OUTPUT 3. ENHANCING REGIONAL RICE RESEARCH CAPACITIES AND PRIORITIZING NEEDS WITH EMPHASIS ON THE SMALL FARMERS

3A. Participatory Development of Rice for Poor Communities in Marginal Areas

- **RHICO a New Rice Type for Confronting Food Insecurity in the Hillsides**

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Abstract
In the hillsides, rice is stable in the diet of the poor. Therefore it is important to develop upland rice with cold tolerance to help confront food insecurity in the mid-altitude mountains. A participatory scheme allowing the farmers to select for the characteristics that the identify as important including acid soil, drought and cold tolerance, and for resistance to rice blast disease. A participatory process of evaluation led to the nomination of the varieties Cirad 446 and Cirad 447. They are the first upland varieties in America with earliness, high tolerance to cold, drought and soil acidity, and with resistance to blast. So they are the first varieties of a new type of Rice for HIllsides with COld tolerance, named RHICO type.

Introduction
The CIAT-CIRAD collaborative project targets resource poor farmers and uses participatory methodologies to test new technologies. This year, the project worked with communities in marginal areas of the mid-altitude hillsides and high rainfall coastal areas. In these areas, the populations are mainly ethnic minorities, for example in Colombia, the mid-altitude site the population is principally native Indians, and the site on the Pacific coast the population is main blacks. Rice is an important crop for both these communities and the short-term goal is to increase the production to a level where these regions are self-sufficient thereby increasing their food security.

Upland rice for hot areas has been grown for several centuries in West Africa and Brazil for example. It is the same for lowland rice for hot areas such as India or Tolima, Colombia. Also lowland rice for areas in which due to the latitude or altitude cold tolerance is essential, for example Chile and Nepal respectively. But the first upland varieties for cold area have not more than a decade of history in Madagascar (Déchanet *et al*. 1996).

The mid-altitude hillsides such as the highlands of Colombia constitute a marginal area for the upland rice crop because of the cold night time temperatures. Often the populations are predominately ethnic minorities as in Colombian Andes (Guambianos, Totoroes, Coconucos, etc.). In these areas, rice is the major part of the diet, and they have expressed their desire to have adapted rice varieties as a part of their cropping systems. The following activities focused on the development of upland rice in the Colombian Andes had been allowed by the financial support of the Foundation Aventis-Institute of France, CIRAD, and CIAT.

Materials and Methods

The participatory evaluation started with the evaluation of 17 F_8 lines from Valès'crosses in Madagascar (Table 1). The trials form a complete dispersal blocks design. The plot size was 2 m^2.

Table 1. F_8 Lines Evaluated in Participatory Trials

		Progenitors		
#	F_8 lines	Female		Male
1	PRA 522-2-63-1-1	F9 PRA 8-F317-6-9-6-M	/	Irat 265-57-2
2	PRA 522-2-66-2-1	F9 PRA 8-F317-6-9-6-M	/	Irat 265-57-2
3	PRA 522-7-24-5-1	F9 PRA 8-F317-6-9-6-M	/	Irat 265-57-2
4	PRA 546-38-71-3-1	Irat 114	/	Irat 380
5	PRA 553-44-64-1-1	Irat 265-57-2	/	Jumli Marshi
6	PRA 553-45-6-2-1	Irat 265-57-2	/	Jumli Marshi
7	PRA 553-45-8-4-1	Irat 265-57-2	/	Jumli Marshi
8	PRA 553-45-8-5-1	Irat 265-57-2	/	Jumli Marshi
9	PRA 553-45-8-6-1	Irat 265-57-2	/	Jumli Marshi
10	PRA 553-45-8-7-1	Irat 265-57-2	/	Jumli Marshi
11	PRA 553-45-8-8-1	Irat 265-57-2	/	Jumli Marshi
12	PRA 565-46-34-3-1	Khonorallo	/	Irat 265-57-2
13	PRA 565-46-42-1-1	Khonorallo	/	Irat 265-57-2
14	PRA 565-46-42-2-1	Khonorallo	/	Irat 265-57-2
15	PRA 565-46-42-3-1	Khonorallo	/	Irat 265-57-2
16	PRA 565-46-64-1-1	Khonorallo	/	Irat 265-57-2
17	PRA 565-47-19-1-1	Khonorallo	/	Irat 265-57-2

Then the best lines were evaluated a second time in a participatory trial with dispersal blocks. The plot size was 10 m^2. The best lines were milled with the manual huller (Vales and Roa, 1999) and evaluated for taste in participatory trials. The brown rice of these lines was compared to the milled white rice. The best, or the two best lines were evaluated in a third trial in plots of 25 m^2. These were also used as demonstration plots.

These lines were evaluated for their partial resistance to rice blast. This was done by using a rice blast pathotype, that overcomes the complete resistance genes of these lines. Then these lines were included in the field the trial using that used this strain to evaluate the partial resistance. Finally the lines that were resistant to blast and selected by the farmers were nominated as varieties and the multiplication has begun during the process of their official registration.

Results and Discussion

During the first semester of 2001, due to the drought the only lines that were harvested were PRA553-44-64-1-1 and PRA553-45-8-8-1 from Irat 265-57-2 / Jumli Marshi. Despite the high risk of drought, a few farmers evaluated these lines in plots of 10 m^2. The yield of the plots was approximately 3t/ha.

A participatory trial for evaluation of the taste of these lines was carried out during a workshop with farmers. The brown rice of PRA553-45-8-8-1 is red due to the color of its pericarp. After cooking, it turned to dark red. The color and the particular taste of this rice were preferred, so the brown (red) rice of PRA553-45-8-8-1 was the preferred rice. In second place was the brown rice of PRA553-44-64-1-1, and milled white rice was selected in third place.

During the first semester of 2002 the lines PRA553-45-8-8-1 and PRA553-44-64-1-1 were evaluated for their resistance partial to blast. The susceptible check was well attacked and the PRA lines were immune in spite of a compatible strain inoculation.

