayajigua site which represents above three sites.

Table 5.4.2 Outline of Verification Study in Each Site

Site	Farming Practice			Post Harvest
	Verification Plot		Control Plot	
Mayajigua Site – Yaguajay Municipality	Cropping system with row seeding with drum seeder in combination with suggested countermeasures		Cropping system in traditional patter with broadcast seeding	Verification on post harvest technology
El Rio Site – Yaguajay Municipality	Cropping system with regular transplanting in combination with suggested countermeasures	Cropping system with random transplanting in combination with suggested countermeasures	Cropping system in traditional patter with random transplanting	
Mabuya Site – Chambas Municipality				

The verification study at the field will consists of the following verification items:

(2) Verification study on production techniques

- Technique for weed control with agronomic management (Technique using cultural soil preparation of dry puddling, technique using hand weeder in regular transplanting or row seeding, and technique using field ponding.)
- Technique to improve the physical and chemical properties of the paddy field soil. (Technique for the production and application of earthworm compost by the producers, technology by using of air-drying effect on mineralization of organic nitrogen and phosphorus, and

technique to incorporate clipped straw into the soil.)

- Technique to increase the quality of germination and crop stand. (Application of certified seeds, technique for seed selection through gravity method.)
- Technique to control pests through the use of biopesticide. (Technique using biopreparations of Metharizium and Bacillus which are produced by CREE.)

(3) Verification study on reaping and post harvesting

- Evaluation of harvesting/post-harvesting loss
- Paddy threshing (Adaptability of axial flow type thresher)
- Paddy drying (Sheet sun drying, adaptability of box-type dryer)
- Rice milling (Effects of rubber-roller husker)

(4) Verification study on irrigation management

- Improvement of water management at the field
- Improvement of irrigation and drainage system
- Collection of data of actual water use at the field in popular rice production

(5) Verification study on agricultural machinery

- Use of small machinery in the field
- Operation and maintenance of small machinery

(6) Verification study on group works

- Collective management and use of agricultural machinery
- Collective management and use of post harvest equipment
- Collective production of organic fertilizer
- Introduction of collective farm works

(7) Verification study on extension activities

- Preparation of a technical manual for popular rice production
- Study tour

5.5 Results and Lessons from the Verification Study

5.5.1 Strengthening of IIArroz

(1) Results of strengthening of IIArroz

The improvement of the infrastructure of seed area was conducted from March 2005 to November 2005 as follows:

- The pipeline system including 1,246 m of pipelines and valves in the plots No. 13 ~ No.16, which was for seed production for popular rice, was replaced.
- Dredging and reshaping of drainage canals, that was 3,340 m in total including the collecting, preliminary and secondary drainage of above seed area.

The field machinery listed below was introduced and delivered to IIArroz on April 2005.

- Riding type tractor, 4 wheel drive, diesel engine 25HP, Including tractor implements of paddy wheel, rotary tiller and bottom plow.

- Side delivery type reaper, walking type, binding function, reaping by 2 rows.
- Self propelled thresher.
- Walking type rice transplanter, 2 wheels, Number of rows planted at a time: 4.

Seed grading machine, mechanical dryer and equipment for seed laboratory listed below were introduced and delivered to IIArroz on November 2005.

- Circulation Dryer for Grain, with batch capacity 1 ton
- Gravity Separator for Seed, with capacity 50~100 kg/hr
- Sieve Grader for Seed, with capacity 50~100 kg/hr
- Equipment for laboratory testing

Due to delay of completion of the construction work of the infrastructure, the verification of the field activity with introduced field machinery in the IIArroz was carried out using existing paddy field. The seed production in the improved paddy field was started as a crop in the dry season and transplanting was conducted on December 2005. Because the cultivation in the improved field is still in progress, the effect of increased of variety and production of seed will be continued to be monitored in the regular activity of IIArroz. The verification on improvement of seed quality by introducing seed grader and mechanical dryer will also continued to be monitored in the regular activity of IIArroz due to delay of delivery of necessary equipment.

(2) Improvement of workability and productivity by improving infrastructure of the seed area

Irrigation and drainage system of around 10 ha of paddy field for seed production was improved and so it becomes possible to apply them an appropriate water management in the field for the necessary time. By securing the paddy field with appropriate water management in the field for seed production, the quality of seed is expected to be improved and the quantity of seed production is expected to increase. In addition, the improvement of water management enables introduction of mechanized farming as proposed in the verification study and it is expected to improve the workability and productivity in the field. The rotational use of seed area in 3 year cycle will contribute to improve quality of seed through preventing variety mixing in the field. The improved seed area will be in-service from the crop in the dry season of 2005-2006 and it is expected that the target of IIArroz, that is to increase the number of basic seed production to 4 varieties and the amount of production to 3.5 tons in each variety, will be realized.

(3) Improvement of activity of seed production by introducing agricultural machinery

1) Rice transplanter

A tractor with rotary tiller introduced in the verification study was used for land preparation works in the paddy field such as plowing, leveling and puddling. It is noted that land leveling was enabled at a high level, which was indispensable to introduce rice transplanter, due to new machinery system. Rice planter is expected to increase efficiency of field work of seed production; however, it is necessary to consider introduction of adequate land preparation work by appropriate mechanized farming integrally.

2) Small tractor and rotary tiller

In comparison with large tractor which had been used for field work in the IIArroz, advantages to enable plowing and puddling suitable for small plot, to enable to reduce fuel consumption, etc.

were confirmed. Above all, puddling by small tractor with rotary tiller has a remarkable positive effect to improve land leveling and it is considered indispensable for introducing rice transplanter.

3) Side delivery type reaper and self propelled thresher

Introducing mechanized harvesting and threshing process using reaper and self propelled thresher is able to significantly reduce workload of harvesting work which was carried out by hand. It is also a recognized advantage of workability that introduced small machinery was suitable to small plot of IIArroz rather than large scale combined harvester. Because the verification study was conducted in the field where drainage system was not developed, some problems on quality and workability of harvesting were observed due to inadequate drainage condition of the paddy field. It is considered that the strengthening drainage function of the field by improvement of drainage system is indispensable to introduce mechanized harvesting and threshing process using reaper and self-propelled thresher.

4) Operation and maintenance of machinery of IIArroz

The introduced machinery was operated and maintained by IIArroz satisfactorily without any serious trouble or problem. It was confirmed that operator and staff of workshop had the necessary skill and knowledge to use the machinery. Necessary consumables such as fuel, lubricant, etc. were prepared by IIArroz as planned except for one particular lubricant. Because it is expected that some of spare parts are difficult to obtain in Cuba, it is recommended to consider procurement of spare parts necessary for operation and maintenance after this study.

(4) Improvement of seed quality by introducing seed grader and mechanical dryer

1) Circulation dryer

Seed grains used to be dried by sun drying in the open space due to superannuation and malfunction of existing dryer of IIArroz. Owing to renewing of mechanical dryer with circulation type dryer, it is expected to increase quality of seed through applying appropriate moisture control of seed, reducing drying unevenness, reducing variety mixing, etc. In addition, it is expected to contribute to reduce workload of researchers and staff of IIArroz.

2) Seed grader

Due to superannuation and malfunction of existing seed grader, it used to be difficult to apply adequate seed grading and to meet problems of impurities and unevenness of quality. Introduced equipment for seed grader is expected to contribute to improve quality, stability and uniformity of seed.

(5) Experimental introduction of manual type rice transplanter

Manual type rice transplanter is expected to contribute to expansion of transplanting technology because labor-saving is possible without fuel. Also, it is possible to expand regular transplanting technology by using machinery while random transplanting is still major even in the area transplanting is popular. Even though the above merits and advantages are recognized, there are several problems to be solved to expand widely manual type rice planter into producers such as: mechanical improvement and organizing mass-production, development of guideline and orientation procedure of preparation of nursery, and introduction of improvement of farming practice including land leveling. IIArroz and IIMA are expected to solve these problems.

5.5.2 Verification Study at the Field

(1) Verification study on production technique

1) Results of the cultivation of rice

The preparation activity for the verification study began in December, 2004. The verification study was carried out in two cropping seasons: that is, dry season cropping of 2004-2005 and rainy season cropping of 2005.

Since precipitation in this dry season was a little more than a normal year, the verification study was not able to be executed well. Because, the shortage of irrigation water caused a delay at sowing time, suppression of the growth resulted, as well as the loss of chance to control the weed by the maintenance of flood condition in the paddy field at Mayajigua. The sowing time was delayed but the irrigation water was sufficient to grow the rice well at El Río, Yaguajay.

The yield of the verification study is shown below.

Table 5.5.1 Yield of Verification Study

	Treatment	Yield (dry paddy[1)], t/ha)
Dry season cropping	Broadcast seeding (Traditional technology)	2.78
	Row seeding with drum seeder (Improved manuring practice)	4.53
Rainy season cropping	Broadcast seeding (Traditional technology)	3.70
	Row seeding with drum seeder (Improved manuring practice)	4.91
Dry season cropping	Random planting (Traditional technology)	6.36
	Random planting (Improved manuring practice)	5.69
	Regular planting (Improved manuring practice)	6.89
Rainy season cropping	Random planting (Traditional technology)	4.82
	Random planting (Improved manuring practice)	4.94
	Regular planting (Improved manuring practice)	4.93

Note: 1) Dry paddy of 14% moisture

The results of the Verification Study show that the yield of the improved manuring practice exceeds the one of the traditional technology. It points out that it is possible to achieve higher yield than present one by the proposed improvement of planting pattern and cultivation technique which is possible to introduce with accessible inputs for popular rice producers instead of herbicide, urea, agricultural chemicals, etc which are difficult to obtain.

2) Technique for weed control with agronomic management

a. Weed control at the time of paddy field preparation (puddling and leveling after plowing at day field)

This technology has been widely recognized as a good method to control red rice and rice grown from the seed dropped at the previous cropping season and has already been introduced by the farmer where the verification study was carrying out. When the popular rice producer introduces this technology, he can easily plow or make the puddling and leveling by animal power or to save the fuel of the tractor for plowing, puddling and leveling at their paddy field,

because the paddy field is flooded once after plowing.

Although the operation of this technology is influenced by the cost of the fuel and the start of the rainy season, the possibility of the technology to be accepted widely is high, because this is effective technology on farming practices for the popular rice producers.

b. Weed control technology by using the manual rotary weeder combined with regular planting or row seeding

It was shown that the manual rotary weeder was extremely effective to decrease the labor and the working hours of weeding for the farmer who adopted the regular planting or row seeding. For the producer who adopted the regular planting, he used the rotary weeder in two ways: in the furrow and in the interhill space after recognizing the effect of the manual rotary weeder. When the rice plants were planted as row seeding, it was necessary to control the weeds in the interhill space by manpower, although the weed, red rice and rice grown from the seed dropped at the previous cropping season in the furrow can be controlled by the manual rotary weeder. However, the labor for weeding by manpower can reduced, because it is possible to control the weed easily by entering between furrows. For these reasons, the use of manual rotary weeder is the technology which has a high possibility to be accepted by the popular rice producers.

On the other hand, the selection of the planting pattern (i.e. regular planting or row seeding) by the popular rice producers will be judged from whether the sales price of the rice will exceed the production cost by the regular planting and guarantee the profit to the popular rice producer or not. The transplanting culture has been established as the technology to control the weed, red rice and rice grown from the seed dropped at the previous cropping season and to obtain enough profit for the popular rice producers, even if the cost for preparation of nursery which is indispensable to transplanting culture, for pulling of rice seedling and for rice transplanting, are high. In addition, this technology is accepted by the popular rice producers and has a high possibility to take root among them because the transplanting culture, which is easy to control weed by rotary weeder, can decrease the labor and the cost for weeding. The row seeding is much influenced by the leveling degree of the paddy field, differing from the transplanting culture which transplants the seedlings during mid grown. The introduction of the row seeding of rice plant is limited to the field where the leveling degree of the paddy field is good, because the income would decrease caused by missing hills by low germination at the puddle.

c. Weed control technology by the maintenance of flooding condition at paddy field

This is a technology that suppresses the generation of the upland weeds, red rice and the rice grown from the seed dropped at the previous cropping season by maintaining the flooding condition through the growth period. This technology has already been accepted widely by the popular rice producers in combination with the transplanting culture, because it is difficult to obtain herbicide.

