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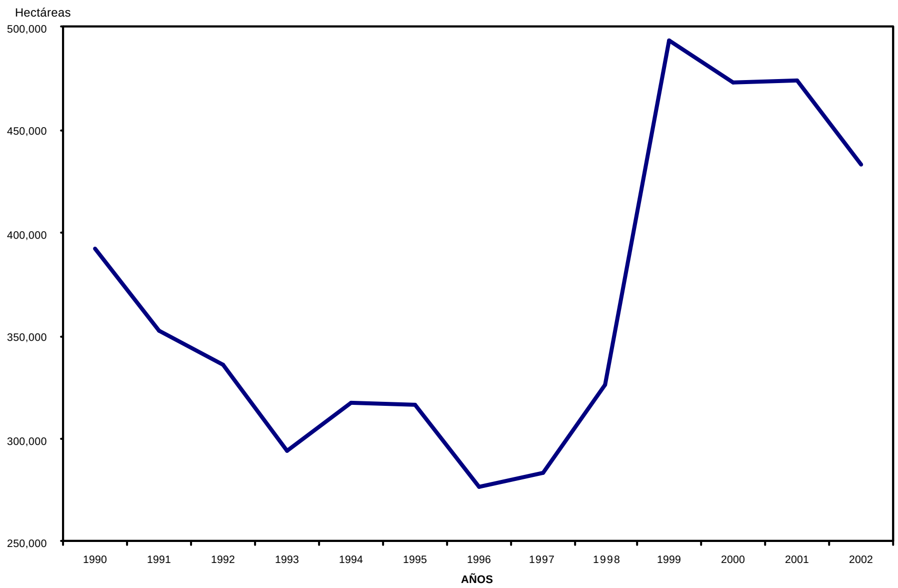
ASSESSMENT OF IMPACTS OF TRADE LIBERALIZATION: THE COLOMBIAN'S RICE SECTOR

FEDERACION NACIONAL DE ARROCEROS DE COLOMBIA
THE UNITED NATIONS ENVIRONMENT PROGRAMME

I. INTRODUCTION, COLOMBIAN RICE SECTOR: 1990-2002

Adoption of “economic openness” happened by the very beginning of 1990’s just as in several Low Developed Countries from Asia and South America. Main component of such model consisted of trade liberalization with a reduction on tariffs. One of the main observed consequences of this process on agricultural sector during the last twelve years are reduction of harvested areas, mainly of cereals, and an increase on importations on those products. By 1991, Colombia imported 816.000 tons of agricultural products; by 2001 the amount reached 3’986.000 tons. Main increases of that value were maize that went from 8.000 tons to 1’579.000, and products such as beans, sorghum, soy, wheat, and rice.

GRAPH 1.
RICE CULTIVATED AREA IN COLOMBIA, 1990 - 2002.

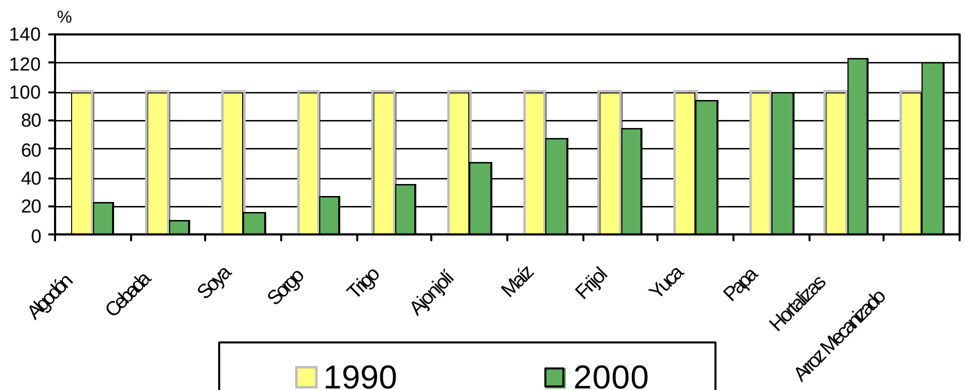


Fuente: Arroz en Colombia, 1980-2002 FEDEARROZ.

Behavior of rice during that period is very important because it is main food source of low-income households and because it is an employment supplier at rural zones. Of short-cycle crops, maize occupies first place in terms of harvested area with 575.000 Has, rice is in second with 448.000 Has, and thereafter the rest of crops (cassava, potatoes, beans, sorghum, cotton, *ñame*, wheat, tobacco, sesame, barley, and peanuts) with less than 200.000 Has. During the last 12 years, harvested rice area presents a whole cycle (Graph 1), starting 1990 (400.000 Has) with a downward trend until 1996 (270.000 Has), and since then an upward trend reaching 490.000 in 1999. During last 3 years, harvested area has fluctuated because of weather conditions.

Harvested area decreased 29% for semiannual crops from 1990 to 2001 as Graph 2 shows. Making a comparison, only rice and vegetables, that occupies a small area increased for that period. Mechanized rice harvested area increased 20% in that time frame. One can deduct from those facts that increase in rice was given for an increase of small farming by a reduction of rotation between rice and other substitutive transitory crops.