During the first semester of 2002, a drought occurred. Both lines were planting in plots of 25m^2 and yielded adequately and demonstrated their tolerance to drought in 25 m^2 parcels of some producers. So these lines were nominated Cirad 446 (PRA553-45-8-8-1) and Cirad 447 (PRA553-44-64-1-1) and the Crops and Seeds Aceituno Ltd. is to produce the certified seeds for the first semester of 2003. The official registration of these new varieties is underway.

In Colombia the cycle of these varieties from sowing to harvest is 3 month in Santa Rosa Experimental Station, Meta (333 m asl and 4°N), 4 month in the Palmira Experimental Station (1,054 m, 5°N) and 5 month in the Popayan sub-exprimental station (1,750 m asl, 2.5°N). Cirad 446 and Cirad 447 are the first upland varieties in America with earliness, high tolerance to cold, drought and soil acidity, and with a high level of partial resistance to blast. They are the first varieties of a new type of Rice for Hillsides with Cold tolerance, named RHICO type.

Perspectives

This program is supported by the Aventis-Institut Foundation of France, and it will receive the financial support of Colciencias Foundation for the next 3 years. The addition of rice, which is a dietary stable, into the cropping systems of these communities, is expected to have a strong impact in confronting food insecurity in the Colombian hillsides.

Reference

1. Vales, M. y J. I. Roa. 1999. Manual huller. Arroz en las Américas, Diciembre 1999,19 (1), (Es): p 6-8, 5 photos.

- **Confronting Food Insecurity in the Rain Forest of the Coasts**

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Abstract
Rice production has been decreasing on the Guapi river strands and had disappeared on the Timbiquí river strands, in the rain forest of the Colombian pacific coast. The rice crop is an important stable and it needed for food security of this region. From two surviving traditional varieties, Brilla Lola and Chino Grande at least 3 other traditional cultivars are recovered. Another six traditional varieties were tentatively identified, and these results need to be confirmed. These recovered traditional varieties are very important as genetic resource. Commercial lowland varieties Orizica Caribe 8 and Fedearroz 2000 were identified as adapted to this area and were accepted by the farmers. Four tones of seeds of these varieties were provided to augment rice production. The first participatory trials showed that the upland variety Irat 216 was adapted for upland and lowland conditions and was accepted by the farmers. This variety is known to have a salt tolerance and may be a widely adapted to a range of local conditions.

Introduction
Few years ago, due to development projects of oil palm tree and coconut tree production for the communities of the pacific coast of the Colombian Cauca Department, their traditional production of rice declined drastically. These development projects were unsuccessful because of a drastic decrease in the coconut price, and disease of the oil palm trees, so never harvested. As a consequence, rice of the Timbiqui river strands disappeared, and only two traditional varieties are maintained in few fields on the Guapi river strands. The main consequence is a growing demand for the important food crops. The town of Guapi imported 720 tones of white rice *per annum*. The resource poor rural community had even less access to the basic commodity rice. For food security, it is urgent to reactivate the rice crop on the Pacific Cost of Colombia.

The National Programs for Transfer of Technology (Spanish acronym PRONATTA) is a major Colombian organization that is working for the development of the pacific coast region of Colombia. It has provided three years financial support for the reactivation of the rice crop in this region.

- **Rescue of the Traditional Rice Varieties Lost: Recovery of Genetic Resources and Traditional Knowledge**

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Introduction

The objective of this work was the rescue of the traditional rice varieties. These varieties were the results of decades of traditional selection and are well adapted for the costal conditions of high rainfall and low light intensity as well as being the quality of rice preferred by these community. These traditional rice varieties are important genetic resources.

Material and Methods

On the Guapi river, only the traditional varieties Chino Grande and Brilla Lola are still grown. Due to an lack of organized seed production, these varieties were not uniform an appeared to be populations. It was a hypothesis that these rice populations were actually mixtures and they contained other traditional varieties.

Seeds from individual plants with different phenotypes were harvested in fields of Chino Grande and Brilla Lola. These extracted lines are fixed by pedigree selection on panicle lines. Participatory selection was made to determine which lines were recognized as traditional varieties by the local farmers.

Results

Forty one lines were extracted: 25 from Brilla Lola, and 16 from Chino Grande. The first results of the participatory identification trials are in the Table 2. From the traditional variety Brilla Lola several traditional varieties were identified including Callila, Chino Grande (barbon), ICA Alto, Fian, ICA 4, and Guacari. From the traditional variety Chino Grande several traditional varieties were identified including Chino Pequeño, Panameño, Negrito, Chino Chiquito, Bogotano and Arroz blanco. These results are still considered preliminary and additional test is being done to confirm that these are distinct varieties.

Discussion

Many different phenotypes were found within the traditional varieties of Brillo Lola and Chino Grande. We are waiting for the complete participatory trial information but some of the fixed lines probably will not be clearly identified by the farmers. This can occur because of the loss of traditional knowledge and some lines come from spontaneous crosses. The recovered traditional varieties are an importance as genetic resource, and they are being incorporated into a collection of progenitor lines to be used to breed new varieties for humid lowland conditions. These traditional varieties will to be included in the next set of agronomic trials as well as incorporated into the seed-banks for the costal area that will be maintained by farmers

Table 2. Identification of Lost Traditional Varieties

#	Identified as	
	Timbiqui (*)	**Guapi** (**)
	Lines from Brilla Lola fields	
1	Calilla	Ica Alto
3		
6		Fian
11		Ica Alto
17		Ica 4
22		Guacari
25	Chino Grande (barbon)	Guacari
	Lines from Chino Grande fields	
26	Chino Pequeño	Negrito
28	Panameño	Panameño
30	Chino Grande	
31		Chino Chiquito
33		Bogotano
34		Arroz blanco
39		Bogotano

(*) Participatory identification during a field day at maturity stage
(**) Participatory identification on seeds (the participatory identification during a field day at maturity is coming up).

