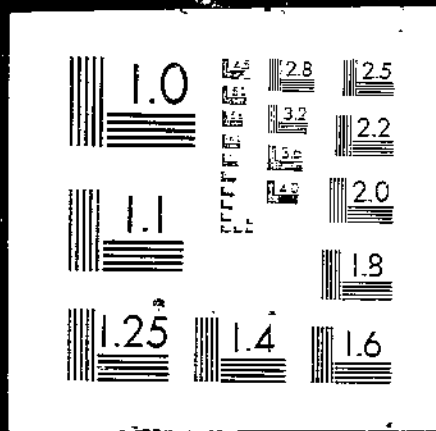FAER-187 DEMAND FOR CARBOHYDRATE FOODS IN COLUMBIA AND VENEZUELA
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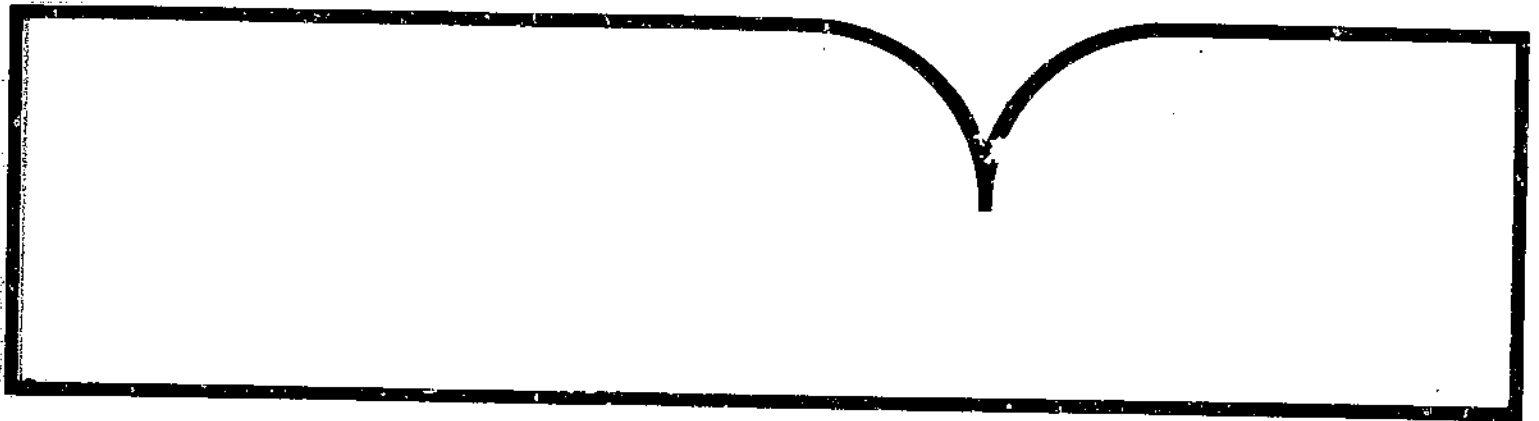
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Demand for Carbohydrate Foods in Colombia and Venezuela

Luis R. Sanint

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Keywords: Rice, consumption, income elasticities, price
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ADDITIONAL
INFORMATION

An ERS staff report presenting a complete description of data,
definitions, sources, and methods used in this analysis is
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CONTENTS

SUMMARY

Remarkable increases in rice production occurred in Colombia and Venezuela during the past 25 years. Retail rice prices fell compared with other carbohydrates (except wheat flour) and consumers more than doubled their consumption of rice. Yet both countries continued to increase their imports of wheat and corn. By 1980, the two countries had a combined import bill for wheat and corn of about $500 million, with almost all of the imported wheat and about a third of the corn coming from the United States.

This study explains how domestic consumption of rice doubled and still had a minimal effect on the demand for imported wheat and corn. Increased rice consumption was largely the result of falling rice prices and rising consumer incomes. The substitution of cheaper rice for other carbohydrates was surprisingly small. In Colombia, consumers appear to have used the savings from lower rice prices to buy more wheat, potatoes, and cassava. In Venezuela, a more urbanized and higher income country, consumers did substitute rice for potatoes, cassava, and plantains in their diets. Plantains and cassava were also found to be somewhat less favored commodities as incomes increased in Venezuela. The substitution of rice for corn and wheat was either minimal or nonexistent in both countries.