GRAPH 2. Semiannual Crops (Comparison). 1990 vs 2000, 1990 = 100



Fuente: SAC, CEGA,FEDEARROZ.

During the last 3 years, rice production has been over 2 million of dry paddy rice with a cycle during the year, as Table 1 shows. Commonly, Colombia has a deficit in rice production during first semester of the year, and a superavit during the second, which requires storing rice from the latter to the former period. In average, Colombia has a 5% deficit to be covered with importations.

Crop productivity has had changes since 1966 when "Green Revolution" techniques showed up. Production went from 2 to 5 tons of green paddy rice per hectare. During the next two and a half decades, technological efforts centered in keeping those yields, that increased positively in one hectare since 1997 with a new seed variety: Fedearroz 50. Currently, average yield in rice is 6.5 tons per hectare of green paddy or 5.2 of dry paddy. It is important to point out that Colombia, a tropical country, produces two harvests a year, for a total production of 10.4 tons of dry paddy per hectare a year.

TABLA 1. AREA, PRODUCTION AND YIELDS: MECHANIZED RICE (IRRIGATED+UPLAND RICE), COLOMBIA, 1990 – 2002.

	Hectares	Tons of Dry Paddy	Tons of Dry Paddy per Ha
1990	371,965	1,633,455	4.39
1991	332,594	1,475,112	4.44
1992	316,180	1,441,342	4.56
1993	274,545	1,277,387	4.65
1994	297,587	1,400,103	4.70
1995	296,717	1,386,082	4.67
1996	256,450	1,213,583	4.73
1997	262,934	1,177,625	4.48
1998	306,332	1,505,589	4.91
1999	468,031	2,330,085	4.98
2000	447,553	2,204,950	4.93
2001	448,999	2,147,282	4.78
2002 *	407,909	2,016,025	4.94

* Estimado
Fuente: FEDEARROZ

Dynamics of Colombian rice sector is easy to evaluate because there were two national censuses in 1988 and 1999[1]. Number of rice producers increased during the period between censuses from 17.517 to 28.128 (60.5%). Number of rice harvested farms also increased from 19.779 to 33.435 (67.3%). Colombian agriculture frontier has not changed significantly during the last 30 years because irrigation districts have not been modified during that period. It is easy to conclude that the size of rice production units decreased to absorb the number of producers. Majority of Colombian rice producers have cultivations of less than 3 Has. only 1.7% of cultivations have areas over 100 Has. Colombian rice is produced by small producers that obtain their income and employ their labor force in this activity.

[1] Fedearroz, 1990-2000, I y II Censo Nacional Arrocero, Bogotá.

Optimal land and infrastructure have a sui generis process during the last years for warm weather crops such as rice, sorghum, and others because of generation of money from drug traffic. Land has become in a sort of saving institution with low risk, increasing its price. For this reason, majority of rice producers (54.1%) rent land instead of owning land. From this fact appear a lot of consequences: first an excessive valuation of that scarce resource. Second, main part of rice producers rent land because they don't have enough capital to buy it. Third, management of land and water from a land renter is different from the management an owner would do.

Rice generates 65.000 direct employments among agro-industry and technical assistance. But main impacts coming from rice is based on economic activity influence along the zones it is produced, nearby cities depend almost entirely on this activity. The whole commerce from input trade, bank activity, mechanic workshops, markets, urban and rural transportation, health services, oil trading, etc, depend directly on rice production. Multiplier factor coming from this activity is important for income generation for tropical Colombian zones. For this reason, when it is said that importations of cheaper goods to Colombia benefit consumers, "rice community" is not taken into account and a loss of purchasing power in that community would imply a loss for a big community.

On the other hand, rice consumption has increased during the last years. Between 1980's and 1990's, rice "apparent consumption" showed a decreasing from 40 kilos per capita in 1980 to 21.8 kilos per capita in 1997[2]. From 2000 National Statistics Department (DANE) estimates in its Household Survey, used to calculate consumer price index, rice consumption. They found that consumption for year 2000 was 40 kilos per capita and 41.5 for 2001. They also found consumption levels of about 63 kilos per capita at Colombian Atlantic Cost, and lower levels for central zone, that contains main part of population. Higher consumption levels were found at Cartagena and Montería at colombian North Zone. Consumption depends on income level, and it has been going down. In spite of that, rice consumption has increased, a reason to think about a general impoverish of colombian people, who substitute expensive goods for nutritive goods with lower relative price. That is, a moving towards "inferior" goods for low-income households. For Colombian case, when relative prices of goods such as meat, milk products and vegetables increase, consumption of rice increases.

Comparing Colombia, Peru, and Brazil with some other Latin American countries, rice consumption is about 42 kilos per capita while average is lower for other countries. For example, Venezuela reaches 15 kilos per capita while weighted average for Latin America is 27 kilos per capita of white rice.