3) The technology for fertilizer application

a. Earthworm manure manufacturing and application technology

Earthworm manure can be produced by using earthworms that don't need expensive production facilities. Earthworm manure scatters easily, because it is dried to 1/10 of the weight of raw material of cattle feces and shows the effect of fertilizer of phosphorus and potassium in addition to nitrogen for a long period compared with chemical fertilizers. The study tour participants who received the explanation on the earthworm manure and had seen effect of the earthworm manure on the rice growth at paddy field of the verification study showed strong interest in this technology. The production of the earthworm manure has already started by some farmers in the surrounding area. As for using the earthworm manure, the possibility to be accepted widely is high even though the production of earthworm manure by the production center or by the each popular rice producer is depend on the regional circumstances.

b. The technology by using of air-drying effect on mineralization of organic nitrogen and phosphorus

Since the air-drying effect cannot appear if the paddy field does not dry at maximum tiller number stage, this technology can only apply to well-drained paddy field. The farmers who had admitted the effect of mineralization of organo-mineral complex supplied by the earthworm manure showed the intention to execute this technology continuously. The possibility to be accepted widely by the popular rice producers is high in the field where irrigation and drainage can be facilitated.

c. The rice straw incorporating technology

The Cuban government prohibits the incineration of rice straw and is encouraging the incorporation of rice straw now. The cutting machine made in Japan combined with the reaper made in Japan was popular, because the cutting machine made it possible to scatter the straw chip on the paddy field uniformly while moving. However, it was pointed out that the procurement of the machine and the cost of the fuel were problems to introducing the cutting machine. The development of the cheap cutting machine that can be connected with the tractor which has been used by the popular rice producers is indispensable to gain acceptance.

4) The technologies for germination rate improvement and establishment of good stand

a. Use of certificated seeds

Popular rice producers have been concerned about the use of certificated seed because the yield can be increased due to pest and disease resistances. Moreover, there is an advantage to prevent mixing it with other varieties and red rice, when the certificated seeds are used. The maintenance of the supply the certificated seed supply system is indispensable because this technology is accepted easily by the popular rice producers.

b. Seed selection technology by specific gravity

Since the certificated seeds produced by the seed producing farmers and the seeds by home seed-raising are selected, the amount of seeds can be reduced and the good establishment of seedlings can be expected. This technology is using syrup which the farmer can obtain easily

and has a high possibility to be accepted by the farmers.

5) The pest control technology by biopesticide

This technology has been recognized recently as an alternative to replace chemical pesticides which are difficult to get.

It is necessary to make sure whether the application of biopesticide as a precautionary measure, in the region where the generation of the harmful insect pest are few, will be accepted or not. Agricultural extension activities are important to introduce biopesticide to the popular rice producers.

(2) Verification study on harvest and post-harvest

1) Investigate the influence on post-harvest practices and losses on the fields of direct sowing and transplanting

- Lack of combine-harvester, thresher, manpower result in the loss increase at reaping due to missing optimum time of reaping.
- Panicle threshing easily leaves un-threshed panicles due to un-equal stem length and irregular panicles though high efficiency of power, selection and sorting.
- The economical way to develop the most appropriate thresher will be to choose the most appropriate specifications among threshers disseminated in South East Asia.

2) To establish the drying method for individual producers in rain season

- Lack of sun-drying sheets though it is the most adaptable and acceptable for popular rice. And no any prominent technical issues.
- Mechanical drying should be minimally utilized only for the emergency case because fuel is hard to obtain and costly.

3) To provide rice producers with the cleaning method

- Threshing just after reaping causes low efficiency of cleaning. It is necessary to disseminate hand-winnowers among producers so that they can clean paddy after drying.

4) To introduce the technology for increasing milling recovery (yield) by custom mill

- Regulations is necessary for the in-series operation of 2 sets of Engleberg machine which has surplus in terms of quantity and capacity.
- Technology of rubber-roll husker and rolls should be introduced for domestic production because they expect to afford huge amount of benefits.

(3) Verification study on irrigation management

1) Improvement of water management in the field

Producers understand the importance of careful water management in the field from the aspect of sufficient cultivation technique and they have positive intention to introduce it. They are expected to introduce adequate water management in the field based on the conditions of the field, such as condition of irrigation and drainage system . The water used in the field using gravity irrigation system relying on small surface water resources is strongly affected by the rainfall condition especially in the dry season. In order to use the limited water resources effectively, it is necessary

to prepare reserved pump system for emergency even in the gravity system. Improvement of water management in the field is expected to contribute to growth of crop and weed management.

Irrigation and drainage system in the field which enable adequate water management for producers is expected to contribute to reduce water loss in the field. Because producers using pump system are well aware of the need for water saving, which contributes to fuel saving directly, they are considered to have high possibility to introduce irrigation with efficient water use in combination with technical instruction of improving cultivation technique. Even though concrete data or information on reduction of water loss in the field could not obtained in the verification study, there is possibility to reduce water loss in the field by improving canal structure, introduction of puddling and improving plot shape.

2) Improvement of irrigation system

Securing water supply is indispensable to realize adequate water management in the field. However, it is impossible to realize it without large investment in the case of irrigation system relying on small surface water. In such area relying unstable water resources, it is necessary to consider improving conditions by improving efficiency of water use or adjusting cultivation period, not by large scale construction work. In addition, preparation of small pump by producers as reserved equipment might be effective to cope with drought to some degree.

Adjustment of water use between water users is comparatively easy to conduct by producers in the case of neighborhood water users located together. Especially in the case of users within a CCS, usual communication of producers facilitates adjustment such as introduction of circulating irrigation. On the other hand, voluntary adjustment between remote groups by themselves is difficult to expect and the intervention of local INRH and extension officer is indispensable. Strengthening of water users organization from the aspect of water use adjustment shall be considered in two basic policies: one is encouraging and strengthening water users relationship based on CCS or neighboring group the other is strengthening intervention by public organization such as INRH for adjustment between remote groups. Local INRH and extension office have an important role for promoting, encouraging and strengthening such activities in both cases.

3) Obtaining information of actual water use in the field of popular rice

Practice of water use in the production of popular rice, such as type of water resource, form of water access, level of water management, varies widely by producers. It is necessary to continue effort to obtain data on water use by producers in order to grasp actual water use and realize rational water use.

(4) Verification study on agricultural machinery

1) Use of small machinery in the field

a. Power Tiller

The power tiller has been used to do several jobs related to cultivation techniques, such as transportation of the cultivation materials with a towing truck, land preparation and puddling of the soil using the bottom plow or rotary tiller, etc. Among the field jobs, the advantages of the power tiller have been confirmed such as obtaining a higher work yield in a small scale field as well as its low fuel consumption when compared to the use of big tractors. Especially when it is

being used for soil puddling activities, an improvement has been observed in the efficiency of breaking down the soil, as well as for land leveling, furthermore these field jobs were done without damaging the bottom of the soil due to the light weight of the power tiller, if we compare it with the use of tractors and animals. Additionally, the yield and the job quality of future crops were improved. On the other hand, when it is used for bottom plowing, it was observed that the yield decreases because the tires slip and it is difficult to do a good job in hard clay soils. The power tiller is a valuable machinery, therefore its introduction will be a topic of future research.

b. Drum Seeder

With the use of the drum seeder, it is possible to sow more efficiently and with fewer personnel. When using the row seeding technique, weed control is easier and more efficiently because it is done in a mechanized way after the sowing. The IRRI drum seeder is transported with floaters that slide over the paddy field; that is why the traction is easier compared with the seeder with wheels. The floaters make it possible to keep the drums in a stable position from the rice field, and it also improves the quality of sowing. However, in order to use this machine leveling the rice field after puddling is very important, as well as draining well the field. If there is water left in the rice field, when the seeds are sown, the seeds will move around with the water and the quality of the drills will be lower. The drum seeder is an essential machinery for the introduction of drill seeding, for the intermediate crop and for mechanized weed control.

c. Manual Rotary Weeder

With the use of the IRRI manual rotary weeder, weed control becomes mechanized and easily done, avoiding the use of herbicides. The yield and job quality of the machine have been accepted by the producers. However, the IRRI type is made of steel, except for the beam; therefore, it is heavy and extended use of it in the rice field is very tiresome. Therefore, it is convenient to research the use of different materials such as wood or bamboo and review the structure in order to reduce the weight. The manual rotary weeder is an essential machinery for the introduction of the drilling technique, for the intermediate cropping and for mechanized weed control.

d. Manual Sprayer

The manual sprayer has been used to apply biological products. It is a common machine with simple structure and there were no problems when it was used.

e. Mechanical Binder

The use of the mechanical binder improves the job yield during harvest, if compared with the manual type. The job is easily done if it is done carefully and improves the quality when compared with the big harvester combine. The loss of grains during harvest has decreased a lot with the use of the mechanical binder. The mechanical binder is a very valuable machinery and the introduction of the adequate harvester for small scale production of popular rice will be a topic for further research.

f. Thresher

In this study, the thresher of axial flux with gasoline engine IRRI type was introduced. The machinery is designed to be transported by four people, that is why there were several opinions in the difficulty of transporting it. On the other hand, presently in most of Cuba, rice harvest and

threshing are done when the rice is not dry enough, therefore the rice has high contents of humidity as well as the straw causing it to gets stuck in the drum of the machinery, reducing the yield in the threshing. To reduce this loss, it is important to dry the rice in the field before it is going to be threshed. The introduction of a smaller harvester, as well as an adequate thresher for small scale production of popular rice will be a topic for further research.

g Rice Straw Chopper

The straw chopper has been used to cut the rice straw after harvest and threshing. This has caught many people's attention because of the high efficiency of the straw mower and the capacity for spreading it in the field. The rice straw was piled up at the same distance, and at each end the mowing and spreading will be done using the machinery. The machinery moves with a small gasoline engine; however it is necessary to further research the use of PTO of the tractor or a diesel engine as an alternative. The straw chopper is an essential machinery to return green manure into the soil, when it incorporates harvest residues into the soil.

2) Operation and maintenance of the small machinery

In general, the operation and maintenance of the small machinery introduced in this study have been done adequately and without problems. The person in charge of the machinery and the operator had experience in the operation and maintenance of the equipment from CCS and was confirmed that they have enough experience to work with the small machinery. In this study, the supply of fuel, lubricants and spare parts of the machinery were in charge of the Study Team, however in the future since some spare parts will be difficult to be obtained in Cuba, it is important to study the procurement method after finishing the study.

(5) Verification study on group works

1) Collective management and use of agricultural machinery

Collective management and use of agricultural machinery has relatively higher feasibility to be sustainably promoted among farmers. The primary reasons of the relatively well performance in Yaguajay are good performance of the owner of the verification site, who works as a keeper of the machines, and adequate control by administrative unit of the CCS. As long as the both key factors are secured, with a person in charge of machine management in the field and administrative unit of CCS, collective management of machinery itself is quite feasible. In addition, the long experience that CCS had operated existing machinery is considered to favor high sustainability in this matter.

2) Collective management and use of post harvest equipment

Collective management and use of post harvest equipment also applies the same assumptions basically as the collective machine use in the field. However, there are some unique points regarding collective use of post harvest equipment. The post harvest equipment entails more commercial opportunities than agricultural machinery abovementioned. The users of the equipment can easily expand to outside of their own CCS. Hence, CCS needs to establish well-considered operation plan and rules, which should include how to take countermeasures during the lower demand season of rice.

3) Collective farm works

Collective farm works are quite difficult to be accepted by farmers. Tradition of payment-based labor work has existed in the area for a long time. Farmers and laborers have a fixed long-time relationship, and moreover, many CCS recently began establishing their own labor groups. Thus, it is quite difficult for collective farm works to be promoted.

As for the production of earthworm manure, it is concluded difficult to be accepted; however, individual production by each farmer has a high possibility of acceptance judging from the strong motivation that farmers have shown.

(6) Verification study on extension activity

It is evaluated that study tour is a very effective method as extension activities, considering the results of the tours. The basic principle of the tour, which tried to transfer information from farmers to farmers, not lecturers to farmers on as many occasions as possible, contributed to better results.

Motorbike and mobile phones for extension officers are also confirmed to be very effective for their extension works, but at the same time they raised difficult questions as to whether the effectiveness exceeded the necessary cost, particularly for mobile phones. The verification study results showed positive effectiveness on introduction of motorbike, but neutral or negative on mobile phones.

CHAPTER 6 DEVELOPMENT PLAN

CHAPTER 6: DEVELOPMENT PLAN

6.1 Importance of the Development Plan for Sustainable Technologies in the Rice Production

In order to achieve improvement on the sustainable production of Popular Rice in the five districts in the central area of Cuba, activities related to production should be carried out. Furthermore, in order to support the increase of national rice production, effective execution over an extensive area is necessary. However, taking into consideration that the capital and inputs are limited for production, this should be carried out gradually.