This study focuses on six staples--rice, corn, wheat, potatoes, cassava, and plantains--in Colombia and Venezuela. These foods represent, apart from sugar, almost 100 percent of carbohydrates consumed for food in both countries and about one-third of total food expenditures. When increased rice production reduced the retail price of rice relative to the other staples (except for wheat flour), consumers increased rice consumption. In Venezuela, consumers substituted rice for potatoes, cassava, and plantains, but not for wheat and corn. In Colombia, per capita consumption of rice more than doubled to displace plantains and a minimal amount of corn.

The increased rice production in Colombia and Venezuela from 1956 to 1977 was due in large part to improved varieties and technologies, along with an expansion of the area planted on irrigated land. Rice yields in Colombia rose from an average of 1.8 tons per hectare from 1956-58 to 4.1 tons per hectare in 1976-78. Rice yields in Venezuela increased from 1.3 tons per hectare to 3.2 tons during the same period. Production of cereal in Latin America has barely kept pace with population growth. Colombia and Venezuela are now self-sufficient in rice and they export modest amounts.

Conversion Chart

This report uses metric units throughout.
1 metric ton = 2,204.62 pounds
1 hectare = 2.471 acres

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Demand for Carbohydrate Foods in Colombia and Venezuela

Luis R. Sanint

INTRODUCTION

Dramatic increases in rice production in Colombia and Venezuela in the last 25 years have changed staple food consumption in both countries. When increased rice production caused the retail price of rice to fall relative to the other staples (except for wheat flour), consumers increased rice consumption. In Venezuela, additional rice consumption substituted for potatoes, cassava, and plantains; in Colombia, increased rice consumption displaced some corn and plantains. However, overall, both countries increased their imports of U.S. wheat and corn.

Colombia had the highest rice yields in Latin America, while Venezuela had the record for the fastest growth in overall production. Rice yields in Colombia increased from a 1956-58 average of 1.8 tons per hectare to 4.1 tons per hectare for 1976-78, sustaining an annual rate of growth in production of 9.6 percent for the period. 1/ Rice yields in Venezuela rose from 1.3 tons per hectare to 3.2 tons per hectare for the same period, but the increase in area planted and improvements in irrigation allowed a 15.7-percent annual rate of growth in production. Rice production in both countries more than doubled in the seventies due in large part to improved varieties and technologies along with expansion of the area planted on irrigated land. Both countries are now self-sufficient in rice and export modest amounts.

Colombia and Venezuela provided an opportunity to compare the impact of rapid expansion of rice production in countries with different economic and demographic characteristics. The study period ran from 1956 through 1977 for Colombia and from 1959 through 1977 for Venezuela. These periods include important changes in the availability and prices of the commodities

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1/ The rates of growth reported here and other descriptive characteristics of the data are based on the fitted values calculated from linear trend equations estimated by ordinary least squares. The coefficient of variation is defined as the ratio of the standard error of the trend regression divided by the mean value of the dependent variable.

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studied, particularly rice, due to a variety of changes in production technology and government policies. The analysis attempts to sort out the net effects of each variable and its implications for trade. Trends and coefficients are based on a long and internally consistent time series. The results of the analysis using this time series provide a good basis for both prediction and extrapolation. 2/

Both countries are middle-income countries, a group of nations which account for an increasing share of world agricultural trade. However, Venezuela earns a major portion of its foreign exchange from oil exports while Colombia depends upon agriculture for three-quarters of its exchange earnings. In 1978, per capita gross national product (GNP) was over three times higher in Venezuela (US$2,850) than in Colombia (US$900). Venezuela is more urban than Colombia and depends much less on agriculture as a source of national income. Despite these differences, the net impact on cereal consumption differed only modestly although the underlying forces acted quite differently to generate the similar results.

