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**NEW CHALLENGES AND TECHNOLOGICAL SOLUTIONS FOR  
RICE-BASED PRODUCTION SYSTEMS FOR FOOD SECURITY  
AND POVERTY ALLEVIATION IN LATIN AMERICA AND THE  
CARIBBEAN (LAC)**

By:

Luis R. Sanint

Executive Director

Fund for Irrigated Rice Development in Latin America (FLAR)

Centro Internacional de Agricultura Tropical

Cali, Colombia

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## NEW CHALLENGES AND TECHNOLOGICAL OPPORTUNITIES FOR RICE-BASED PRODUCTION SYSTEMS FOR FOOD SECURITY AND POVERTY ALLEVIATION IN LATIN AMERICA AND THE CARIBBEAN (LAC)

Luis R. Sanint, Executive Director FLAR

**"Rice is life": Aspects of rice-based systems in LAC.** The slogan of the IYR fits well to the LAC region. Rice plays a prominent role as a primary food source and rice-based systems are essential for food security, poverty alleviation and improved livelihoods. Rice became an important staple and a basic cash crop during the past century. It evolved from being a dominant pioneer upland crop in the process of expansion of frontier areas in the first half of the century, to become, in the past four decades, a well established, intensive, highly technical crop mainly produced in flooded environments.

**Rice Production.** Rice is now cultivated in 113 countries of the world and on all continents except Antarctica. Of those, 26 countries belong to the LAC region; they annually produce in excess of 22 million tons (paddy). Present world rice production is around 592 million tons of paddy (average 2000-2002) of which LAC represents four percent (FAOSTAT 2003). Rice area harvested in LAC is around 5.9 million ha. Annual rates of growth for production over the 1961-91 period were almost identical in Asia and in LAC, at 2.9% per year. Most of the growth in Asia was explained by the contribution from enhanced productivity (79%). In LAC, yield increase accounted for 51%. Over the last decade, rice output in LAC expanded at 1.9% per year, compared to 1.3% in Asia, while yields grew at an outstanding 3.8% per year, versus 1.0 in Asia and area contracted at the pace of 1.8% per year (Table 1). Since 1967, more than 300 new rice varieties were released in LAC (or about ten new varieties every year), the majority of them (90%), targeted to flooded environments. Of the new varieties, 40% came from crosses made at CIAT and several of the rest has parentage from CIAT and/or IRRI progenitors. Modern semidwarf rice varieties (MSV's) now account for 93 percent of all flooded rice production, itself representing more than 80 percent of total rice production in the Region. Average yields in flooded areas have risen from 3.3 tons per hectare in the mid-1960s to 4.9 t/ha by 2002; and total rice production almost tripled between 1967 and 2002 to reach over 22 million tons of paddy rice.

Table 1. Annual rates of growth for rice in the world

	1961-91			1992-2002		
	Production	Yield	Area	Production	Yield	Area
Asia	2.9	2.3	0.6	1.3	1.0	0.3
Africa	2.7	0.4	2.3	2.6	0.3	2.3
LAC	2.9	1.5	1.4	1.9	3.8	-1.8
World	2.7	2.1	0.7	1.4	1.1	0.3

Source: FAOSTAT 2003

**Rice Consumption.** Throughout this century, rice gradually became a staple food in the diets of consumers of tropical Latin America. Per capita consumption of white rice went from less than 10 kilos in the 1920's to about 30 kilos in the 1990's. Although significant improvements have been witnessed in rice production in the LAC, regional demand surpasses production. The region has a net deficit of nearly 1 million tons of milled rice annually. Apparent consumption is approximately 30 kg/capita for the 511 million habitants of the region. There are 14 countries/states in the Caribbean that have little potential for domestic rice production and will

continue to be rice importers. However, there are another 14 countries that have a shortfall in local production to meet internal rice needs but have the natural resources available to support additional rice production, to satisfy national demand and even generate surpluses for the export market.