Colombian rice sector has important institutions from behind. There is a Union that represents producers from 60 years ago. This institution is financed by a 0.5% tax over product sells. Fedearroz researches and diffusion technology, but

[2] Fedearroz, 2001, Arroz en Colombia 1980-2001. Bogotá, Anexo 19, pg.160.

also associations, trades, producers. Five years ago, Colombian Agriculture Ministry created National Rice Council consisting of related associations, Agriculture, Trade, and Economics ministries. Its main function is to join main aspects related to rice such as need for importations, minimum prices, and trading conditions for rice. Some topics concerning research, consumption, and product trading are discussed.

Biological research has played an important role in Colombian rice crop. By 1961, paddy rice yields were about only 2 tons per hectare. Between 1966 and 1973, yields increased by 5 tons. During the latter period, “Green Revolution” occurred leaded by Colombian Agricultural Institute (ICA), International Center of Tropical Agriculture (CIAT) and Fedearroz. These institutions shared basic, management, and technological diffusion research until 1980’s. Since then responsibility is exclusive for Fedearroz.

During last five years, rice yields in Colombia showed an important increase of more than a ton per year because the new seed variety. In a comparison among other Latin American countries, Colombia has a similar technical performance. Yields for irrigated rice, in terms of dry paddy rice, is about 5.2 tons per hectare. Brazil, Uruguay, and Argentina that produce only one crop per year only improve this performance. One of Colombia’s advantages with respect to other American producers is the production of two crops per year with an important sort of varieties. This fact facilitates regional specialization and reduces risks of massive production of one only variety. By 2002, producers had 16 excellent culinary quality and acceptation varieties.

PRICES

Colombia adopted a competition-based price system. There are basically four price levels: a raw materials level that is paid directly to producers in terms of green paddy (25% of humidity and 5% of impure matters). This price depends on grain quality as a percentage of humidity, and over all of location from industrial zones. It could be said that differences between same quality rice are given by transportation costs.

Second price level corresponds to whole sales processed white rice. This rice is traded in 75 kilo bulks and it is used as raw material for final product distribution in packs of less than 5 kilos for sell.

There is a market for packed rice in the country in a sort of varieties: 1 kilo, 5 kilos, 12.5 kilos. It is usual to find positioned brands in the market. Quality of this rice depends on percentage of fractionated grains.

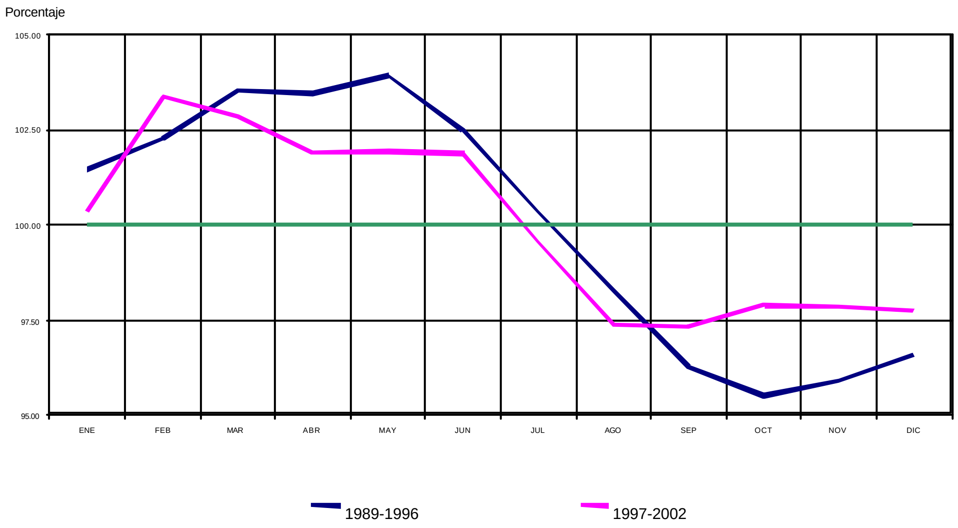
At consumer level, there is another price level, the highest. Final consumer buys rice at the markets, and local shops for consumption that ranges into one or two weeks. At low-income levels, it is used to buy rice daily.

Absolute price level for prices at producer level, in December 2002, was about U$177 for a ton of green paddy or U$209 for a ton of dry paddy. White rice for wholesale purposes had its price about U$342 for whole sales and U$464 for consumers, per ton. Relationship between rice price for consumers and green paddy is about 2. Relationship between rice price for consumers and raw materials is about 2.6.

Rice market has at least three agents: producers, industrial producers, and traders. The number of agents determines competition at each level. At the producer level there are many agents, approaching a competition behavior. At the second level there is a reduction of agents, and currently there are about 130 participants. The number has been lowering during the last ten years. The lower number of participants is located at the third level; there are two or three agricultural industries and three big supermarkets. This last group belongs to the people that imports rice at lower prices than national.

Prices at producer and white rice level have seasonalties along the year. During first semester, raw materials have a price increase and during second semester a decrease. This phenomena is caused by a surplus in August, September, and October. Graph 3 analyses price variability for the last twelve years, showing a reduction of variability during the period 1997-2001 because of importation and a subsidy to incentive rice storage.

GRAPH 3. SEASONALITY OF PRODUCER REAL PRICES, COLOMBIA, AVERAGE 1989-1996, 1997-2002.



Fuente: Arroz en Colombia 1980 - 2002, FEDEARROZ.