- **Evaluation of Commercial Varieties in the Pacific Coastal Region of Colombia**

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Objectives

The rice producers of the lowland areas along the rivers of the pacific coastal region of Colombia know only their traditional varieties. These varieties are very well adapted for the areas in which the crops may be flooded, the temperatures are high but the illumination is low. But these varieties do not grow well in favorable upland conditions that are also prevalent in the region. The objective of this trial was for the farmers to compare their traditional varieties with other varieties of rice. This new knowledge will allow these farmers to have more choices.

Materials and Methods

During the first and second semester of 2001 (cycle 1 and 2 in Table 3) the varieties were evaluated in lowland conditions. These fields were frequently inundated because these rivers rise and fall with the sea tides. During a third cycle, first semester of 2002, these varieties were evaluated in lowland and in favorable upland conditions (Table 4).

Each participatory trial, the plot size was 10 m^2 by material and the planting density 46 kg/ha. The trials were planted in ten communities.

Table 3. Varieties Evaluated in Participatory Trials

Cycle	Name	Comment
1,2,3	Chino Grande MV 966[1]	Traditional lowland variety of this area, as check
1,2,3	Brilla Lola MV 957[1]	Traditional lowland variety of this area, as check
1,2,3	Ica 4	"Like traditional" lowland variety of this area, as check
1,2,3	Orizica Caribe 8	Known variety in this area, so reintroduced by the project
1,2,3	Orizica Yacu 9	Lowland variety
1,2,3	Orizica Turipana 7	Lowland variety
1,2,3	Fedearroz 50	Modern lowland variety
1,2,3	Fedearroz 2000	Modern lowland variety
3	Fedearroz Victoria I	Modern lowland variety
1,2,3	Fedearroz Victoria II	Modern lowland variety
1,2,3	Orizica Llano 4	Variety for favorable upland conditions
1,2,3	Orizica Llano 5	Variety for favorable upland conditions
1,2,3	Orizica Sabana	Upland variety
1,2,3	Orizica Sabana 10	Upland variety
1,2,3	Irat 13	Mutant of traditional upland variety of West Africa
1,2,3	Irat 216	Upland rice variety
3	Cirad 405	Upland variety
1,2,3	Cirad 409	Very early upland variety
3	Slip 72-M	Upland variety with long grain
3	PRA 546 [2]-38-71-3-1	Very early upland variety for cold hillsides, RHICO type
3	PRA 553 [3]-45-8-5-1	Very early upland variety for cold hillsides, RHICO type
3	PRA 565 [4]-46-42-2-1	Very early upland variety for cold hillsides, RHICO type

[1] Working collection number, so this variety was fixed by pedigree selection
[2] Irat 114 / Irat 380 ; [3] Irat 265-57-2 / Jumli Marshi ; [4] Khonorallo / Irat 265-57-2

Results and Discussion

During the first semester 2001, most of the trials were destroyed by very high water levels during of May, mainly along the Timbiquí river. The trials were planted again during the second semester 2001. Due to the traditional management, the fields are too heterogeneous for allowing a statistical interpretation of the results. Still relevant information about the general adaptation of the varieties and farmer's preference were determined. For example the Table 4 give a good illustration of the kind of information obtained from a participatory trial. All the traditional varieties are late, and the farmers had a preference for some of the earlier cultivars. The other preferences of the producers are: medium high plant for an easy harvest, good tillering, strong stems, numerous and long panicles.

This project introduced one ton of Oryzica Caribe 8 seeds to reinitiate the rice production on the Timbiquí river strands. This was done before the participatory trials, because the producers had in memory that this variety and it is adapted to this area. It was the only one commercial variety in the memory and the results confirm the producer knowledge. After the flooding in May 2001, three tons of Fedearroz 2000 seeds were sent to the area as it appears to be the best lowland variety accepted by the producer and with enough available seeds.

Table 4. Participatory Evaluation of Rice Varieties, San Miguel July 21, 2001

Varieties		Comments	
#	Name	UMATA technician	Producers
1	Ica 4	Well adaptation for wet lowlands, but poor growth in upland condition with dry and compact soil	Not accepted because the plants are too short, and their growth and development is slow
2	Orizica Caribe 8	Its development in dry land is very different. It is well adapted for lowland	Accepted, it is a known variety recognized for its yield and adaptability in the area
3	Fedearroz 50	Although it is a new variety in the area, it presents good tillering	Accepted by the producers for a possible sowing for its architecture, tillering (the producers are waiting to know its production)
4	Fedearroz Victoria II	Good development and a height acceptable	Accepted by the producers for a possible sowing for its high number of panicles and is moderate height
5	Orizica Llanos 5	Good architecture and excellent tillering	Possible use because it is very well adaptated for the lowland conditions (the producers are waiting to know its production)
6	Irat 216	It is very well for vegetative development and panicle formation	Accepted to have long panicles
7	Chino Grande	Very good tillering	Accepted to be a native variety for their architecture and vegetative development
8	Brilla Lola	Needs lot of humidity. For this reason some time the plants are too short	Accepted to be native, the producer continue the grow of this variety
9	Orizica Sabana 6	Good number of panicles. This upland variety is good for humid lowland	Accepted
10	Orizica Sabana 10	Good tillering	Accepted. Preferred for their strong stems
11	Orizica Yacu 9	Short plant (blooming stage	Not accepted because the plants are too short for an easy manual harvest
12	Irat 13	Good vegetative development and panicle number	Accepted because it likes for warm period and upland conditions
13	Cirad 409	Earlier variety	Accepted for its earliness
14	Orizica Llanos 4	It is a dwarf variety with a bad architecture	Not accepted to be a dwarf variety
15	Orizica Turipana 7	Blooming stage	Not accepted because too late

The surprise was the good adaptation and acceptability of some upland varieties in rain forest. In the third cycle of the participatory trials, some were carried out in favorable upland conditions. IRAT 216 was frequently selected by the farmers. This is an upland variety is performs well under these lowland conditions. Also, it has some tolerance to salt toxicity (Clement, 2001, person. com.), so it may be possible to grow this variety on the strands in the lower part of the rivers.