First, it is necessary to elaborate a development plan for the sustainable production of Popular Rice in the selected areas. This plan is a combination of the actual production plan for Popular Rice and the activity plan from related organizations supporting these activities.The knowledge obtained through the verification study can be used effectively for the preparation of the development plan. Presently, the Cuban government is carrying out several policies to improve the percentage of self-sufficiency in basic grains and to reduce the amount of imported rice. Therefore, it is expected that the preparation of the development plan will support the national policies.

6.2 Goal and Basic Policies for the Development Plan

6.2.1 Goal of Development Plan

(1) Main goal

GAIPA has been verifying the production plan for Popular Rice, as well as the production goal for the districts, keeping land productivity in mind. Although a new plan was prepared in December 2004.

Hence, the obtained data refers to the required certified seeds for the production of Popular Rice. The demand for certified seeds in 2015 was calculated at approximately 25,500 tons for a total of 330,000 hectares, of which 250,000 hectares function as the cultivation area for Popular Rice and 80,000 hectares are for specialized rice.

(2) Target year

Because a 10-year target is appropriate, 2015 has been set as the long term target year, and 2010 has been set as the medium target year, with 5 years are appropriate to carry out concrete independent activities.

(3) The area object of the plan

The area object of the Development Plan covers the 5 central provinces in the Republic of Cuba; one municipality has been selected in each of these provinces for the implementation of the Development Plan. The following are the provinces and municipalities: Cienfuegos (Aguada de Pasajeros), Villa Clara (Santo Domingo), Sancti Spíritus (Yaguajay), Ciego de Ávila (Chambas) and Camagüey (Vertientes).

(4) Object target

The main target of the Development Plan will be the small and medium scale popular rice producers, mainly members of CCS, préstamos and parceleros, as well as the persons interested in and organizations related to promoting popular rice production.

6.2.2 Basic Policy for the Development Plan

In order to overcome the current restricting factors for the production of Popular Rice, it is necessary to combine improvement of the existing techniques as well as introduction of more effective ones. One single rice production technique or a combination of them (and definitively the latter) can produce effective results. In other words, when a combination or package of techniques is applied at the productive level (field) and at the related organizational levels (production support), it is then possible to increase the production of Popular Rice.

Based on this, the following items have been established as the basic policies for the development plan.

Basic Policy 1: Improvement of the Producer Techniques

1) Improvement of rice cultivation techniques
2) Improvement of the post harvest techniques
3) Application of agricultural machinery
4) Improvement of water management

Basic Policy 2: Improvement of the Production Environment

1) Support for the improvement of rice cultivation techniques
2) Support for the improvement of post harvest techniques
3) Support for the application of agricultural machinery
4) Support for the improvement of water management

Basic Policy 3: Improving the Extension Activities

1) Strengthening of training activities
2) Support for the input (materials) of the extension officer
3) Support for transportation

Basic Policy 4: Strengthening of Related Organizations

1) Strengthening of extension techniques
2) Strengthening of the supply system for certified seeds
3) Strengthening of technical development

6.3 Strategy to Implement Basic Policies for the Development Plan

6.3.1 Basic Concepts

The development plan will be executed by farming activities at district level for Basic Policy 1: Improvement of the Producer's Techniques, Basic Policy 2: Improvement of the Production Environment, and Basic Policy 3: Improving the Extension Activities. The activities for Basic Policy 4: Strengthening of Related Organizations will be carried out by the related organizations at the national level.

6.3.2 Methodology to Reach the Goal

The following table shows a concrete activities that will be carried out as basic policies.

Table 6.3.1 Activities for Realizing Basic Policies

	Technical Improvement in the Field/Producer Level	Development of Circumstance of Popular Rice Production
Improvement of Farming Practice	・ The control of weeds by the agronomic management ・ Incorporation of organic matter into the paddy field ・ The improvement of germination and seedling growth by selection of seeds and the use of certificated seeds ・ Introduction of the direct seeding in drill and the transplant in drill system ・ The use of biological insecticide	・ Establishment of supply system of earthworm manure and fermented animal excrement from animal husbandry units to rice cultivation units ・ Establishment of social supply system of trained labors for rice transplanting
Improvement of post harvest	Reaping ・ Appropriate timing for reaping ・ Upgrading working efficiency at lower cost. Threshing ・ Adequate scale and type of threshing machine Drying and cleaning ・ Introduction of field drying ・ construction of improved drying yard ・ Alternative fuel for mechanical dryer ・ Improvement of cleaning process Rice milling ・ to separate husking and milling. ・ Introduction of an improved prototype of Engelberg	・ Improvement of marketing at the field level ・ From individual to centralized collection/ processing
Improvement of Agro-mechanization	・ Introduction of row seeding and transplanting ・ Promoting the use of manual and animal power machines ・ Introduction of small machines	・ Establishing of inventory system for mechanization ・ Improvement of the operation and maintenance system of agricultural mechanization ・ Securing of necessary machines ・ Securing of fuel
Improvement of Irrigation and Drainage	Improvement of water management in the field level ・ Water management for improving farming practice ・ Water management practice in the field ・ Water management for improving efficiency of water use	Improvement of irrigation and drainage in the system level ・ Effective use of existing water resources ・ Increase of efficiency of the existing irrigation system ・ Electrification of pump ・ Increase of operation and maintenance capacity by strengthening water users organization ・ Others (addressing problems of salt damage, drainage problem) ・
Improvement of extension activities		・ Improvement number of laborers ・ Improvement of conditions of lack of transportation ・ Improvement of extension concerning individual producers ・ Improvement concerning the text for popular rice production techniques ・ Sharing of information ・ Others (Demonstration farm, Encourage of leader for popular rice producers, Coordination of extension activities and institutes concerned)
Improvement of supporting system		・ Strengthening of seed supply system ・ Supporting system for fertilizers (chemicals, organics, biological) ・ Strengthening of IIArroz and branches ・ Strengthening of popular rice unit ・ Others (improvement of governmental service concerned, improvement of post harvesting and marketing system, land rental system, etc.)

6.4 Contents of the Development Plan

6.4.1 Action Plans as Components of the Development Plan

The concrete activities to carry out the basic policies of the Development Plan must be implemented by adapting them to the characteristics of the selected municipalities, including environmental, social and economical aspects. Moreover, not only the independent countermeasures will be important, but also the supplemental countermeasures to assure the implementation of the independent measures. Therefore, municipalities must be analyzed from the viewpoint of the constraints and potentials for the improvement of popular rice, as well as the revision of the improved techniques and the setting of the development plans. It is necessary to include the requests and comments of the local people in the action plans. The action plan of the concerned organizations supporting the action plans at municipal level will be established.

For that reason, it has been decided that the development plan will be carried out jointly with the action plan at municipal level and the action plan of the related organizations at the national level.

(1) Action plan at district level

- It will be carried out as activities based on the characteristics of the selected districts.
- It will be carried out as a package for the improvement of rice production through a combination of techniques related to rice production (cultivation of rice, post harvest, agricultural machines, water management, support for production techniques, extension activities, etc.) and the characteristics of the selected districts where this package will be applied.

(2) Action plan for related organizations

- Carry out training programs for the extension personnel and the leaders among the producers.
- Establish a system of production and distribution of certified seed for popular rice
- Strengthen the activities of IIArroz.

The two action plans above are a package, and the main activities were verified and confirmed through the verification study.

6.4.2 Action Plan at Municipal Level

In order to achieve the development goal by the target year (2015), action plans for the municipalities will be established by defining the roles of the producers, the MINAG, IIArroz, the provinces, universities and other related organizations. The action plan will be established for each municipality; however, since the action plan will take a long period to complete, it is necessary to revise the action plans periodically during several years and to correct them according to external conditions. Therefore, it is recommended to revise the action plan of the Study in 2010, considering the necessary period to achieve the effect of the technical measures and extension activities.

6.4.3 Action Plan for Related Organizations

To establish improvement of farming techniques and introduction of the new technologies, there has to be development of the capacity of extension personnel and of producers who are leaders as well as the execution of more efficient activities. Thus, a program for training and increasing capacity will be established where the target will be extension personnel and producers who are leaders. Furthermore,

it is necessary to guarantee the improvement of Popular Rice productivity, establishing a distribution system for certified seeds and insuring the activities at the field level. For this reason, the preparation and execution of a program for the distribution of certified seeds will be planned. Likewise, it will be possible to duplicate similar activities for the verification study in other areas. For this, it is indispensable to continue technical development adjusting it to the characteristics of the production area, and to support the activities of IIArroz (including the ETIAs).

CHAPTER 7 ACTION PLAN

CHAPTER 7: ACTION PLAN

7.1 Global Consideration for the Development Plan and the Action Plan

In order to carry out the sustainable production of popular rice, action plans at municipality level will be carried out in each site together with established improved techniques. In the action plans at municipality level, the practical improvement of the existing techniques will be carried out, as well as for new techniques without imposing any large expenditure. Through the monitoring of cultivation techniques and production activities related to popular rice in the selected municipalities, it is possible to consider an efficient and complete implementation of the Development Plan in the future. Furthermore, the effect of the demonstration will be expected with the implementation of the Verification Study and interest from local producers is expected to increase.

On the other hand, for the implementation of the action plan at the municipality level, it is necessary to carry out the action plan for the organizations that are supporting cultivation and post-harvest activities of popular rice producers. Also, regarding techniques which are basically related to production, efficiency could be increased at municipality level by prioritizing the action plan of the organizations.

Although the action plan at the municipality level and the action plan of the organizations will be implemented by different bodies, it is expected that IIA and GAIPA of MINAG will be in charge of the overall arrangements. It is also important that the activities of the organizations and the necessary arrangements are considered when the Action Plans and the sources of input are implemented.

7.2 Action Plan at Municipality Level

7.2.1 Selection of Priority Municipality

The following municipalities were selected to carry out action plans as a priority within the five provinces of the central area in Cuba.

Province of Cienfuegos: Municipality of Aguada de Pasajeros, Province of Villa Clara: Municipality of Santo Domingo, Province of Sancti Spíritus: Municipality of Yaguajay, Province of Ciego de Ávila: Municipality of Chambas, Province of Camagüey: Municipality of Vertientes

7.2.2 Characteristics of the Selected Municipalities

The characteristics of the five selected municipalities for the production of Popular Rice are as follows:

The area cultivated with popular rice out of the total municipal area is approximately 40% in Aguada de Pasajeros, Yaguajay and Vertientes, and in other areas it is less than 25% as in Santo Domingo and Chambas. Regarding the yield, Aguada de Pasajeros, Santo Domingo and Chambas have about 4 ton/ha, while Yaguajay and Vertientes have less than 3.5 ton/ha. Santo Domingo has a high percentage (70%) of double cropping, but Aguada de Pasajeros and Chambas have less than 50%. Furthermore, Yaguajay and Vertientes have a very low percentage, 16% and 6%, respectively. The percentage of transplant is quite high (90%) in Aguada de Pasajeros and Santo Domingo, the opposite of Yaguajay (31%) and Chambas (24%) which are both quite low using this technique; in Vertientes transplanting was not carried out. Certified seed is used extensively (80%~90%) in Vertientes, while in Chambas only 40%, and in Aguada de Pasajeros 10~30%. In Santo Domingo and Yaguajay certified seed is not being used.

Regarding the type of agricultural management for popular rice, CCS cover almost half (49%) of the cultivation area in Aguada de Pasajeros. In Santo Domingo, Parceleros (60%) and CCS (20%) cover 80% of the total. In Yaguajay, CCS cover 35% and Parceleros 21%, after CCS. In Chambas, there are various types of management where rice is cultivated, but in the distribution, there is not much difference among them. Empresa/GENT has the highest percentage (22%). In Vertientes, Prestamos have almost half (49%) of the cultivated area of popular rice followed by CCS with 33%; this accounts for about 80% in total.