Nota: Indice calculado con el método de la relación al promedio movil.

There are some other factors that affect price behavior for Colombian rice besides seasonality. Expectations for importation affects price level mainly during harvest season. Minimum price level approved at National rice Council, substitute goods prices (such as potatoes, spaghettis, and bread with a 95% imported component), incentives to storage, administered trade agreements, and available income behavior are the main variables that affect price levels in Colombia.

In monetary terms, for the 1989-2002 period price has been increasing from $84.134 to $496.469. In real terms there is an opposite trend, a reduction of about 38% during the same period, as Table 2 shows. This fact means that rice has been lowering Colombian price index.

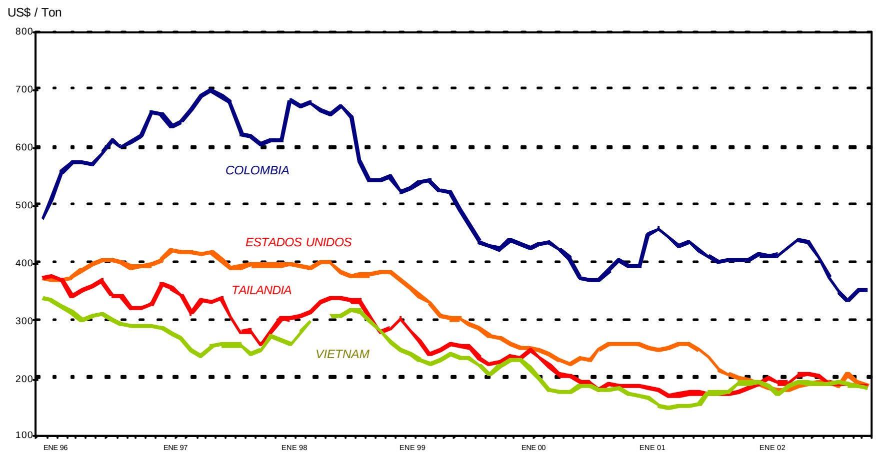
TABLE 2. REAL AND CURRENT PRICES FOR GREEN PADDY RICE FIRST SEMESTER 1989-2002

	MONETARY $ / Ton	REAL $ de 1978 / Ton	
89/A	84,148	9,290	
90/A	92,141	7,959	
91/A	111,594	7,336	
92/A	133,524	6,889	
93/A	139,236	5,824	
94/A	200,047	6,785	
95/A	221,326	6,192	
96/A	269,151	6,270	**- 38 %**
97/A	339,378	6,636	
98/A	430,676	7,042	
99/A	409,364	5,946	
00/A	413,254	5,485	
01/A	515,222	6,331	
02/A	496,469	5,741	

Fuente: FEDEARROZ

Colombian rice prices in dollars maintain a margin with relation to main exportation markets around the world. There is no causality relationship as Graph 4 shows.

GRAFICO 4. PRECIOS MENSUALES EN DOLARES, ARROZ BLANCO, COLOMBIA, ESTADOS UNIDOS, TAILANDIA Y VIETNAM. 1996 - 2002.



Fuente: FEDEARROZ, Creed Rice Market Report.

COSTS

Production costs depend on technological level, production system, input prices, and production zones. For Colombian case, there are two production systems: Irrigated Rice and traditional upland rice. The former is based on water availability through productive cycle, it is highly mechanized, uses modern inputs, and has good yields. In some activities, capital and labor are combined.

Traditional upland rice uses rainfall and depends on rain regime. Distribution of rain through the year varies depending on the geographical location. Technological level is the same as irrigated rice. Risk levels are higher on this system because of randomness of raining seasons. Main problem of this system consists of activity concentration, mainly at harvesting and transportation of the crop, causing huge storages in small time frames.

Production system does not determine the size of productive units nor property. There are producers of every size and kinds in both systems. The 67% of mechanized rice belongs to irrigated rice, and 33% to traditional upland rice.

There is a third production system named manual traditional upland rice, produced at the jungle zones of north Colombia and in Chocó. Rice is sown manually by the shore of rivers in small properties for self-consumption. Yields are about 1 ton per hectare. Occupied area by this production system is 6% that corresponds to 1.5% of total production. However, almost half of Colombian rice producers sow this kind of rice. Importance from this system is that it is the base for feeding communities isolated from markets.

In absolute terms, irrigated rice cost is U$1.000 per hectare, at first semester 2002, as Table 3 shows. Around 57.2% from that amount correspond to land rent, sowing, fertilization, and weed control. In the majority of rice sowing countries, land rent does not belong to costs because it is taken as a part of financial benefits from land return. In Colombia, more than a half of rice producers (irrigated and traditional upland rice) are land renters, this value is the first cost component to be paid.

For the case of sowing process, seed value is the most important item, with a density of about 230 kilos of seed per hectare. Fertilization occupies second place as a percentage: 300 kilos of urea, 50 kilos of DAP, 100 kilos of KCL, distributed into four applications during 4 months of sowing process. Costs coming from weed control have been increasing, and it corresponds to 13.1 % of total cost. In average three weed control applications are made. Need for constant rice sowing and bad land management have increased use of agrochemicals.