Neither Colombia nor Venezuela has been a significant importer of rice (the largest import of rice in the period was 59,000 tons purchased by Venezuela in 1958). However, both countries have been customers for U.S. wheat and corn. In 1956, Colombia imported 53,000 tons of wheat (all under the Public Law 480 program) and Venezuela imported 273,000 tons. In 1977, Colombia imported 216,000 tons of wheat (all commercial) and Venezuela, 705,000 tons. While neither country imported corn in 1956, both Colombia and Venezuela were importers in the sixties and seventies. Colombia alternated between importing and exporting during the period, with imports larger than exports. In 1977, Colombia imported 101,000 tons of corn. Venezuela imported corn in most years from 1961 forward, reaching a level of over 500,000 tons in 1976 and 1977.

Objectives of this study were to:

1. Determine if consumers adjusted their dietary patterns as a result of the increased availability of rice and its associated decline in real prices;

2. Estimate the magnitude of the effect of the price and income changes which contributed to the change in consumption patterns over the study period; and

3. Evaluate the impact of the change in real prices of rice on the imports of wheat and corn.

The evidence provides an empirical basis for formulating expectations about how rapid increases in production of staple

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2/ An ERS staff report is available that presents a complete description of data, definitions, sources, and methods used in this analysis. See inside front cover.

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food crops and reduced real domestic prices might affect demand and trade in other countries. The considerable difference in the economic and demographic characteristics of Colombia and Venezuela contributes to the usefulness for extrapolating the findings.

The study was limited to an analysis of the changes in availability and consumption of staple carbohydrate foods. Wheat, corn, potatoes, cassava, and plantains were thought to be most likely consumption items for which rice would be a substitute. Beef and beans were expected to be less important but were added for completeness of the analysis. Other animal products, fruits, vegetables, and miscellaneous foods were thought to be even less affected and so were ignored.

COLOMBIA

Rice, corn, wheat, cassava, potatoes, and plantains represent a major component of Colombian diets: 51.6 percent by weight; 40 percent of total protein content; and 44.2 percent of total calories in 1972 (table 1). Food expenses in Colombia constituted about 50 percent of the total consumption expenditures in 1977 and the six products included here represented about 33 percent of food expenditures (14). 3/ Per capita consumption of the carbohydrate foods studied increased at an annual rate of 1.4 percent, from 240 kilograms (kg) in 1956 to 309 kg in 1977 (tables 2 and 3). This increase, in addition to an average annual population growth of 3 percent for the 21-year period, reflects enormous growth in the total consumption of these commodities.

Table 1--Colombia: Percentage of selected staples consumed, 1972

Foodstuff	Percentage of total consumption		
	Weight	Protein	Calories
	Percent		
Rice	9.6	12.7	13.6
Corn	3.1	6.8	7.1
Wheat	6.8	12.5	8.5
Cassava	4.6	.6	3.0
Plantains	10.3	2.0	5.8
Potatoes	17.2	5.4	6.2
Other foods	48.4	60.0	55.8
Total	100.0	100.0	100.0

Source: (27).

3/ Underscored numbers in parentheses refer to sources cited in references.

Table 2--Colombia: Annual production and consumption
changes for selected staples, 1956-77

Item	Production	Yields	Per capita consumption	Real prices
	Percent per year			
Rice	9.6	5.5	4.8	-2.6
Corn	0.	1.5	-2.0	-.3*
Potatoes	4.5	2.5	.9*	.8*
Cassava	8.7	2.1	4.2	2.1
Plantains	2.5	-.4*	-.4*	-.5*
Wheat	-6.5	2.7	-.3*	-1.7
Total	4.2	NA	1.4	NA

* = Not significant at the 90-percent level.
NA = Not applicable.

Table 3--Colombia: Per capita consumption of selected staples

Years	Rice	Corn	Potatoes	Cassava	Plantains	Wheat	Total
	Kilograms						
1956	25.59	47.75	46.63	52.23	81.41	19.93	273.54
1960	28.85	45.91	41.87	43.60	80.47	19.17	259.87
1965	36.23	38.28	41.14	43.19	69.75	18.03	246.62
1970	35.58	38.95	43.31	56.93	75.60	13.38	263.75
1975	66.54	33.08	54.68	84.74	75.14	14.68	328.86
1976	62.23	36.99	60.50	79.20	76.12	16.81	331.85
1977	53.86	27.43	62.97	79.48	74.21	11.04	308.99
Mean	38.74	38.38	45.17	59.09	75.79	17.35	274.53
SD	6.21	3.23	7.49	13.19	4.00	3.33	21.68

SD = Standard deviation.