Table 7.2.1 Characteristics of Popular Rice Production in the Five Municipalities (2003)

Rice Cultivation

	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Vertientes
Area of Municipality (ha)	4,178	8,662	6,744	6,910	15,990
Cultivation Area (ha)	2,979	3,427	3,445	2,416	6,307
Double cropping (%)	48	70	16	45	6
Net Area of Rice Field (ha) (% of Municipality Area)	2,013 (48%)	2,016 (23%)	2,970 (44%)	1,666 (24%)	5,950 (37%)
Production (t)	11,697	13,622	12,173	9,567	21,022
Yield(t/ha: White Rice)	3.9	4.0	3.5	4.0	3.3
Transplant (%)	95~97	90	31	24	0
Use of Certified Seed (%)	10~30	0	0	40	80~90

Type of Agricultural Management

	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Vertientes
Number of UBPC Net Area of Rice Field (ha)	14 125	20 62	24 443	30 396	4 80
Number of CPA Net Area of Rice Field (ha)	5 188	6 83	9 362	7 268	14 284
Number of Parcelero Net Area of Rice Field (ha)	110 141	3,460 1,120	736 647	310 391	211 25
Number of Prestamo Net Area of Rice Field (ha)	8 28	99 136	- -	25 329	240 2,697
Number of Emp. and GENT Net Area of Rice Field (ha)	2 141	6 99	3 548	8 524	5 551
Number of CCS Net Area of Rice Field (ha)	9 600	17 370	29 1,060	7 403	13 1,818
Total Area of Rice Field (ha)	1,223	1,870	3,060	2,311	5,455

7.2.3 Cultivation Type and Improvement of Rice Cultivation Techniques

(1) Cultivation type

Optimum farm management and necessary improvement of rice cultivation techniques were examined to meet the circumstances of producer such as the topographic condition of farmland, soil condition, available water resources, etc, and type of farm management that is used for agricultural machinery, available labor force, possibility of contract farming, etc. As a result, the following 5 integrated improvement models of rice cultivation, which are so called Cultivation Types, are proposed to realize sustainable popular rice production under the several limitations.

1) Rice in rainy season – Transplanting – Economic crop (Cultivation type for high benefit with secondary crop)
2) Double rice cropping – Transplanting (Cultivation type for high yield by double rice cropping)

3) Double rice cropping – Direct sowing (Cultivation type for low input with double rice cropping)
4) Rice in rainy season – Transplanting – Soil maintaining crop (Cultivation type for sustainable rice cropping)
5) Rice in rainy season – Direct sowing – Soil maintaining crop (Cultivation type for low input and sustainable rice cropping)

(2) Classification of farm management conditions for selecting suitable cultivation type

The conditions of farm management will be examined and classified, and then a cultivation type will be proposed as a model to cope with the conditions of producers. The following 3 major issues are used to classify the farm management conditions.

- Water use

When securing irrigation water in the dry season, the cost of pump operation shall be considered in case of pump irrigation, in addition to physical availability of water.

- Management scale and available labor force

Physical possibility of securing labor based on scale of rice cultivation area. In addition, the possibility of adding labor cost for transplanting is to be considered.

- Possibility of introducing economic crop as a secondary crop

When introducing economic crop as a secondary crop, the possibility of contract farming with support of agricultural inputs such as fuel, fertilizer and pesticide is a very important factor.

In addition, the following issues need to be considered to classify the conditions surrounding producers.

1) Rice cultivation technology

a. Number of cows (livestock excrement is used for the preparation of earthworm manure):

Plan for earthworm manure production: If earthworm manure is produced from cow excrement, it can be obtained earlier than if it is produced from crop and sugar cane residues and it has a good C/N ratio with a high nitrogen content.

b. Supply capacity of bio inputs:

Pest and disease control plan: The potential amount of bio input production by CREE (Centros Reproductores de Entomófagos y Entomopatógenos) in each municipality.

2) Post harvest technology

a. Adoption rate and method of utilization of the machines and equipment for post-harvest practices:

Compare the adoption rate of combine-harvester, thresher, dryer, rice milling machine for cultivation area (ha) and production (ton). Identify the difference of utilization method and technical level.

b. Related conditions to post-harvest

Collect and analyze the information of weather conditions in rainy season for sun-drying, involving CAI facilities in the Popular Rice process, milling fee (bran or cash) by custom mills, market and top price, market scale, etc.

3) Agricultural machinery

a. Spread of transplanting

In spreading transplanting, it is relatively easy to introduce it in rows. By realizing transplanting, it will become possible to introduce small size machines such as hand weeder, reaper and manual sprayer, etc.

b. Mechanization level of farming

When introducing new machines, it is important to identify the actual mechanization level of farm practice in the area. The necessary information should include not only quantitative data such as the number of machines by agricultural area but also the results of interviews to be carried out.

c. Farming area

When studying the introduction of small size machines, it is important to identify the average area of a region. For the working of tractors, reapers, etc., a target area shall be less than 1 ha, and in the case of larger areas, it is better to use tractors and combines.

4) Irrigation and water management

a. Use of irrigation

The ratio of actual use of irrigation to paddy area will be used as a general index of present irrigation use.

b. Typical resource of water

The type of water resource and type of water intake will characterize the availability of water use in municipality.

c. Characteristic use of the irrigation system

The style of irrigation system use (i.e., private/individual use of irrigation and communal irrigation system) will characterize the method of irrigation use in a municipality.

d. Use Conditions of water

The condition of security of irrigation water is determined by natural conditions and type of water source. Groundwater with pump system secures stable water supply even in the dry season; however, it requires fuel for pump operation. This means the availability of fuel restricts the availability of water.

5) Rural society (Group work)

a. Difference in the numbers of CCS and CCSF

The characteristic of CCSF and CCS is different in terms of possession of machinery.

CCSF has its own machinery as common property with operators; on the other hand, CCS do not. Looking at introduction of machinery in the action plan, CCSF has the advantage in operation of machinery owing to experienced operators, but CCS has to train some personnel to be operators or to find appropriate personnel outside of CCS. Santo Domingo and Yaguajay have both CCSF and CCS in their districts, but the other three districts only have CCSF.

b. Number of private farmers on popular rice (CCSF, CCS, Parcelero, Prestamo)

The number and type of farm management of popular rice producers in the area are to be considered in examining technical extension and group work.

(3) Proposed typical cultivation type by characteristics of priority municipalities

The cultivation types shall be selected and introduced by producers themselves in accordance with their conditions from the various viewpoints mentioned. Thus, cultivation types are proposed as a typical model for producers based on the major characteristics of municipality as shown below:

Table 7.2.2 Characteristics of Priority Municipalities and Recommended Typical Cultivation Type

	Aguada de Pasajeros	Santo Domingo	Yaguajay	Chambas	Veritientes
Typical water resources, its condition and availability	Shared stable water resource of groundwater/ spring water using small pump and rainfed paddy field. Double rice cropping is popular in irrigated paddy field. Average ratio of double rice cropping is almost half. Pump use is stable but fuel is difficult to obtain.	Groundwater, small surface water, and spring water using pump are predominant. Rice double cropping and rice and combination of secondary crop are commonly cultivated. Pump use is stable but fuel is difficult to obtain.	Gravity system from small stream occupies 83%. In addition, irrigation ratio is high, but the ratio of double rice cropping is low due to limitation of water in the dry season. Most of rivers have small catchment area and they have significantly unstable flow which is affected by rain conditions. Thus, it is difficult to obtain water in the dry season.	Gravity system from dam or river is 70% while pump use with groundwater or surface water is30%. Double rice cropping is popular where stable water resource such as dam or large river is available. On the other hand, double rice cropping is not popular with producers using pump due to high cost of fuel.	Dam, rivers – 70%, groundwater -30%. Most of individual producers belonging CCS rely on groundwater, while Prestamos usually use dam water of UBPC. Prestamos do not cultivate double rice cropping because they have lowest priority of water use in the dry season. Groundwater is stable but fuel cost is a burden to producers. Irrigation system of UBPC can provide stable water but sometimes they have maintenance problems .
Scale of farm and availability of labor	It is concluded that labor for transplanting is possible according to the farming scale, since the ratio of transplanting is 95%~97%. Transplanting is a popular technique in this area.	It is concluded that labor for transplanting is possible according to the farming scale, since the ratio of transplanting is 90%. Transplanting is popular technique in this area.	The ratio of transplanting of the municipality is 31% which is average. The availability of labor for transplanting depends on the condition of each farm's management.	The ratio of transplanting of the municipality is 24% which is average. The availability of labor for transplanting depends on the condition of each farm's management.	Due to the large scale of farming, it is difficult to obtain labor force and cost for transplanting in general. It is significant for large scale farming unit such as UBPC and Prestamos. The producers of CCS take a middle position, so that there is possibility to extend transplanting partly.
Possibility of introduction of economic crop		Contract farming of vegetables and root crops is widely conducted and crop rotation of them is expanding. There is high possibility to introduce contract farming of economic crops if producers are able to access markets and agricultural inputs.			
Recommended typical cultivation type	2) Double rice cropping – Transplanting 4) Rice in rainy season – Transplanting – Soil maintaining crop	2) Double rice cropping – Transplanting 1) Rice in rainy season – Transplanting – Economic crop	5) Rice in rainy season – Direct sowing – Soil maintaining crop 4) Rice in rainy season – Transplanting – Soil maintaining crop 3) Double rice cropping – Direct sowing 2) Double rice cropping – Transplanting	5) Rice in rainy season – Direct sowing – Soil maintaining crop 4) Rice in rainy season – Transplanting – Soil maintaining crop 3) Double rice cropping – Direct sowing 2) Double rice cropping – Transplanting	3) Double rice cropping – Direct sowing 5) Rice in rainy season – Direct sowing – Soil maintaining crop

(4) Cultivation type and technical package

Cultivation types shall be achieved by introducing combination of improvement of cultivation techniques, which is so called a technical package, not by individual techniques. The cultivation types proposed in the Development Plan consist of combination of techniques (technical packages) shown below.

Table 7.2.3 Cultivation Type and Technical Package

Proposed Technique	Rice in rainy season – Transplanting – Economic crop	Double rice cropping – Transplanting	Double rice cropping – Direct sowing	Rice in rainy season – Transplanting – Soil maintaining crop	Rice in rainy season – Direct sowing – Soil maintaining crop
Weed control by the agronomic management	O	O	O	O	O
Leveling of the paddy field by animal			O		O
Use of the Certificated seed	O	O	O	O	O
Seed selection by specific gravity	O	O	O	O	O
Planting pattern	Regular planting	Regular planting	Row seeding	Regular planting	Row seeding
Manual rotary weeder	Furrow and inter hill space	Furrow and inter hill space	Furrow space	Furrow and inter hill space	Furrow space
Hand weeding			O		
Weed control by maintenance of the flooding condition of the paddy field	O	O		O	
Application of the earthworm manure	O	O	O	O	O
The use of a biocide	O	O	O	O	O
Midseason drainage at maximum tiller number stage	O	O	O	O	O
Improvement of soil physics and chemistry and weed control by combination of secondary crop	O			O	O
Incorporation of the rice straw	O	O	O	O	O

7.2.4 Components of the Action Plan at Municipality Level and Expression of the Effects

The type of cultivation is part of the package for technical improvement, and it is selected according to the characteristics of the region and the conditions for agricultural improvement. In order to guarantee the introduction and determination of the type of cultivation in the field, the “Program for the Improvement of Sustainable Techniques for the Production of Rice” is being promoted at municipality level (to the producer/field level) as a total package of activities that include postharvest and extension activities. The organizations, under the initiative of MINAGR, should fulfill several projects to carry out this program. Although the types of cultivation to be recommended in each municipality are different; the projects to be fulfilled are similar. Also, if sustainability of the type of cultivation is taken into consideration, the projects become important by the training activities that allow people to develop more seriously rather than by the amount of material inputs.

The effect on determining the type of cultivation will cause an increase on the amount of Popular Rice production. The first 5 years, up to 2010, will give priority to the introduction and determination of the type of cultivation in the existing cultivation area. The following 5 years, up to 2015, will have a repercussion effect attributable to the promotion of the “Program for the Improvement of Sustainable Techniques for the Production of Rice”, and an approximate expansion of 30% of the existing cultivation surface of Popular Rice (2003) is presumed. Also, the rate of diffusion of transplanting

technique in the future is predicted by GAIPA at approximately 60%.

7.2.5 Project Profiles

(1) Improvement of cultivation techniques

1) Project for the creation of production and distribution units of earthworm compost for popular rice producers in the municipalities

To satisfy, in part, the shortage of fertilizers (nutrients) in the cultivation of Popular Rice by taking advantage of organic residues without affecting the environment.

2) Project to support production of biological pesticides in CREE of each municipality

Increase production of biological pesticides for the producers of Popular Rice.

3) Project for the production of small machinery and validation of demonstration areas for popular rice producers

Construction and distribution of drum seeders, hand weeders and straw cutters.

4) Project for the improvement of water management at field level

To support the introduction of improved cultivation techniques and to realize effective use of irrigation water through improved water management techniques in the field, focusing on the producers.

5) Project for the strengthening of water user's organization

To achieve rational use of irrigation water through an adequate operation and maintenance by water users and appropriate water use adjustment.