Integrated Pest Management (IPM) is a positive sum practice for Colombian case. This has turned into a common practice that consists of an evaluation of infesting levels and risks to take a decision to manage pests. There is a series of indicators about damage levels to apply or not to apply insecticides. Use of insecticides has reduced, turning into only 2.2% of total per hectare cost.

TABLE 3. ESTIMATED NATIONAL PRODUCTION COSTS PER HECTARE, PERCENTAGES ,IRRIGATED RICE, FIRST SEMESTER 2002.

	NATIONAL AVERAGE 2002 / A Pesos	SHARE %
1.- TECHNICAL ASSISTANCE	26,042	0.9
2.- LAND RENT	476,549	16.2
3.- PREPARATION	150,431	5.1
4.- SOW	363,410	12.3
5.- IRRIGATION	183,410	6.2
6.- FERTILIZATION	459,645	15.6
7.- WEED CONTROL	385,989	13.1
8.- PEST CONTROL	68,057	2.3
9.- SICKNESS CONTROL	180,678	6.1
10.- RODENTS AND DESPALILLE	34,634	1.2
11.- RECOLLECTION	215,105	7.3
12.- TRANSPORTATION	100,639	3.4
SUB-TOTAL	2,644,589	89.7
13.- MANAGEMENT	79,338	2.7
14.- INTERESTS	177,120	6.0
15.- DIRECT TAXES	46,248	1.6
TOTAL COST / HECTARE	2,947,295	100.0
ton/ha GREEN PADDY	6.16	
COST / TON. GREEN PADDY	478,612	
Ton/ha DRY PADDY	5.23	
COSTO / TON. DRY PADDY	563,073	

Fuente: FEDEARROZ.

Land preparation is relatively cheap at Colombia because depreciation of machinery has been taken into account years ago. Two kinds of rakes are used two or three times a season.

With relation to costs between production systems, water, fertility, and rent make the difference. Zones with irrigation districts have high land rent costs, even 6 times higher than traditional upland rice.

Yields per hectare have increased during last years, because of Colombian Peso depreciation (last four years) the costs of imported imputs increased. Producers have adjusted to these changes and cost has reduced 34%, in real terms, between 1989 and 2002, Table 4 shows. This change should have benefited sector's competitivity levels with respect to international community, however, it is not enough to reduce the gap because of drastic reduction of international prices.

TABLA 4. PRODUCCION COSTS PER TON, CURRENT AND REAL PRICES, COLOMBIA, FIRST SEMESTER , 1989-2002

	CURRENT $ / Ton	REAL $ de 1978 / Ton	
89/A	89,990	9,396	
90/A	107,543	8,713	
91/A	135,697	8,387	
92/A	147,564	7,148	
93/A	168,892	6,729	
94/A	199,316	6,454	
95/A	247,012	6,597	**- 34 %**
96/A	288,076	6,387	
97/A	361,531	6,777	
98/A	415,524	6,500	
99/A	445,407	6,358	
00/A	473,603	6,173	
01/A	514,710	6,213	
02/A	563,073	6,511	

Fuente: Div. Econ. FEDEARROZ

INTERNATIONAL TRADE

Economic openness model in Colombia, reduced tariffs in exchange for a reduction of production subsidies from developed countries. This brought an increase in food importations of about 388%, and a reduction of sown area for semiannual crops of about 25.9% during 1991-2000 period. Rice sector became a net importer since 1991.

In average, Colombia imported during 1990's 236.000 tons of dry paddy rice to cover deficit caused by excess demand.

TABLA 5. IMPORTATIONS OF RICE IN COLOMBIA, 1990 – 2002.

		IMPORTATIONS Ton de Paddy Seco	**Origin**
1990		(39,457)	
1991		(119,255)	
1992		116,553	
1993		52.702	
1994		356,892	
1995		170,876	
1996		284,668	
1997		252,100	
1998	*	449.200	USA 69%, VEN 16%, ECU 15%
1999	**	270.000	ECUADOR 98%
2000	***	178.644	VEN 71%, ECU 21%, USA 2%
2001	A/	321.847	ECU 48%, VEN 20%, USA 27%
2002	B/	127.662	ECUADOR 98%

Fuente:
FEDEARROZ

* 330.000 Ton. de comercio registrado + 119.200 Ton. ilegales de Venezuela y Ecuador

** Incluye 76.500 Ton. de Ecuador y 193.500 de contrabando.

*** Incluye 70.000 Ton de arroz Blanco y 5.000 Ton de Paddy Seco / mes de contrabando

/a. Incluye 147.445 Ton de Ecuador, 62.000 Ton de otra procedencia (contrabando)
Y 112.402 Ton de Otros Países.(INDUARROZ) Comité Nacional de Estadísticas.

/b Incluye 123.262 de Comercio Administrado (CAN) y 4.400 de la Salvaguardia del 2001 B

The highest importation levels happened in 1998 with 499.000 tons. Suppliers of imported grain have changed through time depending on the supply conditions, imposed by Rice National Council. This institution considered importations of dry paddy rice to concentrate it at industry, which buy the national production.