In the 1956-77 period, the domestic availability of these carbohydrates grew at an average annual rate of 4.2 percent, a 21-year increase of 136.5 percent (table 2). There was relatively little annual variability.

Crop Production

Rice had the largest rate of production increase (9.6 percent) because of widespread adoption of improved seeds and irrigation that started in 1957 and intensified in the sixties (4, 8, 13, 29, 32, 34, 44, 53, 57). The Colombian Agricultural Institutes's (ICA) expanded rice research program first introduced new varieties in 1964 and has continued to provide rice farmers with improved genetic material in collaboration with the International Center for Tropical Agriculture (CIAT) located in Colombia. New dwarf-varieties, now accounting for over 90 percent of the seed used, caused a shift in the location of production of rice from rainfed areas to irrigation and swampland areas (53, 57). Yields grew at an annual rate of 5.5 percent per year to achieve the highest growth rate and, at 4,030 kilograms per hectare in 1977, the highest yields in Latin America.

Cassava production, with the second most rapid growth rate among the commodities studied (table 2), remained relatively stable from 1956 (700,000 tons) to 1967 (850,000 tons), and then began a steady growth. This growth was due to increases in both area and yield. After 1967, yields grew at an annual rate of 4.67 percent, compared with the 2.1-percent growth rate for the entire period. ICA has been multiplying and distributing disease-free planting material using varieties selected after joint ICA/CIAT evaluations. Agricultural extension services are making the new technology available to the small farmers who are the major producers of cassava.

Potato production began to show a marked increase in 1972. Adoption of new technologies, continuous growth in the availability of subsidized credit, increased use of fertilizer, and increased price stability at the farm level played important roles in stimulating higher yields and production. In 1977, 61 percent of potato output came from labor-intensive production (72 percent of the area) while the remaining 39 percent came from mechanized production (28 percent of the area).

While average plantain yields showed no significant trend over the entire period, they declined significantly during the last 10 years, mostly due to diseases and increased area devoted to intercropping with coffee (on the average, monoculture yields are almost twice as high as those of mixed planting). In 1977, about 33 percent of the area was monoculture and the rest was interspersed with coffee trees.

Corn production had no significant trend while wheat production, never very significant, declined sharply. Although average corn yields grew at an annual rate of 1.13 percent per year during the 1956-77 period, yields are still low mainly because about half of the area planted to corn is

Table 4--Colombia: Real retail prices of selected food items, in 1970 prices

Year	Rice	Corn	Potatoes	Cassava	Plantains	Wheat	Beef	Beans
				Pesos/kg				
1956	5.56	2.89	2.14	1.44	1.79	6.39	10.39	10.26
1960	6.17	2.83	1.90	1.70	2.21	4.83	16.96	13.01
1965	5.91	2.11	1.86	3.73	2.08	5.42	16.66	11.00
1970	4.58	1.96	2.12	2.13	1.71	4.14	16.43	11.04
1975	3.82	2.39	2.34	2.74	1.86	5.14	16.02	13.21
1976	3.54	2.27	1.79	1.93	1.79	5.00	16.75	11.49
1977	3.69	2.88	1.83	1.88	1.98	5.08	21.76	10.57
Mean	5.09	2.36	1.98	2.24	2.04	4.93	16.55	12.46
SD	.41	.26	.38	.66	.43	.59	2.36	2.41

SD = Standard deviation.
Source: (16), deflated by CPI for food.