In the analysis of the weaknesses for Popular Rice production it was found that one of the main problems of Popular Rice producers is related to the lack of certified seeds, because the demand is higher than the production of seeds that is carried out for Specialized Rice. Taking into consideration that this problem should be approached from the level of the related organizations (GAIPA, IIArroz, etc.) all the way to the municipality, we have decided to present it in this report as one of the programs of the related organizations, including the activities at municipal level that will be elaborated as part of the action plan of the related organizations.

(2) Improvement of postharvest techniques

1) Pilot project for the interoperation of agricultural machinery and facilities by the group of popular rice producers

Productivity enhancement and quality improvement of paddy at field level by the producers' group. Also, upgrade the production efficiency by sharing the appropriate equipment and facilities. Furthermore, develop the pilot project by progressive utilization of the equipment for the verification study.

2) Project for the improvement of paddy drying system for popular rice producers

Establishment of a paddy drying system for popular rice producers

(3) Improvement of extension activities

When determining the type of cultivation for Popular Rice, it is indispensable to promote new technologies with the producers, such as the introduction of transplanting and drilling, use of biological insecticides, use of earthworm compost, introduction of small agricultural machinery and improvement of field management with the appropriate water management. Therefore, the training program is necessary for the selected producers and it is expected that the actions of the leaders among the producers will contribute to turn the technical extension into an efficient program. Also, the purpose of the establishment of demonstration fields at town level is to increase the interest of producers in the new techniques, as an effective means of promotion. However, the items related to invigorating the training of extension officers, improving the infrastructure of Popular Rice Units in the provinces, increasing the number of extension officers in the municipalities and organizing individual producers who do not belong to any other cooperative association, guaranteeing their training, will be included in the Action Plan of the related organizations and for that purpose the following project profile is included.

1) Project for capacity building of leaders among producers and extension officers

Capacity building for the leaders of producers and support as a nucleus for extension activities of the region.

2) Project of study tours as an extension method

Organize the opportunity so the producers can be trained on new techniques on rice production through visits to the field of leading practical farmers.

7.2.6 Action Plan for each Municipality

(1) Municipality of Aguada de Pasajeros

a. Estimated cultivation area of Popular Rice in 2015: approximately 3,900 ha

b. Number of planned (GAIPA) extension officers: 5

c. Number of planned leaders of producers: approximately 100

d. Number of objective Popular Rice producers: 2,000 ~ 2,500

e. Recommended cultivation type:
Cultivation type 2: Double cropping - Transplant
Cultivation type 4: Rice for spring season - Transplant - Crop for soil maintenance

f. Implementation Projects: Program for the Improvement of Sustainable Techniques for Rice Production:
- Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities,
- Project for the Support of Biological Pesticides Production at CREE in the Municipalities
- Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers
- Project for the Improvement of Water Management at Field Level
- Project for Strengthening Water User's Organization
- Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the

Group of Popular Rice Producers

- Project for the Improvement of Paddy Drying System for Popular Rice Producers
- Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers
- Project of Study Tours as an Extension Method

g. Implementation Plan:

Program / Project	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities										
Project for the Support of Biological Pesticides Production at CREE in the Municipalities										
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers										
Project for the Improvement of Water Management at Field Level										
Project for Strengthening Water User's Organization										
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers										
Project for the Improvement of Paddy Drying System for Popular Rice Producers										
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers										
Project for Study Tours as an Extension Method										

h. Estimated production of Popular Rice: 23,000 ton (2010), 30,000 ton (2015)

(2) Municipality of Santo Domingo

a. Estimated cultivation area of Popular Rice in 2015: approximately 4,400 ha

b. Number of planned (GAIPA) extension officers: 5

c. Number of planned leaders of producers: approximately 100

d. Number of objective Popular Rice producers: 2,000 ~ 2,500

e. Recommended cultivation type:
Cultivation type 2: Double cropping - Transplant
Cultivation type 1: Rice for spring season - Transplant -Cash crop

f. Implementation Projects: Program for the Improvement of Sustainable Techniques for Rice Production:

- Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities,
- Project for the Support of Biological Pesticides Production at CREE in the Municipalities
- Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers
- Project for the Improvement Water Management at Field Level

- Project for Strengthening of Water User's Organization
- Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers
- Project for the Improvement of Paddy Drying System for Popular Rice Producers
- Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers
- Project of Study Tours as an Extension Method

g. Implementation Plan:

Program / Project	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities										
Project for the Support of Biological Pesticides Production at CREE in the Municipalities										
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers										
Project for the Improvement of Water Management at Field Level										
Project for Strengthening Water User's Organization										
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers										
Project for the Improvement of Paddy Drying System for Popular Rice Producers										
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers										
Project for Study Tours as an Extension Method										

h. Estimated Popular Rice production: 31,000 ton (2010), 40,000 ton (2015)

(3) Municipality of Yaguajay

a. Estimated cultivation area of Popular Rice in 2015: approximately 4,400 ha

b. Number of planned (GAIPA) extension officers: 6

c. Number of planned leaders of producers: approximately 120

d. Number of objective Popular Rice producers: 2,400 ~ 3,000

e. Recommended cultivation type:
Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance
Cultivation type 4: Rice for spring season -Transplant - Crop for soil maintenance
Cultivation type 3: Double cropping - Drilling
Cultivation type 2: Double cropping - Transplant

f. Implementation Projects: Program for the Improvement of Sustainable Techniques for Rice Production:

- Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities,

- Project for the Support of Biological Pesticides Production at CREE in the Municipalities
- Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers
- Project for the Improvement of Water Management at Field Level
- Project for Strengthening Water User's Organization
- Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers
- Project for the Improvement of Paddy Drying System for Popular Rice Producers
- Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers
- Project of Study Tours as an Extension Method

g. Implementation Plan:

Program / Projects	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities										
Project for the Support of Biological Pesticides Production at CREE in the Municipalities										
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers										
Project for the Improvement of Water Management at Field Level										
Project for Strengthening Water User's Organization										
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers										
Project for the Improvement of Paddy Drying System for Popular Rice Producers										
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers										
Project for Study Tours as an Extension Method										

h. Estimated Popular Rice production: 20,000 ton (2010), 26,000 ton (2015)

(4) Municipality of Chambas

a. Estimated cultivation area of Popular Rice in 2015: approximately 3,100 ha

b. Number of planned (GAIPA) extension officers: 4

c. Number of planned leaders of producers: approximately 80

d. Number of objective Popular Rice producers: 1,600 ~ 2,000

e. Recommended cultivation type:
Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance
Cultivation type 4: Rice for spring season - Transplant - Crop for soil maintenance
Cultivation type 3: Double cropping - Drilling
Cultivation type 2: Double cropping - Transplant

f. Implementation Projects: Program for the Improvement of Sustainable Techniques for Rice Production:

- Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities,
- Project for the Support of Biological Pesticides Production at CREE in the Municipalities
- Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers
- Project for the Improvement of Water Management at Field Level
- Project for Strengthening Water User's Organization
- Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers
- Project for the Improvement of Paddy Drying System for Popular Rice Producers
- Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers
- Project of Study Tours as an Extension Method

g. Implementation Plan:

Program / Projects	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities										
Project for the Support of Biological Pesticides Production at CREE in the Municipalities										
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers										
Project for the Improvement of Water Management at Field Level										
Project for Strengthening Water User's Organization										
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers										
Project for the Improvement of Paddy Drying System for Popular Rice Producers										
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers										
Project for Study Tours as an Extension Method										

h. Estimated Popular Rice production: 18,000 ton (2010), 23,000 ton (2015)

(5) Municipality of Vertientes

a. Estimated cultivation area of Popular Rice in 2015: approximately 8,200 ha

b. Number of planned (GAIPA) extension officers: 7

c. Number of planned leaders of producers: approximately 140

d. Number of objective Popular Rice producers: 2,800～3,500

e. Recommended cultivation type:

Cultivation type 3: Double cropping - Drilling
Cultivation type 5: Rice for spring season - Drilling - Crop for soil maintenance

f. Implementation Projects: Program for the Improvement of Sustainable Techniques for Rice Production:
   - Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities,
   - Project for the Support of Biological Pesticides Production at CREE in the Municipalities
   - Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers
   - Project for the Improvement of Water Management at Field Level
   - Project for Strengthening Water User's Organization
   - Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers
   - Project for the Improvement of Paddy Drying System for Popular Rice Producers
   - Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers
   - Project of Study Tours as an Extension Method

g. Implementation Plan:

Program / Projects	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities										
Project for the Support of Biological Pesticides Production at CREE in the Municipalities										
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers										
Project for the Improvement of Water Management at Field Level										
Project for Strengthening Water User's Organization										
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers										
Project for the Improvement of Paddy Drying System for Popular Rice Producers										
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers										
Project for Study Tours as an Extension Method										

h. Estimated Popular Rice production: 32,000 ton (2010), 41,000 ton (2015)

7.3 Action Plan for Related Organizations

7.3.1 Program for the Improvement of the Extension System and Capacity Building.

(1) Background and present conditions:

Since the beginning of the Rice Development Program in 1967, the extension activities and capacity building were mainly focused on the technical personnel in charge of rice production in the Rice Enterprises (later called Rice CAI). These activities were easily performed as production technologies were similar in all the provinces and the trained directive personnel had a high technical and educational level. Since 1996, the Ministry of Agriculture started supporting the popular rice production. It became a big challenge for the institutions in charge of extension and capacity building, as there was a large diversity of technologies, production forms and producers' distribution. In order to increase popular rice production, spreading new technologies to producers becomes indispensable, such as spreading of transplantation (specially row transplanting), drilling, application of earthworm compost, crop rotation, introduction of small agricultural machinery either manual or with low fuel consumption, as well as the diffusion of technologies related to reaping and postharvest.

(2) Objective of the program

The objective of the program is to strengthen the extension system and capacity building for popular rice.

(3) Content of activities

1) Training of extension officers, both at provincial and municipal level.

Presently, the extension officers have limited access to learning new techniques in rice production. This program provides opportunities for extension officers to be trained so they strengthen their own knowledge, allowing them to respond to the technical demands from the producers.

2) Strengthening the structures of popular rice units at provincial and municipal level.

The development of the extension activities has been impeded by the current infrastructure conditions, both in the human resources aspect as well as in the physical aspect. Among the several infrastructure components, the program is focused on the improvement of (1) limitations on the means of transportation, (2) revision of orientation materials (manuals) for extension, maintaining a sufficient quantity for distribution, (3) Increasing the number of extension officers.

3) Establishing the most convenient ways to train individual producers who are not organized at present (parceleros in some municipalities and prestamos in other cases, etc.).

In order for extensionismo activities to be implemented more effectively, the collective objective, that is to say the groups of producers, are really effective. The current process of organization of the parceleros in CCS varies in each municipality and in the case of Prestamos the process of organization has not yet started, making it necessary to establish producers groups to determine an effective training system.

(4) Implementation site

The problems in extension activities and in capacity building were identified in all the municipalities in the Study Area; therefore the projects will focus on the specific conditions of each municipality, although most of the problems are common in the Study Area.

(5) Implementation period, inputs and cost estimation:

The implementation period, necessary inputs for the implementation and the cost estimation will be determined by the complexity and scope of each project conceived at the municipal level.

(6) Organization of the implementation

The organization of the implementation will be done by clearly defining the organizations responsible for implementing every activity included in the projects. The participation of several entities such as the National Group of Popular Rice (belonging to GAIPA), Provincial Popular Rice Units, IIArroz and its experimental stations, and the different research institutes related to rice cultivation is expected.

(7) Possible funds source

The Ministry of Agriculture, through the Branch Programs of Science and Technique can provide a portion of the budget in domestic currency (Cuban pesos) for the projects submitted and approved, considering their priority and expected impact. Some budget, also in domestic currency, is also possible from the Territorial Programs of the Ministry of Science, Technology and Environment (CITMA) in each province.

The following fund sources, in foreign currency, might be mentioned for the budget to implement the projects:

1. Getting financing from international donors, requesting the support of the Ministry of Foreign Investment and Economic Collaboration (MINVEC) and the Ministry of Agriculture (MINAG).
2. Getting through the Ministry of Agriculture (MINAG) some inputs purchased abroad by the Cuban Government

(8) Remarks

The Ministry of Agriculture (MINAG), through GAIPA, has a proposal to increase the number of extension officers in the provinces and municipalities. This will allow improving extension activities and capacity building. Similarly, some modifications for producers who are using areas of prestamos are being considered. These modifications will encourage producers and their organization, enabling activities on capacity building.

7.3.2 Program for Strengthening Production and Distribution of Certified Seeds for Popular Rice

(1) Background and present conditions

The Production System for Certified Seeds established in Cuba has worked for the requirements of specialized rice production. Popular rice producers use non-certified seeds, while some of them get certified seeds from varieties produced by Rice CAIs, though generally these are not the most appropriate varieties for their cultivation conditions.