OUTPUT 3. ENHANCING REGIONAL RICE RESEARCH CAPACITIES AND PRIORITIZING NEEDS WITH EMPHASIS ON THE SMALL FARMERS

3B. Rice and Sorghum Participatory Plant Breeding in Central America

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Introduction

This new collaborative research project between CIAT and CIRAD was first discussed and agreed upon during the fifth CIO/CIAT meeting held in Cali in June 2001. It was further strengthened by discussions between CIAT and CIRAD-CA (first proposal of a concept-note of the project) and by the visit of Dr. Gilles Trouche to Nicaragua, Honduras and CIAT's Headquarters in November 2001. The project began in April 2002 with the signature of a Memorandum Of Understanding between CIAT and CIRAD-Ca and further outposting of Dr. Gilles Trouche in Managua, Nicaragua. The project proposes to develop participatory variety selection (PVS) and participatory plant breeding (PPB) approaches for two « model plants » -- i.e., rice and sorghum – for small and medium-scale farmers undergoing progressive crop intensification and increasing access to markets.

Upland rice, otherwise known as aerobic rice, is a developing staple crop in several Central American and Caribbean countries, mainly in plains with high rainfall (1300-1500 mm per year) but also on hillsides as a component of diversified cropping systems. The total area of rice, upland and irrigated, in Central America and the Caribbean totalizes 630,000 ha with a global paddy production of approx. 2400,000 tons (FAO, 2002). In Nicaragua, aerobic rice covers 55,000 of the 83,000 ha which makes up the average total rice area (MAGFOR, 2002).

Because of its superior drought tolerance, sorghum provides an alternative production to corn in the semi-arid areas, non-irrigated cropping systems of Central America and the Caribbean. In four Central America countries (Honduras, El Salvador, Nicaragua and Guatemala) sorghum-planted areas comprise approximately 255,000 ha, half of which is cultivated by small-scale farmers. In these semi-arid areas, sorghum grain is either used for human consumption (particularly replacing corn in "tortillas") or as animal feed (poultry, pigs) while straw is an important forage for cattle during the dry season.

The project aims to further develop methodologies of PPB and to improve breeding material. The specific objectives of the project are two-fold:

- The PPB work will be conducted in cooperation with existing farmer organizations and other relevant local actors. It is through these organizations that the activities of the project will be organized.

- The PPB will be based on the genetic enhancement of locally adapted populations with a broad and/or narrow genetic base, mainly through recurrent selection but also through more conventional breeding methods.

For rice, segregating material and fixed lines derived from populations and crosses developed by the CIAT Rice Project will be used.

For sorghum, it is proposed that introduced segregating and fixed material from CIRAD West-Africa Breeding Programs will be used. This material is genetically and morphologically diversified. Other available local improved breeding materials (from INTSORMIL and regional NARS) will also be used. All this material would first be evaluated together with farmers for adaptation to local cropping systems. Special emphasis will be placed on environmental adaptation (response to photoperiod, drought and pest tolerance) and on grain and forage quality. Existing composite populations developed from African germplasm may be further enhanced using better local materials to correspond to local constraints and production objectives.

Participatory and decentralized plant breeding is a breeding strategy which addresses needs and preferences of small-scale farmers in marginal areas where conventional plant breeding had little success. PPB proposes to involve farmers and other product users of a specific crop in all stages of a breeding program. Decentralization would ensure that the specific conditions of the target environment (climate, soils, agronomic practices …) are respected, in order to better control genotype by environment interactions, which are often very high in traditional cropping systems in marginal areas. PPB goals may be 1) gains in productivity, and a higher product value through quality increment 2) better effectiveness of breeding work because of effective targeting of user needs and production conditions 3) biodiversity enhancement and dynamic conservation of diversity 4) capacity building and knowledge generation for farmer communities and formal research (Sperling et al., 2001). Stakeholders participation in a PPB program can be characterized depending on the stages of participation during the process development of the new varieties, their degree of participation and the role of the different actors (Sperling et al., 2001). In PPB, we used to distinguish Participatory Varietal Selection (PVS) in which farmers select for fixed lines or varieties and Participatory Plant Breeding (PPB), in which farmers participate in the selection of segregating material (Witcombe et al., 1996).

General Problems

Rice blast (*Pyricularia grisea* Sacc.) is one the major constraints to upland rice production in Central America. Other main constraints for rice production enhancement identified in Nicaragua and Honduras are: a lack of improved varieties which are adapted to the diverse farming systems, insufficient weed control, drought, unsatisfactory grain quality for industry requirements and competitive pressure from imported rice.

Factors that limit sorghum yields and farmers' gains include drought, low soil fertility, pests (midge, head bugs, fall armyworm) and diseases, as well as low straw quality and little improved varieties offer.

Materials and Methods

Identification of Sites and Partners

This first step, necessary for adjusting and implementing this project, started during the first trip in November 2001, to Nicaragua and Honduras. During these first five months of implementation of the project activities, we focused our activities on these two countries. Emphasize was placed on Nicaragua, the actual project location, because of the country's greater diversity of agroclimatic and institutional environments for both rice and sorghum.

For the identification of sites, existing literature from different sources was reviewed: national agricultural statistics, research publications from NARS, CIAT and other institutions, studies from NGO and projects etc. Additionally, interviews and meetings were conducted with key informants such as national researchers, CIAT staff, extension services and NGO leaders, in order to verify and complete the former information. Field visits in the regions during the cropping season have also been frequently organized.

For the identification of partners, not only CIAT's long experience and institutional relationships in the region were used but also CIRAD's experience and relationships in Nicaragua developed during the 90's with project such as the "Programa Regional de Reforzamiento a la Investigación Agronómica sobre los Granos en Centroamérica" (PRIAG). Regarding possible NGOs as partner, we mainly looked for local organizations having a great experience in technical or/and financial support to small and medium-scale farmers in one or both crops, in training for farmer experimentation and in farmers' organization capacity building and NGOs which work with networks of farmers in the project area.

Diagnostic on Crop Systems and Farmers' Variety Needs

This activity comprises diagnostic to characterize the rice and sorghum cropping systems as well as farmers' variety needs. For this purpose, several meetings and workshops were organized with farmer groups in the study area.