Table 5--Colombia: Relative prices of selected food items
with respect to the price of rice

Year	Corn	Potatoes	Cassava	Plantains	Wheat	Beef	Beans
				Percent			
1956	0.51	0.38	0.25	0.32	1.14	1.86	1.85
1960	.38	.23	.25	.30	.88	2.45	2.11
1965	.35	.31	.63	.35	.91	3.20	1.86
1970	.42	.46	.46	.37	.90	3.94	2.31
1975	.62	.61	.71	.48	1.34	4.68	3.46
1976	.64	.50	.54	.50	1.41	4.83	3.24
1977	.78	.49	.50	.53	1.37	4.97	2.86
Mean	.48	.41	.46	.41	.99	3.42	2.51
SD	.08	.08	.12	.10	.18	1.05	.60

SD = Standard deviation.
Source: Table 4.

in subsistence units, mostly on hillsides. Corn production is a good example of the dualism that exists in Colombia; commercial corn producers in the Cauca Valley obtain up to 5 tons per hectare (ha) while small farmers in mountainous Cundinamarca produce under 1 ton per hectare. Among commercial producers, corn faces tough competition from other commercial crops like sorghum and soybeans. Wheat production during the study period fell from 140,000 tons in 1956 to 39,000 tons in 1977 because of sharply reduced planted area and little improvement in yields. Wheat production is concentrated in small and medium-size farms. The government price policies intended to provide low-cost food to urban consumer combined with poor yields have made wheat growing an increasingly unattractive proposition. Yields grew at an annual rate of 2.56 percent, from 820 kgs/ha in 1956 to 1,150 kgs/ha in 1977. Use of better seeds and exit of marginal producers are among the reasons for this moderate increase.

Prices and
Consumption

With the notable exception of wheat flour, retail prices tended to parallel developments in crop production. During the early part of the period, import controls held the price of rice artificially high. Thus, when rice production increased and pushed down prices, consumers benefited directly. Real retail rice prices fell 42 percent throughout the 21-year period. These changes were accompanied by reductions in real prices of wheat flour of 30 percent due to a combination of government policies and world price trends. Real prices of corn, plantains, and potatoes remained fairly steady, while real cassava prices more than doubled during the first half of the period and then fell by about a third (table 4). The year-to-year price variability was highest for the perishable commodities: cassava (29.5 percent), plantains (21.1 percent), and potatoes (19.2 percent). Prices of other carbohydrates relative to rice increased substantially during the 21 years, except for wheat flour (table 5).

These factors significantly changed the composition of carbohydrates in the Colombian diet during the 1956-77 period (table 6). Cassava gained almost 6 percent in its share by weight but plantains lost about the same percentage. Together they accounted for half of the carbohydrate consumption. By the end of the period, the remaining half was comprised of potatoes (20 percent, up from 17 percent in 1956), rice (17 percent, up from 9 percent), corn (9 percent, down from 17 percent), and wheat (4 percent, down from 7 percent). Coinciding with the increase in per capita rice consumption, per capita consumption of potatoes and cassava also rose, while that of wheat, corn, and plantains fell. The question is whether these changes were caused by price and income mechanisms or by government intervention and other exogenous factors.

Grain import policies had a substantial effect on carbohydrate availability and hence on prices to consumers and producers. During the 21-year period, virtually no rice was imported. However, imported wheat accounted for an average of 59 percent

Table 6--Colombia: Percentage of the total annual consumption of the selected carbohydrates represented by each commodity

Year	Rice	Corn	Potatoes	Cassava	Plantains	Wheat
			Percent			
1956	9.36	17.46	17.00	19.09	29.76	7.29
1960	11.10	17.67	16.11	16.78	30.97	7.38
1970	13.49	14.77	16.42	21.59	28.66	5.07
1975	20.23	10.06	16.63	25.77	22.85	4.46
1976	18.75	11.15	18.23	23.87	22.94	5.07
1977	17.43	8.88	20.38	25.72	24.02	3.57
Mean	13.00	14.20	16.50	21.10	27.90	6.40
SD	1.43	1.48	2.28	3.40	2.43	1.07

SD = Standard deviation.

of wheat consumption through the period. Imports from the United States under the Public Law (P.L.) 480 program peaked in 1972 at 145,000 tons, 35 percent of wheat imports for that year (1, 18, 31). A 30-percent import duty was in effect throughout the period but the state trading agency (IDEMA) imported and sold wheat at subsidized prices from 1968 to 1974, thus discouraging direct imports by millers during this interval. In 1974, coinciding with IDEMA's financial crisis, the support price for wheat was raised by 50 percent and the import subsidy was eliminated (61). However, wheat production did not respond to the higher price support. Consequently, total imports fell sharply as annual per capita consumption declined from 22 kg to 11 kg between 1974 and 1977.