The Seed Production System established for rice cultivation covers original seed production only in IIArroz headquarters, while basic seed is produced by IIArroz and its experimental stations located in the provinces of Sancti Spiritus, Camagüey and Granma. The Rice Experimental Station in Los Palacios also produces basic and original seed from its varieties. The registered seed and certified seed are produced in two farms located in Havana, belonging to IIArroz. Certified seed II is produced in specialized farms located in Rice CAIs. At the moment the volume of production of original, basic, and registered seed, as well as the number of varieties is insufficient, therefore it is necessary to increase them. Another problem is related to the system of seed certification of those producing Popular Rice. The system is well established for Specialized Rice but it should be adjusted for small and medium scale producers.

Considering the annual increase of popular rice production and taking into account that the areas for popular rice are mainly cultivated from non-certified seeds, it is necessary to establish a new system for certified seed production and distribution, to cover the demand of popular rice producers.

(2) Objective of the program

The objective is to establish a production and distribution system of certified seeds for popular rice producers.

(3) Contents of the activities

1. To strengthen the capacity for producing original and basic seed in the research centers in charge of this activity.
2. To strengthen the production capacity of farms producing registered seeds.
3. To establish farms for certified seed production based on the characteristics of each municipality.
4. To modify technical regulations and quality specifications for certified seed production for popular rice.

(4) Implementation site

The low degree of utilization of certified seed by popular rice producers is a major problem identified in all the municipalities in the Study Area, except for Vertientes. Project profiles should focus on the different levels of the production system of certified seeds proposed for popular rice producers.

In the Program for reinforcing the production system and certification of seeds the Action Plans at municipality level and the level of the related organizations are closely related, since the activities for improving the production of original, basic and registered seed, as well as the adjustment of the system to certify seeds for Popular Rice correspond to related organizations, although the establishment of the production farms for certified seeds is an activity for each municipality.

(5) Implementing period, inputs and cost estimation

The implementation period, necessary inputs for the execution and cost estimation will be determined by the complexity and scope of each one of the projects conceived for the different levels of the proposed system.

(6) Organization of implementation

The organization for the implementation will be done by clearly defining the organizations responsible for implementing every activity included in the projects. Among the main institutions concerned are IIArroz, ETIAs, seed production farms and Rice Experimental Station in Los Palacios. An important role will be played by the System of Inspection and Certification of Seeds (SICS) of the Ministry of Agriculture at both provincial and municipal level. The participation of the National Group of Popular Rice (belonging to GAIPA) and the Provincial Units of Popular Rice is expected.

(7) Possible fund sources

The financing in domestic currency (Cuban pesos) must be requested to the Ministry of Agriculture (MINAG) considering the expected impact of utilizing certified seed in popular rice.

The following fund sources might be mentioned for the budget in foreign currency to implement the projects.

1. Getting financing from international donors, requesting the support of the Ministry of Foreign Investment and Economic Collaboration (MINVEC) and the Ministry of Agriculture (MINAG).
2. Getting through the Ministry of Agriculture (MINAG) some inputs purchased abroad by the Cuban Government

(8) Remarks

As part of the activities of the Development Program carried out, a Verification Study is being implemented at present in IIArroz to develop the capacity of production of original and basic seed.

7.3.3 Program for the Improvement of Research and Development Activities

(1) Background and present conditions

Rice Research Institute (IIArroz) is the main center for research related to rice cultivation in Cuba, holding 3 experimental stations located in the provinces of Sancti Spiritus, Camagüey and Granma. Located in the headquarters of IIArroz, the Rice Germoplasm Bank of Cuba stores more than 2,300 domestic and foreign varieties, including those that have been traditionally cultivated by farmers during many years. In addition, there are other centers in Cuba performing research on this crop, such as Rice Experimental Station in Los Palacios, Pinar del Rio province.

IIArroz and the experimental stations have equipment which has been used for many years, thus limiting the quality of investigations, extension activities and training of which they are responsible.

(2) Objective of the program

The objective is to strengthen the activities of research and development on the technologies for popular rice.

(3) Content of the activities

1. To provide the necessary equipment for research centers in order to produce new varieties and technologies adapted to the different conditions of popular rice cultivation.

2. To strengthen the capacity of the research centers for the preparation, edition and distribution of understandable texts and technical brochures for popular rice producers.

(4) Implementation site

Project profiles must be implemented basically in the research centers related to rice cultivation.

(5) Implementing period, inputs and cost estimation

The implementation period, necessary inputs and cost estimation will depend on the complexity and scope of the each one of the projects formulated.

(6) Organization of implementation

The organization of the implementation will be done by clearly defining the organizations responsible for implementing every activity included in the projects. Among the main institutions concerned are IIArroz, ETIAs, seed production farms and Rice Experimental Station in Los Palacios. The participation of other research centers is also expected, such as the Institute of Research on Agricultural Mechanization (IIMA), the Institute of Research on Plant Protection (INISAV), the Soil Research Institute, etc.

(7) Possible funds source

The Ministry of Agriculture, through the Branch Programs of Science and Technique, can provide a portion of the budget in domestic currency (Cuban pesos) for the projects submitted and approved, considering their priority and expected impact. Some budget is also possible from the Territorial Programs of the Ministry of Science, Technology and Environment (CITMA) in each province.

The following fund sources might be mentioned for the budget in foreign currency to implement the projects.

1. Getting financing from international donors, requesting the support of the Ministry of Foreign Investment and Economic Collaboration (MINVEC) and the Ministry of Agriculture (MINAG).
2. Getting through the Ministry of Agriculture (MINAG) some inputs purchased abroad by the Cuban Government

7.4 Contents of the Action Plan

Many activities are necessary to find out in detail the type of rice cultivation applied in each municipality. The effect of the cultivation techniques which are activities in the field will appear depending on the characteristics of each region. On the other hand, the postharvest techniques that are the activities outside of the field have little difference among the regions. Also, the activities that make up the Action Plan are composed of two parts: the productive activities of rice including the cultivation techniques and the postharvest activities where the producer (farmer) and the group of producers will become the nucleus, and the support activities where the central, provincial or municipal government will be the nucleus.

Table 7.4.1 Contents of Action Plan

Action Plan at Municipality Level	Action Plan for Related Organizations
Program for the Improvement of Sustainable Techniques for Rice Production Improvement on Cultivation Techniques 1. Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities. 2. Project for the Support of Biological Pesticides Production at CREE in the Municipalities 3. Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers. 4. Project for the Improvement of Water Management at Field Level. 5. Project for Strengthening Water User's Organization Improvement of Postharvest Techniques 1. Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers. Project for Strengthening Water User's Organization Improvement on Extension Activities 1. Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers. 2. Project for Study Tours as an Extension Method	1. Program for the Improvement of the Extension System and Capacity Building 2. Program for the Strengthening of Production and Distribution of Certified Seeds for Popular Rice 3. Program for the Improvement of Research and Development Activities

The center for the Action Plan is the "Program for the Improvement of Sustainable Techniques for Rice Production" which will directly contribute to increase the production and productivity of popular rice. Furthermore, "Improvement of Cultivation Techniques" which directly collaborates with increase in production among the productive activities will be put in the nucleus of the Action Plan. In consequence, production sustainability of popular rice will be possible, and this will contribute to increase the self-sufficient proportion of rice in Cuba as a result of the repercussion effect.

7.5 Implementation Plan for the Actions

7.5.1 Adequate Implementation

The Development Plan which was elaborated as "Sustainable Technical Development for Rice Production in the Central Area of the Republic of Cuba" is a plan where the goal will be achieved by means of implementing the Action Plans in each one of the selected municipalities in the Study Area containing the five central provinces. Also, the support activities are important elements conforming the Development Plan and the strengthening of the related organizations should be carried out together with the rest of the activities.

In order to achieve the development goal in the target year (2015), the action plans will be executed for each one of the municipalities, however the Action Plan was not designed for a long period of time and it is necessary to revise the action plans periodically during several years and correct them, keeping in mind the changes of the external conditions. Consequently, it is recommended that the Action Plan should be revised in the year 2010. The Development Plan only considers the production increase with the increment of productivity without taking into account the increment of cultivation area since resources are limited at the moment. The increment of the area will be carried out gradually when the government considers it appropriate.

Because of this, implementation of the Development Plan and the Action Plan for the 5 selected municipalities as models should be completed preferably. For an early execution in the 5 selected municipalities, the plan could be expanded to the neighboring municipalities through a model project, monitoring the organization for the implementation and making it possible to consider a new

development plan completely and efficiently. Furthermore, the execution of the Action Plan in the selected municipalities completes the demonstrative effect and it is possible that this will improve the participation and interest of people, with their participation in the continuation of the Verification Study, collaborating in the execution of a future plan of similar development. On the other hand, if there is financial possibility, it should consider that the Development Plan can be enlarged further, based on the acquired experiences.

7.5.2 Implementation Plan for the Programs

The Action Plan has 12 components with the objective of being implemented during 10 years from 2006 to 2015. The component Programs should be executed systematically based on the objectives, importance and urgency.

The projects will be completed corresponding to their period of execution in two stages, medium and long term. During the first five years, the implementation of the nucleus project and the preparation period for the long term plan are carried out, as well as the support system and necessary training for the improvement of the cultivation techniques. After that, the activities are promoted and the improvement of the cultivation technique is established as a long term plan.

Table. 7.5.1 Implementation Plan for Programs

Program	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Program for the Improvement of Sustainable Techniques for Rice Production										
Program for the Improvement of the Extension System and Capacity Building										
Program for the Strengthening of Production and Distribution of Certified Seeds for Popular Rice										
Program for the Improvement of Research and Development Activities										

7.5.3 Inputs for the Plan

The programs /projects that integrate the Development Plan are considering that the inputs for the new projects will not be a heavy load. The majority of the costs in the Plan are expenses for personnel and supply materials besides taking into consideration the priority of what products can be obtained within the country. As for the part of foreign expense, fuel, agricultural machinery, etc. are necessary to input.

The related organizations are aware of the condition on shortage of supply materials and budget (lack of foreign currency, fuel shortage, lack of equipment, materials and research equipment and the wear and tear of agricultural machinery), the effective execution of the project is expected with few inputs. The effective use of all the resources including human resources is very important.

7.6 Organization of the Plan Implementation

7.6.1 Method of Implementation

(1) Projects for technology transfer

Pilot projects are those which are directly applied at producers' level without requiring any type of improvement from the related organizations.

(2) Projects for technological innovation

The projects where there is a decisive participation from one or several of the related organizations are considered. This type of project should have a verification component from the proposed objectives and therefore, the monitoring should be different from the projects for technological innovation.

7.6.2 Organization for the Implementation

Each project type has different characteristics so the organization will highly depend on the scope of the project and financing sources. IIArroz will be in charge of follow-up tasks for all the projects in execution and will inform GAIPA on the situation of each one of them.

The organization of the implementation, the organization of the executioner (execution nucleus) and the organization related to the program/project of the Action Plan are as follows:

Table 7.6.1 Organization for Implementation of Action Plan

Project / Program	Implementing Organization	Selection Nucleus	Related Organization
Program for the Improvement of Sustainable Techniques for Rice Production	MINAG, GAIPA, IIArroz	GAIPA, IIArroz	ANAP
Project for the Creation of Production and Distribution Units of Earthworm Compost for Popular Rice Producers in the Municipalities	CCS or CPA	Popular Rice Producers	Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in Municipalities
Project for the Support of Biological Pesticides Production at CREE in the Municipalities	National Directorate of Crop Protection	CREE in municipalities	INISAV, Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in municipalities
Project for the Production of Small Machinery and Validation in Demonstration Areas for Popular Rice Producers	CCS or CCS-F	IIMA, IIArroz	Provincial and Municipal Delegations of Agriculture, Popular Rice Unit in Municipalities
Project for the Improvement of Water Management at Field Level	Provincial Delegation of Agriculture	Municipal Extension Officer, Leaders among Producers and interested persons	INRH, IIRD
Project for Strengthening Water User's Organization	Provincial Delegation of Agriculture, local INRH	CCS and its members, Municipal Extension Officer, local INRH	IIRD, ANAP
Pilot Project for the Interoperation of Agricultural Machinery and its Facilities by the Group of Popular Rice Producers	MINAG, IIArroz	GAIPA, Group of Producers (CCS)	ANAP
Project for the Improvement of Paddy Drying System for Popular Rice Producers	MINAG	IIArroz	GAIPA
Project for the Strengthening of Capacity Building of Leaders among Producers and Extension Officers	IIArroz, GAIPA	Municipal Extension Officer, ETIA	CCS, ANAP
Project for Study Tours as an Extension Method	IIArroz	IIArroz, ETIA, Municipal Extension Officer	GAIPA, ANAP

Program for the Improvement of the Extension System and Capacity Building	GAIPA	IIArroz	National Group of Popular Rice, Popular Rice Unit in Municipalities and Provinces, ANAP
Program for the Strengthening of Production and Distribution of Certified Seeds for Popular Rice	IIArroz	IIArroz, ETIA, Rice Experimental Station at Los Palacios	SICS, GAIPA, Popular Rice Unit in Municipalities and Provinces, CAI
Program for the Improvement of Research and Development Activities	IIArroz	IIArroz, ETIA, Rice Experimental Station at Los Palacios	IIMA, INISAV, IIS

(1) National level

The Ministry of Agriculture (MINAG), through the Agro-Industrial Group of Cattle and Rice (GAIPA) and the Rice Research Institute (IIArroz) will define the scale of execution for the activities. The related organizations should play a very active role so the Development Plan can achieve the expected results and it can be extended to the neighboring municipalities and areas outside of the Study Area.