Regarding rice, knowledge on farmers' needs and results of participatory evaluation of new rice varieties which have been underway since 1998-99 are available for the hillsides areas of Yorito in Honduras and San Dionisio in Nicaragua, where the CIAT hillsides project PE-3 has been working for many years in participatory evaluation of new germplasm in relationship with the CIALs farmer committees. In these regions, rice is considered as an alternative staple crop to the two predominant crops, bean and maize. Outside these areas, three meetings were organized jointly with INTA and/or the NGO NITLAPAN with rice growers in upland rice areas of Rivas (Ochomogo and San Juan Viejo villages), Jalapa and Masaya. Three other meetings are programmed in collaboration with NGOs for September and October in the rice growing areas of Chinandega, Quilali and Waslala.

For sorghum, very few recent data about constraints of cropping systems and farmers' variety needs are available in the existing literature. Therefore, it was considered necessary to conduce a more complete diagnostic study at the beginning of this project. The diagnostics will be carried out by two students from CNEARC Tropical Agronomy School (France) and UCA University (Nicaragua) in one representative sorghum production area with small and medium-scale farmers in Nicaragua. The first thesis work is been conducing by Felipe Martinez to obtain a master of science in tropical agronomy. The thesis work comprises a participatory diagnostic of sorghum cropping systems and variety diversity used and proposals for developing a participatory breeding program for the Madriz department area, in Esteli region (North of Nicaragua). This study is being carried out in collaboration with the NGO INSFOP/UNICAM in four farmer communities which represent different sorghum production conditions in these semi-arid hillsides in relation to climate, soils, topography, ethnic skills, social organization and institutional environment. The second thesis work seeks to improve the understanding of the cultural practices, constraints (abiotic and biotic) and potentiality for different sorghum cropping systems (including photoperiod-sensitive and insensitive sorghum type) in three farmer communities of the same region. For the first study, workshops were organized in each community in order to get general information about the community (natural resource map, social classification). Information was also gathered on the history of the sorghum crop, existing cropping systems, present and old varieties used and farmers' needs to improve sorghum production and use. Individual semi-structured interviews with 10 to 12 farmers and focus interviews with key informants were held in each community. Following the workshops, local sorghum varieties were collected from each community. The main part of these varieties were planted in one of the community for a participatory characterization and classification of these with farmers.

For the second thesis, about 40 sorghum plots will be studied during the two growing seasons of sorghum, *primera* and *postrera* in the three selected communities.

In other regions of Nicaragua, three meetings with sorghum producers have been organized in collaboration with local NGO or with the CIALs in Somotillo (one of the driest region of Nicaragua), in Ciudad Dario and in San Dionisio. During each meeting, a rapid participatory diagnostic on sorghum cropping systems, utilization of grain and stover, existing varieties and farmers' needs was conducted, which permitted to determine objectives, conditions and choice of the varieties for the PVS trials to be proposed during this first year. Two meetings have also been organized with farmer groups in Honduras, in the El Paraiso department in collaboration with the NGO Movimondo and in Yorito in collaboration with IPCA and the CIALs.

Plant Materials

Evaluation of rice and sorghum germplasm introduced from different sources:

Rice

Observation Nurseries

- 323 CIAT progenies from CIAT/Peru program and from interspecific crosses *Oryza sativa* x *O. glaberrima*, *O. sativa* x *O. barthii* and *O. sativa* x *O. rufipogon* for lowland irrigated conditions or favorable aerobic conditions (from Cesar Martinez program).
- 24 F_4 CIAT-CIRAD progenies derived from PCT-4 population for aerobic upland conditions (from Marc Chatel program).
- 5 CIAT-CIRAD varieties for upland conditions: CIRAD 409, 446, 447, ORYZICA Sabana 6, ORYZICA Sabana 10
- 6 CIAT varieties for irrigated conditions : Fedearroz 50, Fedearroz 2000, Bg90-2, Oryzica 1, Selecta 320 and Oryzica 3

Participatory Breeding

- PCT-18 : narrow genetic base population adapted for upland conditions for rice blast resistance and grain quality (from Michel Vales program).
- PCT-17 : narrow genetic base population adapted for high altitude hillsides upland conditions for rice blast resistance, cold tolerance and grain quality (from Michel Vales program).

Participatory Varietal Selection

- 14 advanced lines and varieties from INTA Rice Program for upland and lowland conditions.
- 9 CIRAD varieties from collaborative program in Ivory Coast, Brazil and Madagascar for less favorable upland conditions.
- 15 CIAT-CIRAD advanced lines for high altitude hillsides.

Sorghum

Observation Nurseries

- 21 photoperiod sensitive landraces and improved lines from CIRAD germplasm collection (late-flowering core from different origin Cameroon, Chad, Mali, Burkina, Sudan).
- 30 fixed lines, landraces and varieties from CIRAD-INERA program in Burkina Faso and other African origins with drought tolerance, early-flowering, foliar diseases and midge and bugs resistance or double purpose use.
- 13 forage sorghum and pearl millet advanced lines and varieties from ICRISAT-CIAT program in Colombia.

Participatory Varietal Selection

- 22 improved varieties from different CIRAD collaborative programs in West Africa (14 from joint CIRAD-INERA program in Burkina Faso) with drought tolerance, foliar diseases and sorghum midge and bugs resistance or double purpose use.
- 5 improved varieties from INTA.

Methods

Observation nurseries were planted on INTA experimental stations in Managua (CNIA), Posoltega (upland rice) and Sebaco (irrigated rice) and at the CIAT referential site SOL for agriculture hillsides of San Dionisio in Nicaragua. PVS trials and PPB work were conduced at the referential sites SOL of San Dionisio and Yorito (Honduras) and in farmer fields in Madriz, Rivas and Chinandega departments in Nicaragua.
For rice, one observation nursery with 30 lines and varieties was planted on the Posoltega INTA experimental station. Another nursery will be planted during the 2002-2003 dry season with 342 F_6 diversified lines for lowland conditions on INTA experimental station in Sebaco valley. Three PVS trials were planted at the CIAT referential sites of San Dionisio (low hillsides) and Yorito (medium and high hillsides) with respectively 12, 7 and 12 entries. Two rice populations were sown at San Dionisio (PCT-18) and Yorito (PCT-17) to start a PPB work with local CIALs. Two on-farm PVS trials were planted in the Rivas region with both 18 entries. The designs used for PVS trials were randomized complete blocks with two o three replications.