Importation excluded traders and any entity that made business with foreign countries. Main provider was United States that increased production because most of Latin-American countries followed up Colombia buying paddy rice. Ecuador and Venezuela have exported paddy rice to Colombia, by the way.

As Ecuador has increased areas, and Venezuela had a depreciated Bolívar, Colombia turned into main importer from these countries. From 1999, those countries exported to Colombia because of Andean trade agreements with a zero tariff politic.

There is some trade with United States because of prices, payment facilities, and industry productivity. Trade with Ecuador keeps restrictions because of quality and low production volumes in short time periods. National industry mixes this rice with native to sell it as a final product.

United States and Thailand that have reduced their prices since January of 1998 in more than 50% guiding international prices. This meant a loss in competitivity with a pass-through effect that has reduced Colombian prices too.

As a net result, during last three years production costs and product prices have reduced sharply (about 30%), Colombian rice has not improved its competitive levels because of reduction in international prices.

II. TRADE POLICY DEVELOPMENTS

Colombia and Multilateral Agreements

Colombia entered firmly to GATT in 1981 and participated in Uruguay Round in 1986 where agricultural product policies were defined.

In terms of trade policy, by 1980's Colombia started a unilateral economic openness, gradual and selective. It went further by 1990's, before Uruguay Round that ended into WTO. By the time trade agreement between Andean countries took shape into Andean Nations Community (CAN).

As a product of this openness, there were important reductions in production and an increase in food importations. Meanwhile, there were sharp decreases in our agricultural product prices and an appreciation process that implied loss of competitive levels. In face of this crisis, by 1994, agriculture reactivation was searched and some sensible products, such as rice, were subject to tariffs and quantity control policies.

Agreement on Agriculture (AoA), in 1995, came up with higher tariffs than applied and Colombia committed to reduce exportation subsidies and Amber Box mechanisms[3]**.**

Furthermore, Colombia applied an importation policy for non-automatic licenses rice conditioned to acquisition of native production in defined price terms.

Those commitments have been accomplished for they did not implied policy changes that concluded with adjustment in agricultural policy. Even more, importation flows on last decade do not relate to AoA but to regional agreements.

ANDEAN COMMUNITY

AoA allows integration agreements among nations that apply for their commerce with preferential conditions. At CAN, not recognized as Custom Union, trade is somehow free with the exception of some items from Decision 414 that regulates Peru's entry to community that finishes by 2004.

[3] 10 años de período de implementación. Reducción de MGA del arroz, notificada en US $ 90.5 o el 22.7% del total de US $ 397.7 millones de dólares. Reducción de subsidios a la exportación al arroz desde una cifra de US $ 118,3 millones y 18.911 toneladas. Derecho arancelario de base 210% y consolidado de 189%.
Contingente inicial de acceso mínimo de 39.598 toneladas, al 80% y final de 75.188 toneladas.

This Custom Union is not perfect because while inter-regional good flow is tariff-free, there are different treatments to third parties such as multilateral preferences, tariffs, and quantity control from each of the countries.

TABLE 6. COLOMBIAN ACCESS TO MARKETS COMMITMENTS TO CAN COUNTRIES FOR RICE

	Bolivia	Colombia	Ecuador	Perú	Venezuela
Safeguard	No	Sí	No	No	Sí
Tariff 2004 (%)	40	189	67.5	68	122
Actual Access	0	13,681	0	0	30,197
Minimum Access	0	75,118	0	0	30,197

For the case of rice, differences with WTO commitments are different as table 6 shows. But this fact has not caused any obstacles in production because region has a high self-sufficiency level and importation from third parties is not significative. Differences are given mainly in commerce between Colombia, Ecuador, and Venezuela, self-sufficient countries that produce with excess with prices that are higher than international levels, so exportations are possible only to their neighbor countries generating perturbations to the unstable equilibrium in those markets.

Under those circumstances Colombia has imposed safeguard mechanisms with its neighbors, and non-automatic licenses with third parties. This implies regulated rice importations with fixed entry dates attached to native production with minimum prices policies.

Andean Safeguards

Community's legislation allows for non-discriminatory application of safeguards to limit importations in necessary amounts to cover transitory supply deficits and when price perturbations appear because of low prices, to allow preferential importations.

Trade policies have fortified competitive levels of CAN countries, with tariff preferences. This way, Ecuador's production has benefited from this fact, supplying rice when necessary. Only during few years, andean production has not been enough.

Conclusion

Economic openness meant openness of Colombian rice market.

Since WTO's AoA, there is not a dependency on foreign rice so it did not have bad effects on native production.

Tariff has been lower than the one applied by WTO and a high percentage of importations are made inside andean countries with no tariffs.

International subsidies for rice mean very low prices and high tariffs for third party countries. Competitive level of Andean rice has fortified in front of other countries.

New AoA negotiations, beginning next year, have the component of United States interest for empowering their support mechanisms but speaking about free trade. European Union would reduce supports without losing self-sufficiency because of high political costs of agricultural policy even more when lower developed countries are entering community.