**Nutrition.** In the developing world as a whole, rice provides 27 percent of dietary energy supply and 20 percent of dietary protein intake. Rice is the most important grain crop for human consumption across most of the tropics of LAC. It supplies more calories to these people's diet than wheat, maize, cassava, or potatoes. In the rapid process of urbanization of LAC, where 70% of the population now lives in the cities, rice has displaced from the diets traditional, bulky and perishable staples like plantains, cassava, yams, potatoes, etc. About half of LAC's population lives below the FAO poverty line, and income is lowest in the tropical parts of LAC. Food purchases account for over 50% of total expenditures for the poor, and rice accounts for about 15% of their total food purchases. With rice prices falling by about 50 percent in real terms over the period, consumers have been the main beneficiaries (Sanint et al, 1998). In the tropical regions of this continent, rice is now well established as a "wage good". There has been a marked increasing trend in consumption during the last 15 years on high level consuming countries like Ecuador, Dominican Republic, Cuba, Perú, Brazil, and Colombia. Rice is the main source of calories and protein for urban dwellers in big centers such a Sao Paulo, Rio, Porto Alegre, Panama, Barranquilla, Guayaquil, etc. In spite that the average consumption level is far from that of Asian countries, Brazil, the largest producer in the region accounting for half of its supply, is at the level of 60 kg *per caput* of paddy rice, equivalent to a daily intake of 400 calories.

**Agro-biodiversity and Environment.** A paramount achievement of rice technologies in LAC was the fact that its production tripled while area did not grow. This was, largely, the result of higher yields in the irrigated sector and it is a vivid example of the release valve effect that higher yields on favorable ecosystems have on other less favorable, more fragile environments. Unit cost of rice fell by over 50% in real terms and this was accompanied by a similar fall in prices. Rice ceased to be a preferred crop in those less favored environments and its production moved to the flooded systems. The role of rice in agricultural and rural development has been notorious. The cereal was a key pioneer crop in the early part of the century as traditional and improved tall upland rice varieties were very well adapted to the newly opened, frequently acid soils of the savannas, the lowlands and the forest margins. Upland rice area peaked at more than 6.0 million hectares in 1976, when it accounted for over 75% of the rice area in the region. With the incursion of the new semidwarf varieties in the 1970's, upland rice lost its competitive ability against the rapidly growing yields and the descending real unit production costs of the flooded rice areas. Currently, upland rice has plunged to less than 2.5 million hectares (40% of the rice cultivated area in LAC), its vast majority still found in the Brazilian Cerrados, as rice production increasingly concentrates in the more stable lowlands under irrigated and flooded conditions driven by the higher productivity of these systems. Rice-based systems are hubs of biodiversity. They combine well with other agricultural production activities, such as the raising of fish or ducks on waterlogged rice fields, and the feeding of rice straw to livestock. In turn, ducks and fish feed on weeds and small aquatic organisms, while livestock help with transportation and land preparation, as well as providing organic fertilizer. Rice fields also host a wide variety of natural enemies that control harmful insects and pests

**Water and land management.** In LAC, rice is a key commodity in pasture establishment and renovation, mainly in Brazil (both in the upland Cerrados as well as in the temperate irrigated areas of the South), Uruguay and Argentina. In the temperate region, the system includes

cattle and sheep. While rice was a preferred crop in forest margins settlements in the 1960s and 1970s, the drop in its price associated with higher yields and lower unit costs relegated it in the rank of alternatives, particularly in Central America, Colombia, and Ecuador, to maize, cassava, cotton, etc. In Brazil, Peru and Bolivia, rice is still important among forest margins settlers. In the Cerrados, besides pastures, rice is a key element in rotations with other crops, mainly soybeans. In several flooded areas, rice is the only viable cash crop and represent a vital tool to the efficient management of such ecosystems. In these ways, rice-based systems provide great opportunities for improved nutrition, diversified agriculture, increased incomes and the protection of genetic and agricultural resources.