For sorghum, four nurseries were planted for observation and seed multiplication in Nicaragua, respectively on the Managua CNIA station, at the San Dionisio referential site SOL (2 nurseries) and at an INTA site of experimentation in Madriz during the *primera* and *postrera* seasons, with respectively 51, 11, 28 and 20 lines and varieties, including local checks. Seven PVS trials were planted during the second growing season (*postrera*), each one trial at the referential sites SOL of San Dionisio and Yorito, while the remaining four were conducted on-farm in the five different communities of Nicaragua and Honduras in which workshops and rapid participatory diagnostic of variety needs with local farmer groups have been previously carried out. The designs used for PVS trials were randomized complete blocks with two replications.

Preliminary Results (April to September 2002)

Identification of Partners and Sites

For both Nicaragua and Honduras, the CIAL farmer committees in San Dionisio and Yorito will be partners for both crops. Rice and sorghum are an alternative food crop to maize and bean in these mountainous areas. In both countries, CIALs have been involved since 1999 in participatory evaluation and selection of new upland rice varieties. Moreover, in the San Dionisio area, the NGO Prodessa had previously carried out participatory on-farm trials for rice varieties since the early nineties, which has led to the adoption by farmers of two improved IRAT varieties. Possible partners in San Dionisio and Yorito include local NGOs and farmer organizations already involved in the SOL and CIALs processes such as Campo Verde y ADDAC in San Dionisio and IPCA and Sertedeso in Yorito.

INTA is considered a strong, responsible partner in Nicaragua for the research area because it manages research programs both for rice and sorghum and recently concluded a general agreement of scientific cooperation with CIAT. A specific agreement for the project has been written and will most likely be completed between INTA and CIAT before October.

Other project partners in Nicaragua will be the NGOs NITLAPAN and UNICAM/INSFOP. NITLAPAN is the first provider of micro-credit for small and medium-scale farmers in Nicaragua. Besides providing micro-finance, NITLAPAN also supplies training and technical assistance to a wide network of farmers. In collaboration with this NGO, four meetings with farmers had been carried out while three rice and sorghum PVS trials were co-managed at two representative sites of sorghum and rice production areas. A specific agreement between CIAT and NITLAPAN is currently under discussion. For the dry hillside areas of North of Nicaragua, we have identified the local NGO UNICAM as a strong partner for the sorghum activities. Since 1996, UNICAM has been offering training and technical support to experimental farmers groups, which are known as CPEC. UNICAM works in 11 villages and with 70 communities representing 1200 families. It is a very active promoter of farmers exchanging knowledge and experiences, organizing every year in Nicaragua a Central American meeting for innovative farmers. Developing the PPB activities with the CPEC network could probably lead to a rapid and major impact. In 2002, UNICAM is involved in the diagnostic work on sorghum cropping systems and variety diversity, as well as the sorghum PVS trials carried out in the Madriz department.
For Honduras, we have identified the NGO Movimondo and the Alauca area as probable partner and site for sorghum activities. The traditional rice area of Comayagua department has been identified as an appropriate region to conduce PPB rice activities; its proximity from Yorito area will permit to take profit and to authorize a better impact of the results here obtained because, contrary to Yorito area, the Comayagua area is an old and present rice area where exist a great farmer knowledge of the crop and functional plants for transforming and commercializing rice.

Diagnostic on Crop Systems and Farmers' Variety Needs

Rice
In the traditional upland rice area of Rivas in the Pacific plains of Nicaragua, rice covers about 2,000 hectares. Production is mainly carried out by small and medium-scale farmers. Meetings with rice producers groups in Ochomogo and San Juan Viejo have helped to identify soils fertility, rice blast, bugs, climatic conditions (rainfall irregularity, drought and drying winds in November), access to credit and selling prices as major constraints to rice production in the area. Implementation of modern improved varieties of rice from INTA or ANAR (Asociacion Nacional of Arroceros) is generally low and depends on the level of intensification and the institutional environment. In Ochomogo, with the influence of the local farmer cooperative which exploits 70 hectares for rice production with irrigation, upland rice producers of this area know and partially use modern varieties. In San Juan Viejo, farmers use two modern varieties, limited on the flattest areas with better clay soils, but still use four local or ancient improved varieties, more rustic, to plant on the hillside less fertile soils. Farmers ask for new varieties that will provide plants with intermediate height (80-100 cm), early-flowering (90-100 days to harvest), resistant to blast rice and bugs, less fertilizer consuming (in comparison with INTA modern varieties), good grain and straw yields and adequate grain quality for market. Both villages are very interested in testing new rice varieties within their own environments.

In the wet, fertile Jalapa valley in North of Nicaragua, upland rice is an important and traditional crop, the third most cultivated after maize and bean. In the 1980s, rice cultivation in the valley reached 3,300 hectares (1982) and then decreased to 1750 ha in the 1990s and 1000 ha in 2002 because of lack of credit, problems of land property and low prices on the national market. Because of a government program introduced in 2001 to increase prices paid to the farmers, in order to boost the national production of rice (PAPA program), prices are now more incentive for rice producers. In this area, rice production is carried out by medium and large-scale farmers and firms. Blast rice and red rice are the main production constraints, while Cerscosporium and Rhyncosporium diseases appear to be secondary constraints. Farmers use mainly three varieties, ANAR 97, Altamira 9 and Altamira 14. In addition to increasing resistance to the aforementioned diseases, farmers are now asking for more early-flowering varieties in order to permit different planting and harvesting dates. The farmers appear to be satisfied with grain yield potential and grain quality of the above varieties.