The projects are focused on supporting rice production with sustainable methods for small and medium scale producers and in every case they have a multidisciplinary scope so several institutions will have to collaborate. The main institutions that will participate in the execution of the projects are the following.

- National Group of Popular Rice: It directly represents Agro-Industrial Group of Cattle and Rice (GAIPA) and is in charge of the entire strategy for the development of popular rice in Cuba.
- Rice Research Institute (IIArroz): It is the main institute in charge of research performed on rice in the country and it will be in charge of executing and monitoring the projects. It will participate in all the improvement activities of the cultivation techniques and in the training and extension activities of provincial and municipal extension officers.
- Institute of Investigation of Agriculture and Stockbreeding Mechanization (IIMA): It will be in charge of the construction of manual equipment (manual seeders, etc.) and training for the use of the machinery.
- Institute of Investigation of Irrigation and Drainage (IIRD): It will be in charge of the training related to water management in the field, and communal management of the irrigation systems and available water.
- Institute of Investigations of Soil and Fertilizers (IIS): It should participate jointly with IIArroz in formulating the ways of agricultural management, especially related to crop rotation systems and the use of different alternatives for organic fertilizers.
- Institute of Investigation of Vegetable Sanitation (INISAV): The activities of this institute will be closely associated to the Centers for Reproduction of Entomophagous and Entomopathogens (CREE), for the production of biological pesticides.

Besides the previously mentioned institutions, there are others under the Ministry of Agriculture such as the System of Inspection and Certification Seeds (SICS) who will

execute some specific tasks, such as improving the system for certified seeds for popular rice. The participation of the National Enterprise of Agriculture and Stockbreeding (ENPA) is also expected.

- National Association of Small Farmers (ANAP): The ANAP should play a fundamental role in the organization of individual producers to facilitate training. An active collaboration is expected to establish an effective training system and extension activity for parceleros (6 cordeles) who are not yet organized in cooperatives and for producers that use prestamos.

(2) Provincial and Municipal level

The Ministry of Agriculture has delegations in every county and municipality, and through them many of the planned activities will be coordinated. At municipality level there will be a group of institutions that will work directly in the execution of the projects and they should maintain a close relationship with the related organizations.

- Provincial Units of Popular Rice: The Popular Rice Units are the representatives of Agro-Industrial Group of Cattle and Rice (GAIPA) in the province and they will be the liaison between the level of the related organizations and the municipality. Their main function should be directed to the coordination of activities for the execution and monitoring of the projects, although it will also participate in the training activities.
- Municipal Extension Officers for Popular Rice: The municipal extension officers have a decisive function in the implementation of the projects since they will be in charge of working directly with the producers. Presently, the number of extension officers is insufficient, but they will soon be increased in every municipality.
- National Association of Small Farmers (ANAP): At the municipality level ANAP should organize and promote training and extension activities for producers that are already organized and support the creation of groups with producers that are not yet organized in any cooperative form.

7.7 Procurement of Financing

The programs/projects included in the Action Plan are divided into production activities (economy) for producers and public investments from the financial point of view. Since it is difficult to procure all the project costs from the budget of MINAG and there is also a limit on public investment, the introduction of financing from outside sources should be revised. The main organizations that could provide financing are the following:

(1) Direct financing from the Ministry of Agriculture (MINAG)

This form of financing could be received directly through the Ministry of Agriculture or through the departments in the counties and municipalities.

(2) Financing through Projects of Technological Innovation (National, branch and territorial)

The related organizations should take advantage of the experience that they possess on obtaining financing through different programs that are executed by the Ministry of Science, Technology and Environment (CITMA) at national level, in every province or through the branch programs of the Ministry of Agriculture.

(3) Collective financing from producers of CCS and CCSF

In order to execute some projects where producers will benefit, support is expected of individual producers of CCS and CCSF

(4) Financing from international cooperation (international organizations, donating countries, NGOs, etc.)

All the arrangements will be done by MINVEC and MINAG for the reception of financing in Free Convertible Currency (MLC, Moneda Libremente Convertible) through international projects.

7.8 Evaluation of the Plan

7.8.1 Basic Concept

Since the main objective of the Development Plan is to improve the techniques for sustainable Popular Rice production, the evaluation is focused on the objective use, by appropriate techniques, of national resources in particular soil and available manpower.

7.8.2 Background of the Development Plan

(1) Land use

This project was initiated in the context of the national agricultural policy of diversification from sugar cane monoculture. Major parts of the unsuitable land for sugar cane cultivation have been converted /restored into forests, range lands and citrus groves. By contrast conversion into paddy cultivation has been minor in scale. Two major constraints are limited availability of suitable lands and heavy investment to establish drainage as well as irrigation networks. For principal popular rice producers, the sizes of land parcels are small, holdings are small, and the scales of irrigation systems are small.

(2) Demand side

Rice is one of the three major grains. Paddy and maize can grow domestically, whereas wheat cannot. Most import of rice, which covers about 65% of the total consumption now, goes to the national basic food ration system and social use. The domestic production consists of two categories (special rice and popular rice) whose sustainable growth of production is the goal of this project. The usage of popular rice is roughly divided into two types: the major part is for self-consumption, and the rest is for the market.

(3) Production side

Management of national paddy fields has been decentralized and private landholders have been encouraged to cultivate paddy. For their own benefit in both input-purchase and marketing they have been advised to organize cooperatives in the form of CPA or CCS/ CCSF, the strengthening of which is also a major aim of this project. Taking account of its priority rank in the national energy consumption policy, national paddy production policy has set its long-term target at the two thirds of the domestic consumption.

(4) Great expectation on small landholders on the part of the administration

The following equation exemplifies the expectation:

[@tiny quantity] x [mass of producers] = significant amounts

A case in point is the history of urban agriculture development with appropriate technology. Urban agriculture produced 4 million tons of vegetables in 2004 which grew at an annual growth rate of 2.5%; it provided employment to 400,000 people.

Now, the volume of popular rice production and sales in the market is as follows:

Year	Production (tons)	Sales (tons)
2002	225,000 tons	39,500 tons
2003	272,000 tons	96,400 tons

In 2003, 272,000 tons were produced (21% annual growth rate) with favorable rainfall and market situation, and presumably administrative support sensed by the producers from the initiation of this project ; 96,400 ton was sold (144% annual growth rate)

139,000 tons, or two thirds of the production in 2002, went to self-consumption of producers, their family members and laborers, equivalent to 2.3 million people based on the assumed per capita annual consumption of 60 kg.

7.8.3 Methodology of Project Appraisal

The project is not seeking the maximum efficient paddy growing method, but an optimum system of paddy cultivation conducive to the given physical, social, and economic conditions of Cuba.

The policy emphasis is put solely on efficient land use with more labor-intensive or foreign-exchange-saving approach in some techniques by tapping into so-far not utilized domestic resources which will contribute the domestic society to enhance its economy base, as is the case with urban agriculture.

The emphasis has been changing, so has the methodology, from the generic method of quantitative comparison of ‘with project’ situation and ‘without project’, to an evaluation on the concept of the project (i.e., a qualitative method specific to the project of encouraging popular rice production) by highlighting its uncountable values in the national socio-economy.

7.8.4 Influence on Socio-economy

(1) Development Plan

Method of paddy cultivation

First of all, the project should establish a working hypothesis on optimum combination of technologies appropriate to the local situation, and then they should be verified.

Research and extension services of the administration

Second, the project should define the roles of the different fields of administration in agriculture, particularly IIARROZ and its related institutes and of the different levels of extension agencies, and further propose networks for closer teamwork, as well as feedback system between them and the producers.

Taking local differentiations into account

Although the basic strategies are common to all the five target municipalities, the project needs to specify the general system in more detail because each of the technical, and socio-economic features of paddy cultivation are not compatible with one another.

The long-term perspective of the project

Finally when the project considers the long-term perspective in the form of action plans, it is compelled to take a conservative view by diverting from its original stance on resources, notably irrigation water combined with energy sources, because there are considerable unknown factors in the circumstances in which the resources are placed.

(2) Verification study

The study team has conducted verification studies at two selected paddy fields for two consecutive seasons. Each prospective technique has been compared with the present one, and financial benefits and costs were also estimated.

The characteristics of the proposed production methods are:

- Depend less on limited energy resources, and more on those of animals and humans.
- Maintain present level of imported essential input dosage, but use more organic input.
- Produce agricultural machinery and tools using domestic materials.
- Introduce technology adaptable to the present cultivation environment.

In short, the project is not to find the maximum efficient technology available to remove obstructive physical conditions, but to find the combination of appropriate technologies adaptable to the existing physical, social, and economic condition of the target area.

Our verification study highlights six sequential techniques of paddy cultivation methods: the use of compost with earthworms, gravity-sorting of seeds[1], straight-line-sowing, straight - line - transplanting, biological pest control, weeding[2] with an implement. They were compared with the use of chemical fertilizer, no-sorting, sowing/transplanting at random, agro-chemicals, and manual weeding respectively.

The initial study has indicated that the combination of six techniques increases unit yields. Cost aspect apart, in direct sowing method, straight line sowing has a better unit yield by about 50% than sowing at random; further, straight-line transplanting has a better unit yield by about 50% than direct straight line sowing. In this comparison, though, either the aspects of availability of labor or an upper limit of the paddy cultivation area in which transplanting method is financially advantageous is not estimated yet.

Trial cost-benefit analysis for two seasons indicated that productivity gains at CAI unit purchase price exceeded the increase of total costs in all the four cases. Whereas cost analysis reveals that both labor and machinery costs do not differ much in the traditional and improved cases (i.e., labor requirements and fuel consumption have not changed much), input items have changed from those of chemical origin to organic origin.

(3) The role of administration

Their principal roles of administration will be as follows:

- Diffusion of improved input and technical information through the guidance of IIARROZ and other related institutes.

[1] All seeds are certified.
[2] All the fields are weeded by plowing and irrigating before sawing the seeds or transplanting the seedling.

- Improvement in the extension working system.
- Issuance of produce insurance policy for drought damage.

To support the first two of the above mentioned efforts, technical assistance programs mentioned below have been proposed and it is hoped will be carried out by Japanese government.

- Verification study on various aspects of rice production methods.
- Donation of necessary equipments to IIARROZ
- Training of extension agents in Japan on Japanese methods of paddy cultivation

(4) Characteristics of paddy cultivation in the five target municipalities

On the characteristics of the popular rice production in the five target municipalities, at first glance, the differences of some characteristics of each municipality are noticeable: For example, Vertientes clearly separates itself from other four municipalities in production environment, and Santo Domingo has better shallow ground water sources. Accordingly, either adoption of transplanting or use of certified seeds shows low correlation with the increase of unit yield of rice.

(5) Comments on the action plan and their long-term socio-economic impacts

All the components of the action plan take account of the results of the verification studies. Then each of the action plans for the five target municipalities were prepared specifically designed to match the present needs of their community of rice producers.

Cultivation method: Action plans are based on the use of compost with earthworms, gravity-sorting of seeds, straight-line-sowing or -transplanting, biological pest control, weeding with implements.

Extension services: Quality aspects are always given priority over quantity.

Irrigation & drainage: All the efforts except the introduction of new water resources are meant for better water management: namely, the reduction of leakage and percolation along the water passage and the paddy fields themselves, and effective use of irrigation water according to the growth stages of paddy. The savings can be converted into financial terms. The source of energy for bringing irrigation water is a constraint which is out of scope of this analysis. It depends on the management sense on the part of the producers.