**Employment and income.** Rice cultivation is the principal activity and source of income for about 100 million households in Asia and Africa, and several countries are highly dependent on rice as a source of foreign exchange earnings and government revenue. In LAC , there are close to one million rice producers. Together with the crop activity, important linkages occur in milling, mechanization, commercialization as the threshing, milling, processing, market transport and post harvest of rice helps support rural livelihoods and other rural people generate income from producing, servicing and maintaining tools, implements and equipment for rice cultivation and post-harvest operations. Furthermore, rice involves many professional services and other indirect effects on employment, investment and growth, as rice has an important multiplier effects on aggregate demand to the extent that there are places known as rice regions and rice towns as this cereal constitutes the life of the community.

**Gender.** Women and men often develop different agricultural expertise and knowledge, and women play important roles in both rice production and post-harvest activities specially among the traditional farming systems in forest margins of LAC.

**Science.** Improved technologies enable farmers to grow more rice on limited land with reduced need for water, labor and agro-chemicals. In rice cropping, a significant number of scientific developments converge that go from biological knowledge and discoveries, to engineering (machinery, irrigation, post harvest), social sciences, management, statistics, etc. The confluence of all this wealth of information, coupled with resource endowments and attitudes of diverse social groups towards them, configure a very wide array of rice cropping systems throughout LAC.

**Economic policy issues.** For many decades, rice was one of the most heavily protected agricultural commodities. Since the 1980s, structural adjustment programs and the 1994 WTO Agreement on Agriculture have changed this situation, and world rice trade is expanding strongly. Still today, rice is the most subsidized cash crop in the world. While urban consumers enjoy most of the benefits (especially lower rice prices) many of them face the effects of unemployment associated with the deployment of the national rice production capacity. Yet, rice farmers in developing countries bear the brunt of change. Developing countries now face the challenge of advocating for fair rice trade policies and practices where everyone will be able to reap the benefits associated with more efficient resource allocation.

## **Challenges and Opportunities for Rice in LAC**

The IYR aims to confront the many issues associated with rice-based systems in a global, coordinated framework in order to positively harness the potential of properly managed rice-based systems. The following discussion touches on the issues identified at the global level and puts them in the perspective of LAC.

### Improving Nutrition and Food Security

Rice must continue its consolidation as a food staple in LAC. It is essential that rice maintains an advantage as a cheap energy source for the poor and that this rice is produced locally to adequately exploit comparative advantages as well as maintain a production base that generates employment and income. Several countries have low levels of per capita rice consumption. In those countries with low individual consumption, rice is offered at relatively high prices in presentations of high quality products (low contents of broken grains). Therefore, rice does not compete well with other available carbohydrates such as wheat, cassava, plantains, potatoes or maize. It is important that the market for rice products be enlarged by tackling the low income groups with lower quality but much cheaper rice while, at the other end, offering products with higher value added (convenience foods, elaborated products, etc.). A major challenge for food security in the rural sector is to maintain viable alternatives in the face of huge subsidies in developed nations for major cash crops, such as rice. The effort here must be two-fold: increase efficiency and maintain policies that check unfair trade policies in the world market to ensure competitiveness.

### Managing Water Resources in Rice Ecologies

There is growing concern over the sustainability of global fresh water resources. In Latin America, there are three prevalent approaches for addressing the issue water scarcity within rice-based systems.

Table 2. Per capita water availability by continent (1000 m<sup>3</sup>).

Country	Year				
	1950	1960	1970	1980	2000
Africa	21	17	13	9.4	5.1
Asia	10	8	6	5.1	3.3
Latin America	105	80	62	48.8	28.3
Europe	6	5	5	4.4	4.1
North America	37	30	25	21.3	17.5

SOURCE: FAO, 1996.

The first two approaches refer to demand and use: one approach aims at reducing the amount of water required for cultivation. Another approach focuses on justifying water use by employing each drop of water for multiple uses - an example being the concurrent use of water both for irrigation and aquaculture. The third approach focuses on the supply of water and efficient use of water cycles in the atmosphere and in the environment. LAC possesses abundant water supplies and the rice producers, being prominent users of the resource must be vigilantes and promoters of investment in processes of water procurement and supply. The IYR can help raise awareness among the many beneficiaries of water in rice fields such as the diversity of life forms that are

sustained within the rice-based systems while also promoting the development of rice cultivation in low water regimes and the need to foresee water needs and investments in a longer time frame.