In Masaya area, where favorable soils and climatic conditions allow diversified farming systems (including maize, rice, bean, cassava and fruits), rice is mainly produced for family consumption. Like in the San Juan Viejo area, the use of "official" modern varieties seems to be low. Since the 1990s farmers have been accessing new varieties and seed via informal exchange with other farmers or NGOs. The exact origin of these varieties is not known. Because of recent rainfall irregularity, farmers have been asking for more drought-resistant varieties with intermediate height (1-1.2 m) and resistance to lodging.

Sorghum

The diagnostic study carried out centered on four communities in the Madriz department. The study revealed a great diversity of sorghum cropping systems. Photoperiod-sensitive sorghum landraces, generally referred to as "millón" in Nicaragua and "maicillo" in Honduras, are planted in combination with maize, bean or insensitive sorghum with different geometric arrangements depending on soils, slopes or climatic constraints as well as farmers' strategies and goals. Because of its rusticity and ability to adapt to poor, unfertilized soils, as well as its very long cycle (may to December) which allow to support better middle season droughts, millón play an important role in the kind of low-risk crop that guarantees family subsistence production when maize and/or bean production has failed. Since the mid-1980s, short cycle and insensitive white grain sorghum have gradually been replacing maize and millon on the flattest and most fertile lands. As a result, millon sorghum is now more concentrated on the hillsides, as it is also the case in the area of Somotillo and in the semi-arid central hillside area of Ciudad Dario-Terra Bona. In the Madriz department exists an interesting connection between the diversity of sorghum varieties and the cropping systems with their diversity of production constraints and goals. Therefore, following the workshop organized in each of the communities, 30 varieties were collected in the four communities taking part in this study. Among them, 18 are supposedly photoperiodic-sensitive landraces and two are broomcorn varieties. All these varieties have been planted both on–farm and on the Managua CNIA station. At the on-farm site, a participatory characterization and classification of these varieties will be carried out with farmers from the four communities. More formal descriptions of these varieties will also be obtained from both sites. Numerous varieties are thought to come from the border countries of Honduras and El Salvador, demonstrating the importance of informal exchange of seed between farmers. No improved short-type millon varieties were found during this survey. Among short-cycle insensitive improved varieties, Tortillero precoz is the most largely diffused variety in entire Esteli region (Julio Molina, personal communication). This variety is a derived line from IRAT 204, a CIRAD/ISRA-improved variety from Senegal, which is well adapted to sahelian conditions and has a good grain quality. Short-cycle sorghum is mainly planted during the *postrera* season (August to November) in order to achieve three different objectives: grain for family consumption (tortilla, pinol), grain for chickens and pigs, and straw for ruminant alimentation (for farm needs or for selling). The importance of these objectives depends on production constraints and on the individual strategies of the farmers.

The following breeding objectives resulted from the different workshops organized with the farmer groups:

a) Photoperiod-Sensitive Sorghum:
- To decrease plant height in order to reduce risks of lodging and to better control head insects
- To improve grain yield
- To decrease plant cycle for harvesting in December (more early flowering and to reduce flowering-maturity duration)
- To improve straw quality (more green leaves at harvest, improved stem quality)

b) Short-Cycle Insensitive Sorghum:
- To improve grain and stover yields
- Improved resistance to bugs, sorghum midge and stocks insects
- Better grain size in order to achieve a better price
- Early cycle and drought resistance
- Grain quality to give good white tortillas
- To improve stover quality for ruminants

Crop Improvement

Following former participatory testing and selection with farmers initially carried out by the NGO Prodessa and then by CIAT hillsides project in collaboration with the CIALs in San Dionisio, IRAT 301 and IRAT 364/90 have already been adopted by farmers in the hillside central regions of Nicaragua. Data from on-farm trials along with qualitative information from farmers was collected in order to convince INTA to include these two varieties into the official validation for 2003 with a view to a possible official release in Nicaragua.

As a result of the last two years' on-farm trials with CIALs, the rice varieties IRAT 301, IRAT 362 and IRAT 364 are now in a phase of demonstration trials in the low hillside area of Yorito, Honduras. IRAT 364/90 and IRAT 392 are, meanwhile, in validation trials for high hillside conditions in the same region. An official release of the best two or three varieties has to be decided on in 2003.

For all on-station and on-farm trials conducted in 2002, the first results for participatory evaluation and selection with farmers groups and agronomic data will be available in October-November.

Futures Activities

1. Implementing activities of diagnostic and PVS trials at all sites in Nicaragua and Honduras.
2. Writing a project proposal to obtain funds from French Cooperation for Centro-America for further sorghum activities .
3. Visit to Guatemala and El Salvador to identify areas and possible partners and donors for the project (2002).
4. Visit to Haiti (2003).

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OUTPUT 3. ENHANCING REGIONAL RICE RESEARCH CAPACITIES AND PRIORITIZING NEEDS WITH EMPHASIS ON THE SMALL FARMERS

3C. CIAT – FLAR Collaboration

The Latin American Fund for Irrigated Rice (FLAR), created in 1995, is one of the institutions located in Agronatura. CIAT, one of its founding partners, makes an annual contribution to be a member of FLAR. In addition, CIAT has provided financial and administrative support to FLAR as well as support for training. FLAR is mainly an outreach mechanism for scaling out research results generated at CIAT. The network of collaborators include nine country members with multiple organizations in each country linked to the private sector (producers, millers, seed multipliers) and the public sector.

As a service to FLAR, CIAT provides the infrastructure for the evaluation of rice lines for resistance to *T. orizicolus* and RHBV. CIAT also processes FLAR rice lines in the anther culture facility. The milling and cooking quality laboratory is a joint activity, with CIAT providing space and instruments and we share labor costs. FLAR maintains a germplasm bank, which contains well characterized materials for crosses. This has provided many of the materials that are going into the CIAT rice germplasm bank that will be maintained in the Genetic Resource Unit of CIAT.