New ALCA negotiations are defining treatment to sensible products and lists to reduce tariffs, so there is nothing said about rice. However, Colombia is subject to reductions in tariffs and conditioned to reduction in subsidies and disturbing support from exporter countries.

III. Social and economic impact of Agreement on Agriculture Mechanisms over activities related to rice production in Colombia

In principle, Colombian rice production was affected by price reductions and starting 1995 there was a reactivation caused by different protection policies against international trade and subsidies. However, national prices followed international downward trend. To understand this phenomena it is mandatory to take a punctual and retrospective look into behavior of production and trade around the world to identify main variables that influence world market evolution.

One of the main variables is related to producer support. There are indicators to quantify and analyze evolution of support in developed rice producer countries, globally and by country. There is a relation between amount and evolution of subsidies with international rice prices, to identify impact they had on international price levels and on production levels and trade flows.

A series of econometric estimations establish the relationship between rice prices and subsidies, that measure elasticity of price with respect to subsidy for OECD countries globally and independently.

Relationship between international rice prices and Colombian price levels was analyzed to understand influence of international rice prices over Colombian price levels and Colombian producers income.

A direct relationship was identified between international and national price levels through substitutive product prices with high penetration in national market such as wheat. There are estimations of substitution among these products in national market.

National price impact over rice production and produced area are measured to quantify influence of subsidies on national production. By the way, there is an identification of the effect that elimination of subsidies would have over main exporter countries and national production.

The effect of trade policy over gross income of producers, national prices and production over gross income was measured. There is also an estimation of the effect that activities connected with rice have on income.

Last, there is an estimation of trade policies on harvested areas over employment and wages perceived by workers in direct rice production in Colombia.

A social aspect that has happened during last 12 years is migration of non-qualified labor from legal crops to illegal crops. The attraction is higher relative prices for these products in international market. Reduction of harvested area in labor-intensive crops such as cotton, has facilitated exodus of workers to marginal zones.

IV. Environmental Topics related to Rice Production

Colombian rice production produces under productivity and ratability principles because it is a profitable activity. Some indicators of this activity are evidenced in that expansion of agricultural production frontier, increase of small property harvests, simplification of ecosystems, mechanization, increase of imported inputs such as agrochemicals, and some other topics that affect environment and its influence zones.

Expansion of rice crop has not taken into account conservation of its environment as a competitive and sustainable input in spite of its influence to generate employment and food security. Current market trends require sector's participation in the implementation of plans, programs and projects of sustainable products in harmony with society and environment. This is to generate policies to prevent and control environment pollution and to guarantee its use and sustainable use of natural resources.

Rice production is affected mainly via land rent and use, activities to adequate it and management of irrigation districts, establishing a differential pricing of land depending on the producing zone and on the production system. Another important indicator is land property, having into account that renters have a negative impact over environmental variables.

Industrial and commercial activities imply employment generation, consumption of inputs, production of services, product distribution, supply of raw materials, and equipments to accompany crop production. Rice production requires development of an adequate infrastructure to secure availability and quality of water resource through irrigation districts that have into account environmental variables. Facts show that during the last three decades there has not taken place enough investment to improve, maintain and actualize infrastructure to guarantee water availability for cultivated area and eventual expansions.

There is also deforestation rate in basins and wrong practices associated to rice crop that have affected water bodies. This situation has given rise to actions coming from rice sector to protect basins. For example a pilot project is developing with "Asociación de Usuarios del Río Chipalo" at Ibagué, a Colombian municipality, to evaluate benefits from water use in the irrigation to reply this model to the whole country.

Rice sector has been improving its environmental management through its "Convenio de Concertación", a mechanism to cleaner production of industrial rice to improve productive resources, reduce and control waste generation, fortify institutional capacity and develop environment-friendly technologies.

Mill industry generates 400.000 tons of husk waste, with no management and disposal policies. The most popular alternative is to burn this waste, polluting air and generating conflicts with people who live nearby.

Another policy instrument designed recently by sector and environmental authorities is a document: "Guía Ambiental para el Sector Arrocero". This document was designed to promote environmental-friendly practices to improve sector, written to be read by producers of every size and production system.

In the frame of national competitive level improving, an agreement of competitivity was signed for rice sector. Agriculture Ministry, producers, mill industry, and other institutions that influence this productive chain to guarantee economic and social sustainable development to compete internationally through short, medium, and long term actions to improve competitive level of chain and industry sponsored this agreement.

Environmental exigencies expose new challenges toward sustainability and stabilization of productive system throughout new environmental variables into rice production. To mitigate and control environmental impact in rice, introduction of environmental friendly activities and technologies is mandatory also to improve competitivity, productivity, and sustainability of rice sector.

Colombia has a wide legislation in environmental issues, starting with a National Natural Renewable Resources and Environment Code, through Decree-Law 2811 of 1974. The 1991National Constitution takes into account this code and establishes a set of duties and rights for the State, institutions and private agents relating to environment. Starting with this, appears law 99 of 1993 to create National Environmental System (SINA), Environment Ministry, and reorders Public Sector related to environmental issues.

SINA has four research institutes, with technical and scientific support from universities and other research centers- It also has 34 regional environmental authorities to protect and preserve environment.