Post harvest: The verification study clearly shows the benefit of separating rice bran from husk. The machine used is of small scale. The process has produced more whole rice grain than the one using the existing type of machine. It, therefore, will increase the quality of the products and subsequently their unit price. The present usage of byproduct of the mixture of rice bran and husk for animal feed could add value to usage of rice bran. This animal feed contains some useful vitamins and enzymes for the food supplement industry. As an excellent exporter of pharmaceutical products, Cuba could easily develop a processing plant for rice bran.

Expected overall socio-economic impact of the action plan: It will go a long way toward promoting popular rice production among private farmers as well as the member-producers of cooperatives. Through extension activities, it is hoped that both the national institutes and producers will share common information, which will lead to the improvement of both the quality of rice and productivity of rice cultivation. It is also hoped that semi-free rice market will expand, and that various small industries surrounding rice production will develop, and employment in the agro-related industry will increase as well.

7.8.5 Environmental and Social Considerations

As mentioned previously, the main objective of the Development Study is to formulate a Development Plan to increase the sustainable production of rice (Popular Rice) in the 5 central provinces of the Republic of Cuba. The main aspects that should be taken into account to find out about the possible environmental impacts would be the following:

(1) Social environment

The Development Plan does not expect to carry out infrastructure changes in the area for the Development Plan, so migration of the population is not expected. As for increasing the new areas for the production of Popular Rice, it is expected that the majority will be from the restructuring process areas of the Ministry of Sugar as well as the loans increased for lands belonging to the Ministry of Agriculture. In connection to land use, in some cases the crop will be changed but the land use will remain as agricultural activity. The activities of the study will have a positive effect in the local economy in the area for the Development Plan.

(2) Natural environment

In the Development Plan there will not be any changes that affect the topography and likewise, no practice will be carried out that could cause soil erosion. However it will be necessary to clearly include some measures for soil protection, keeping in mind that for most of the land dedicated to the production of Popular Rice, the physical and chemical characteristics are unknown for establishing a correct strategy for their protection and conservation. In the Development Plan the volume of water is not expected to be remarkably increased for irrigation farming, although it hopes to establish some measures to increase drainage efficiency. The new areas that will be increased for rice cultivation are presently used for other agricultural crops, so the land use will not change and the flora and fauna in the area of the Development Plan will not be affected at all.

(3) Contamination

The Development Plan will be formulated under the principles of establishing a sustainable crop production, where there will be a minimum application of chemical products for fertilization, weed control, insects and against diseases. It also hopes to widely use organic fertilizers and bio-pesticide products thoroughly, so it is not likely for soil, air or water contamination to occur. In the Development Plan there will not be any type of activity that could cause large scale waste or noises that affect the population.

7.8.6 Summary Evaluation

The execution of the Action Plan is based on the Development Plan as a result of technical improvement by the producers, improvement of production conditions, improvement of extension activities and reinforcement of the related organizations. Increase in production and improvement of productivity of Popular Rice will be foreseen in the objective area of the Development Plan and in the neighboring municipalities. The implementation of the Plan will be a big stimulus for the productive activity, and an increase on production is expected to contribute to the stability and sustainability of Popular Rice production in the objective area. Consequently, as a repercussion effect, it will contribute to the national economy due to the expansion of the self-sufficient percentage.

From the above, it can be said that the implementation of the Development Plan is appropriate due to

the results of the economic analysis that was calculated by the tangible benefit that is obtained from the cultivation type, that is, the improvement of rice. Additionally, the socio-economic effects that were analyzed as intangible benefits could also be expected. Moreover, no problems are expected from the environmental and social points of view; therefore the immediate implementation of the Development Plan is recommended.

CHAPTER 8 CONCLUSIONS AND RECOMMENDATIONS

CHAPTER 8: CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

Cuba is a food importing country and its production of main grains only covers 23% of the requirements. Rice, which is a staple food for the population, occupies second place among the imported cereals after wheat. In the year 2001, 44% (217,000 tons) of the consumed rice was produced in Cuba, while 56% (496,000 tons) was imported (FAO, 2001). Taking this into consideration, the Cuban government regards the increase of rice production as a matter of national importance.

The five central provinces of the country (Cienfuegos, Villa Clara, Sancti Spíritus, Ciego de Ávila, Camagüey) are currently producing around 45% of Popular Rice and they have the potential of increasing production through increasing productivity (improving agricultural and milling yield) as well as through the expansion of the cultivation area. Since the individual producers of small and medium scale Popular Rice have very limited resources, it is necessary to improve the techniques for rice production by using available capital and agricultural inputs.

The Development Plan should fulfill two indispensable requirements: in the first place it should be sustainable, taking into consideration the limited resources of the individual producers of Popular Rice of small and medium scale and therefore the entire strategy to improve the cultivation techniques should be focused on sustainability. In second place, it should be accepted by the producers and should be carried out mainly with their own resources, utilizing to the maximum the available capital and inputs. In order to achieve these two requirements and to be able to carry out the correct implementation of the Development Plan, the role of related organizations that are supporting the activities of the producers is of utmost importance.

It is well known that the increase in production is achieved by means of incrementing the yield as well as by expanding the cultivation area; nonetheless, since inputs are limited currently, it is recommended to promote incrementing the yield at moment, and then to increase the cultivation area gradually when the economic situation will allow it. The Development Plan is fundamentally directed to increase production through the increment of productivity.

On the other hand, to reach the goals of the Development Plan, first it is necessary to accomplish the Action Plan, which was elaborated based on the characteristics of the areas for rice production. For this reason, one municipality from each of the provinces of the Study Area has been selected as a representative. These selected municipalities will be used as models. Hence, the characteristics of rice production from each municipality have been analyzed in order to prepare the most appropriate technical package. It is expected that the execution of the proposed measures in the Action Plan will produce a positive impact in the increase of production.

The goals of the Development Plan called “Sustainable Development for Rice Cultivation in the Central Area in the Republic of Cuba” will be accomplished through the extension of the Action Plans in each one of the selected municipalities from the five central provinces in the Study Area. At the same time, in order to achieve the proposed goal in the Development Plan the related organizations should be strengthened, as well as the rest of the supporting activities for production.

Through the implementation of the Development Plan, the small and medium scale producers of the five provinces in the central area of Cuba will achieve an increase of production by utilizing

sustainable techniques. Furthermore, through the execution of the Action Plan in each one of the municipalities, a knock-on effect will take place in order to establish this type of production as a sustainable technical model, which will be transferable to other municipalities in the central provinces. This will contribute to increase production of Popular Rice in Cuba. Taking this into account, the immediate implementation of the Development Plan is very important.

8.2 Recommendations

(1) Immediate implementation of the Development Plan

In order to implement the Development Plan, the Action Plan of each one of the selected municipalities should be executed first. To be able to achieve the expected effect on production increase and productivity improvement of Popular Rice through the implementation of the Development Plan, the institutions executing the project such as the Ministry of Agriculture (MINAG), the Institute of Rice Research (IIArroz) and other organizations should actively work in the selection and execution of the projects. This Development Plan shall be considered the model for the cultivation of Popular Rice for small and medium scale producers utilizing sustainable methods and shall serve as a model for the neighboring municipalities, gradually being adopted by them in the future.

(2) Strengthening of the executing institutions of the Project

The Ministry of Agriculture (MINAG), especially through the Agro-industrial Group of Cattle and Rice (GAIPA) and the Rice Research Institute (IIArroz), which is the institution in charge of the immediate and effective implementation of the Development Plan, shall make the necessary arrangements with the rest of the institutions at the central, provincial and municipal levels. Similarly, the implementation of the Development Plan and the execution of the pilot projects will require the active participation of the following essential institutes and institutions: Institute of Investigation of Agriculture and Stockbreeding Mechanization (IIMA), Institute of Investigation of Irrigation and Drainage (IIRD), Institute of Investigation of Soil and Fertilizers (IIS), Institute of Investigation of Vegetable Sanitation (INISAV), Reproductive Centers for Entomophagus and Entomopathogens (CREE), National Enterprise of Agriculture and Stockbreeding (ENPA), System of Inspection and Certification Seeds (SICS), National Association of Small Farmers (ANAP), Agro-industrial Complex for Rice, (CAI Arroceros), Cooperatives of Credit and Service (CCS and CCS-F), etc. The organizations (institutes and institutions) related to the improvement of the people's capacity in charge of the management and implementation of the projects, should guarantee their training and preparation of the necessary materials.

(3) Promoting change towards new ways of agricultural management

The proposed technologies imply a change in the manner of thinking of the individual producers since there is little dependency on inputs (mainly agrochemicals) for the cultivation of rice. Agricultural management is mainly based on the use of the producer's own resources.

(4) Promotion of extension activities

An increase in the number of extension officers in each of the municipalities (between 4 and 7 in the selected municipalities), has been planned by the Agro-industrial Group of Cattle and Rice (GAIPA) and identification and training of the leading producers has also been considered. The activities of the extension officers are essential for the diffusion of the cultivation techniques of

Popular Rice; therefore it is important that the increase in personnel dedicated to this activity is carried out as soon as possible by the Ministry of Agriculture (MINAG).

(5) Use of the trainees from the training courses in Japan

Since 2003, Japan International Cooperation Agency (JICA) has been holding a Special Course for Cuba called "Techniques for Small Scale Rice Cultivation" and approximately 30 Cuban technicians have already participated in this training course. After returning to their country, the scholarship holders have continued working in research, extension activities and administration. The techniques on rice cultivation and the extension methods learned in Japan can also be applied to the increase and stability of the production of Popular Rice in Cuba. The training that was received to carry out diffusion activities of new technologies and for the training of extension officers and leaders among the producers should be taken advantage of to the fullest extent possible.

(6) Improvement of the System for the Inspection and Certification of Seeds for Popular Rice

Presently, the System for the Inspection and Certification of Seeds (SICS) has been established and it is working for Specialized Rice. However, the production of certified seeds from the Seed Farms belonging to the Rice CAI is insufficient to supply the demand from the producers of Popular Rice. Therefore the promotion of production of certified seeds by the producers of Popular Rice has started. The main problem that has been encountered is related to charging the producers for sample analysis. Changes should be made since both the management and the volume of production are completely different from Specialized Rice to Popular Rice.

(7) Construction of manual equipment for cultivation

Presently, the import of agricultural machinery is very difficult and therefore the development of light machinery that can be manufactured in Cuba and that can be modified to the required conditions for the cultivation of Popular Rice is very important. During the Verification Study some equipment was built at the Institute of Investigations of Agricultural and Stockbreeding Mechanization (IIMA) at a very low cost. An example is the construction of the manual row seeder, based on a design from the International Rice Research Institute (IRRI) in Philippines. The IRRI seeder had better characteristics than the Vietnamese manual seeder which was tested by IIArroz before. In so far as the economic resources, the Ministry of Agriculture should facilitate the construction of some equipment such as the manual row seeder and the manual weeding machine.

(8) Continuing research and technical development activities for Popular Rice

The program for the production of Popular Rice is relatively new and different from the production of Specialized Rice and the most adequate techniques for its management have not yet been established; therefore, it is very important that the research and development activities, as well as technology transfer activities are continued. It is indispensable to establish and promote the most adequate techniques pertaining to the cultivation area and the type of agricultural development. The following items are especially important: a sustainable production system with a small amount of inputs, environmental considerations with the application of organic fertilizers and biological control of pests, use of animal traction in small and medium scale cultivation, establishment of a training system, transplanting technique, introduction and establishment of two cultivation seasons per year, crop rotation systems, the use of short cycle varieties, and the establishment of a production and distribution system for certified seeds.

The Verification Studies carried out had the expected demonstration effect and therefore they can be used as models for the technological development of rice production with sustainable methods. It is necessary to promote the realization of verification studies in different municipalities as well as promoting the techniques applied for the improvement of productivity, extension activities, etc.

(9) Possibility of international technical cooperation

Support for the execution of the projects can be requested from international organizations, donating countries and NGO's through the Ministry of Foreign Investment and Economic Cooperation (MINVEC) and the Ministry of Agriculture (MINAG). It is extremely important to have the possibility of visits from experts from countries with experience on these topics, and it is also important to train the people involved in management, implementation and monitoring of the projects.

(10) Project financing

The Ministry of Agriculture (MINAG) shall adjust the budget for the execution of the Development Plan and shall revise the content of the project for the prioritized activities to be executed immediately. For the execution of the project, the financial support from the provinces and municipalities is also expected, as well as from farmers' organizations (CCS, CCS-F) and if possible, the cooperation of international aid as well.