This year, FLAR selected 81 advanced lines, mainly from the interspecific crosses made at CIAT, for further evaluation. Although germplasm exchange has mainly been by FLAR of CIAT lines, we expect that this will become a reciprocal activity. CIAT has free access to all FLAR lines for research purposes. FLAR, FEDEARROZ and the Rice Project have agreed to have closer collaboration in the development of improved germplasm with resistance to Rhizoctonia. Advanced lines derived from interspecific crosses with *O. rufipogon*, as well as Oryzica 3, Palmar, Pankai and Remadja will be used as donors. The CIAT rice pathology group and Patricia Guzmán of FEDEARROZ will do the greenhouse and field evaluation of the breeding populations. Some single crosses from FLAR that already had Palmar as a donor were top-crossed to Pankai, Remadja and will be one of the populations tested.

For rice blast resistance, the CIAT pathologist has collaborated with FLAR members in establishing a hot spot for rice blast in Brazil and training in breeding methodology for stable resistance. A long-term joint study between CIAT and FLAR was initiated in 2000 to evaluate the association of selection for blast resistance in early generations (F_2) and the stability of this resistance in advanced generations. Since blast resistance is the result of the action of many resistance genes, our hypothesis is that F_2 families which show a higher number of blast resistant plants, and which showed a higher number of resistant sister lines, will give origin to more stable resistant lines in the advanced generations. On the contrary, those lines originating from F_2 resistant plants selected within crosses where F_2 susceptible plants predominate, will be less stable. This study has implications for the method of selection for durable blast resistance and will help breeders to concentrate in those crosses with higher probabilities of yield stable blast resistant lines.

FLAR complements activities of CIAT in the area of crop management efforts. FLAR has ongoing crop management activities in Venezuela, Brazil, Colombia, Costa Rica, and Guatemala.

OUTPUT 3. ENHANCING REGIONAL RICE RESEARCH CAPACITIES AND PRIORITIZING NEEDS WITH EMPHASIS ON THE SMALL FARMERS

3D. Collaborators, Training and Information

- **Collaborators**

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Peter R. Jennings, Consultant
Edward Pulver, Consultant
Edgar A. Torres, Research Fellow
Luis Sanint, Executive Director

Training

- **Thesis**

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- **Workshops**

1. Reunión interna del Proyecto Arroz. CIAT. Noviembre 5-6, 2002. Presentaciones de trabajos realizados durante el año. Participants: 40.
2. Colombian Biosafety Workshop: Organized by OEA and Cambiotec, Canada. October 2002. Cartagena, Colombia. Z. Lentini Lecturer. Participants: 50 .
3. 2o. Taller Internacional sobre Manejo de Plagas en Arroz. Juma, Bonao, República Dominicana, Octubre 28 a Noviembre 1, 2002. Participants: 40
4. Biosafety Workshop: Z. Lentini, P. Chavarriaga, J. Tohme. Coordination of Workshop on Agriculture Biosafety for the Colombian Ministry of Environment. September 15-18. CIAT, Cali, Colombia. Participants: 25.

5. Valès Michel. Taller II, “Desarrollo participativo del arroz de laderas” Escuela Verde, Santander de Quilichao, Cauca, Agricultores pertenecientes a la red ARDECAN de CETEC. Abril 12, 2002. Participants: 13.
6. International Course on Biosafety of GMOs: Organized by University of United Nations, Tokyo Chapter BioLAC. April 2002. Caracas, Venezuela. Z. Lentini Lecturer. Participants: 30.
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8. Châtel, M.; Ospina, Y.; Gamboa,C.; Marassi, M.A.; Marassi, J.E.; Hernaiz, S.; Alvarado, R., Taboada, R.; Guzmán, R.; Pérez, R. Composite population breeding using recurrent selection in Latin America and the Caribbean. 29th Rice Technical Working Group Meeting. Arkansas, U.S.A. February, 2002. Participants: 300.
9. Biosafety Open House: Z. Lentini, P. Chavarriaga, J. Tohme. Workshop on the Biosafety of GMOs for the CIAT community. November 27 – December 2, 2001. Participants: 100.
10. I Taller Internacional de Selección Recurrente de Arroz de Riego.Venezuela-San Felipe, October 2001. CD ROM publication by Fundación DANAC-Venezuela, CIAT/CIRAD-Colombia and EMBRAPA-Brazil. Participants: 31.
11. II Taller Internacional de Arroz de Secano en Bolivia. Marzo 4-9, 2002. Moreno Berrocal, A.; Châtel, M.; Guimarães, E.; Ospina,Y. Estudio agronómico del sistema arroz (*Oyza sativa* L.) intercalado con siembras nuevas de café (*Coffea arabica* L.). Participants: 18.

- **Formation and Training**

1. José Martinez Teruel, student at the ENITA of Clermont-Ferrand, France. He was received by Fundación DANAC-Venezuela to do its technical practice work, during 6 months from May to October 2002. Supervisor Dr.Marc Châtel.
2. José Hurtado. INIA. Programa de Arroz del Ecuador. Entrenamiento en Mejoramiento de Arroz bajo la supervision del Dr.Martínez durante Junio y Julio 2002 en CIAT Palmira y en Laboratorio de Fitopatología y entrenamiento de campo en la Estación Experimental de Santa Rosa bajo la supervision del Dr.Correa en Agosto de 2002.
3. Renata Pereira da Cruz. Ph.D. IRGA Brasil. Cultivo de Anteras. 12 Agosto, 2002. Supervisor Dr.Zaida Lentini.
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- **IP-4 Web Site** – María Nelly Medina

Starting in May 2002 CIAT launched a new format for its Web Site. This format is more user friendly and contains much more information that is useful to our partners than the previous version. The CIAT Rice Project Web Site is in both English and Spanish which fulfills the needs of the majority of our visitors. Posters, pamphalets, and manuals of selected research topics are included to highlight strategic work and give greater access to this information. Significant effort is also devoted to keeping the site updated with relevant information on contacts, publications, research activities at CIAT as well as events in the rice sector. We hope that you find the CIAT Rice Project Web Site useful.

http://www.ciat.cgiar.org/riceweb/index1.htm
http://www.ciat.cgiar.org/riceweb/esp/inicio.htm

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