Rice sector and industry has a positive start in the search for new sustainable products that will affect positively industry culture in Colombia. Focus of environmental policy on rice converges to the search for alternatives for environment preserving and to improve competitivity and productivity.

A coordinated labor must be defined for a better environmental management in rice sector assuming same and higher harvested areas for the future under a sustainability focus.

V. A measurement of productivity and technical change on agrochemicals: The Case of Colombian rice After Green Revolution

During last 12 years, rice crop real costs had a considerable reduction per hectare of about 25.7%. In some extent, this reduction was caused by appreciation of Colombian peso that made input importation and use more attractive. Real cost of labor reduced during the same period about 31.7%. Cost of land also reduced in real terms (38.2%) because of demand reduction for semiannual crops. Fertilizing costs (an imported input) reduced by 14.4%, because of more efficiency and lower real dollar price. Machinery, commonly a rented input, reduced in real terms about 46%. It is surprising that agrochemical costs increased about 3.0%. Herbicides costs increased about +2.5%, insecticides –30%, and fungicides +25.6%. Growth in agrochemical costs could be explained with a higher physical quantity applied, and product prices. The former explains better because of Colombian peso appreciation process.

TABLA 7. REAL PRODUCTION COSTS FOR IRRIGATED RICE PER HECTARE, COLOMBIA, SEM.A 1990-SEM. A 2001

ITEM	Sem.A 1990	Sem. A 2001	Change
	----------1978=100	--------------	%
MACHINERY	11.135	6.016	-46.0
LABOR	5.043	3.442	-31.7
AGROCHEMICALS	6.455	6.650	+ 3.0
FERTILIZERS	5.245	4.490	-14.4
LAND	7.599	4.697	-38.2
SEED	4.099	3.434	-16.2
WATER	425	623	+46.7
TECHNICAL ASSISTANCE	480	288	-40.0
MANAGEMENT	1.214	889	-26.8
INTERESTS	2.410	2.176	- 9.7
TAXES	654	562	-14.1
TOTAL	44.759	33.268	-25.7

Fuente: Fedearroz, División Investigaciones Económicas.

For the case of agrochemicals, continuous use of land only on rice (monoculture) influences appearing and growth of weeds, making them more resistant to herbicides. These aspects, joint to a study on non-chemical inputs are studied in this section.

Main objective is to evaluate through econometric models how productivity and use of other inputs has evolved in rice crop for the last 20 years.

To estimate econometric models five different inputs were picked up: Capital, land, chemicals (pesticides, herbicides, fungicides), fertilizers, and land. This separation allows a better understanding and application of methodology to explain input productivity.

Colombian rice crop data was separated into two groups depending on the production system: Irrigated (mechanized rice), and traditional upland rice. For irrigated rice, data covers period starting first semester 1981 to second semester 2001. Traditional upland rice is annual starting 1981 and ending 2001.

First estimations are individual *Translog* cost functions for each production system. A joint estimation for both systems was not possible because of different data and production structure.

Estimation of three different elasticities of substitution was calculated to evaluate relationships among inputs: Allen-Uzawa elasticity, cross-price elasticity, and Morishima elasticity. For analytical reasons conclusions are based on the third elasticity because of its more accurate and clean measurement of substitution relationships among inputs. This elasticity allowed estimation of the effect of relative changes on a pair of inputs prices on its shares. Standard deviations were calculated for these measures to validate results.

Lastly, for estimation of productivity changes on inputs and output, an approximation of a Törnqvist-Theil index was calculated. This approach is based on recent studies and is known as the rate of cost diminution, a continuous version of a productivity index.

Summary

Estimation of translog cost function for irrigated rice showed importance of introduction of Fedearroz-50 variety on production through the use of dummy variables. Cost function and shares showed a bias towards the use of agrochemicals for both production systems.

Elasticities of substitution showed that capital is substitute for the rest of factors, but relationship is higher with labor and chemicals. Labor is substitute for capital and agrochemicals. Fertilizers resulted to be complements for all other factors, mainly land and labor. This would indicate that it could be substituted labor use for chemical use, increasing need for labor and saving natural resources.

Productivity estimations showed a downward trend through time. However, inputs for irrigated rice seemed very productive along the time. Chemicals and fertilizers productivity is downward trending along the time, a worrying situation for environmental policy.

For traditional upland rice thing did not change substantially. There are biases towards the use of agrochemicals and land during the same period. But there is capital and land saving. Fedearroz-50 variety affected only use of fertilizers.

Elasticity analysis showed that capital was a substitute for chemicals and labor. The latter appears to be substitute for capital and chemicals. Deriving the same conclusion as for irrigated rice.

Productivity estimation showed a downward trending in total productivity. However, none inputs were productive in this case, specially for the cases of chemicals and capital.

VI. Conclusions y Recommendations

VII. Possible Stages

There are three possible stages to predict and anticipate economic, social and environmental impact of policies in medium term.

- 30.000 irrigation hectares + arrangement of CAN agreement (free trade with Ecuador, Venezuela, and Peru).
- 30.000 irrigation hectares + zero subsidies in rice exporters.
- 30.000 irrigation hectares + ALCA agreement.