### Environmental Protection

There are a growing number of environmental concerns in rice production. Flooded rice production has been receiving most of the attention in LAC, outside Brazil. Input use efficiency is a must to reduce undue pressure on systems that are increasingly intensive in input use. A major challenge is to increase yields without augmenting input amounts. The answer is in higher precision and timing is a critical issue. The IYR will help to exchange concrete ideas on these environmental issues and related challenges and opportunities among the various stakeholders.

### Enhancing Productivity: New Technologies with the Efficient Use of Resources

Most existing rice varieties, and particularly the high yielding varieties (HYV) and hybrids, have a potential yield that exceeds actual yield. Furthermore, there is considerable variation in the actual yield levels achieved even under similar production systems. Production under irrigation and the highly favored upland systems currently account for approximately 70% of all rice production in LAC and high-yielding genotypes currently occupy more than 90% of the area. However, farmers' yields remain far below the potential of available varieties. The difference between readily obtainable yield and average farm yield is referred to the "yield gap." The yield gap is apparent in all irrigated rice production areas and bridging the yield gap represents the most immediate opportunity for increasing rice production in the LAC. The yield-gap is apparent in all countries of LAC; however, the size of the yield-gap varies across regions, among countries and within production zones. The yield potential for irrigated rice is higher in the temperate region of the Southern Cone due to more favored climatic conditions. In the tropical zone, the yield potential for irrigated rice is lower but the yield-gap is approximately the same when compared to the temperate region. This is due to lower current yields in tropical South and Central America. The estimated yield-gap for this region takes into account only areas capable of supporting high productive rice, i.e., irrigated and favored rainfed systems. The increase in production feasible by bridging the yield-gap in 12 LAC countries analyzed is estimated at 2.7 million MT. This is equivalent to a 27% increase in production and will contribute annually more than US \$ 400 million to the gross income of rice growers. The technology for bridging the yield-gap is available but must be introduced, modified to suit local conditions and, more importantly extended to growers. Technology transfer is the key ingredient to bridging the yield-gap and the focus on grower associations provides the means for transferring technology in an economical and sustainable manner.

### Rice in the Institutional Context

In the wake of reduced capacity in public agricultural research and extension, the private sector institutions have become crucial partners. Since 1995, several LAC countries created the Latin American Fund for Irrigated Rice (FLAR), a new institutional model financed mainly by the rice sector and that incorporates national and international public research institutions as well as those from the private sector. This new model represents a pioneering work in international research. Currently, nine countries from LAC and CIAT collaborate to generate new and better technologies for the rice sector and contribute close to US\$600,000 per year. Its main thrust is on germplasm development but crop management has received increased attention since 2003, when the Common Fund for Commodities (CFC) granted almost one million dollars, through FAO, for a three year project to close the yield gap in rice in Venezuela and Brazil. While FLAR is

entering its tenth year of activity, the challenge to ensure its permanence is still real. Partners in FLAR are quite diverse in nature, have dissimilar interests, even conflicting paradigms and opposing commercial interests. But they know the value of international cooperation, of research and technological innovation and of avoiding duplication of efforts. On the other hand, declining funds for public research is also a challenge for the sustainability of vital partners in that sector, both at the national and international levels and the answer must be to pool resources from all institutions involved and strengthen strategic alliances within the countries and at the regional level.

## **Conclusion**

Latin America tripled its output during the past three decades due to rapid adoption of improved varieties while area remained basically stagnant at 6 million has as production in upland areas was replaced by that on flooded environments; Consumption steadily grew and rice became a staple for the urban poor with self sufficiency levels above 90%. Average yields, at 3.8 t/ha, are still low as crop management has to close the gaps to allow varieties to express their yield potential. The region has abundant supplies of water, land and people and represents a potential rice basket for the world. A major challenge for the region is the consolidation of FLAR, a pioneer model for rice research funded mainly by rice sector funds that includes international, national and private research institutions.

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