Corn was imported more frequently and in generally larger amounts in the seventies than in the late fifties and sixties, although small amounts of exports were still interspersed with imports. Colombia's net imports of corn were 360,000 tons from 1970 to 1977 contrasted to 115,000 tons from the 1956 to 1970 period. Corn for feed use declined from 150,000 tons (20 percent of corn production in the late fifties) to 78,000 tons by 1977 (9 percent of production) as lower cost sorghum replaced corn in feed formulas.

Corn and wheat imports together amounted to $72 million in 1977, about 26 percent of the total value of agricultural imports.

VENEZUELA

In 1977, the six staples accounted for about 33 percent of the protein and calories consumed (table 7) and about 33 percent

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Table 7--Venezuela: Percentage of selected
staples consumed, 1977

Foodstuffs	Percentage of total consumption	
	Protein	Calories
	Percent	
Rice	4.0	5.4
Corn	11.8	14.5
Wheat	15.6	12.8
Roots and tubers	2.1	3.6
Others	66.5	63.7
Total	100.0	100.0

Source: (21).

of total food expenditures (5). Half of the total expenditures
for carbohydrates was for wheat products and 30 percent was
for rice and corn.

Crop Production Venezuela's rice production started to increase after 1959;
for that reason the relevant period of study is changed to
include the 1959-77 period. The per capita consumption of
staples grew at an annual rate of 0.4 percent during the
1959-77 period, from 161 kg to 210 kg (tables 8 and 9). Much
of the increase was in rice consumption with some in wheat and
corn. Per capita consumption of potatoes, cassava, and
plantains declined. Population growth raised the total
consumption of each commodity, even those with per capita
declines.

Total domestic availability of the six foods grew at an annual
rate of 2.6 percent between 1959 and 1977, somewhat less than
the 3.5-percent annual growth in population. This growth in
availability was made possible by an impressive 10.1-percent
annual rate of growth in rice production from 1959 to 1977,
which resulted from increases in both area and yields (6).
Still the food deficit grew and was satisfied by imports of
wheat and corn.

Rice production grew from 47,000 metric tons in 1956 to
496,000 metric tons in 1977. Use of improved seeds, expanded
irrigated area planted to rice, increased mechanization, and
readily available government-sponsored credit were the main
factors for the rapid expansion. In 1975, about 33 percent of
the cultivated rice area was irrigated rice production in
Guarico, which accounted for 51 percent of the total output
(48). Use of improved seeds was crucial. The most common
varieties used were IR 22 (38 percent) and CICA 4, developed
in nearby Colombia (18 percent) (48).

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Table 8—Venezuela: Annual production and consumption changes for selected staples, 1959-77 1/

Item	Production	Yields	Per capita consumption	Real prices
	Percent per year			
Rice	10.1	4.6	4.3	-3.6
Corn	2.1	1.1	2.3	2.3
Potatoes	2.0	2.4	-2.0	-.2*
Cassava	.1*	-.9	-3.3	1.5
Plantains	2.4	2.7	-1.3	1.4
Wheat	-.1*	-2.2	1.1	-1.7
Total	2.6	NA	.4*	NA

* = Not significant at the 90-percent level.
NA = Not applicable.
1/ For the 1959-77 period used in the quantitative analysis that follows. Percentages will differ considerably when calculated using a 1956-77 period.

Table 9—Venezuela: Per capita consumption of selected staples

Year	Rice	Corn	Potatoes	Cassava	Plantains	Wheat	Total
	Kilograms						
1956	3.45	46.92	11.41	26.81	35.06	40.47	164.12
1960	10.46	46.64	18.67	42.31	37.62	36.94	192.64
1965	18.88	44.62	15.60	30.89	29.04	45.23	184.26
1970	16.28	55.36	12.34	27.15	31.69	58.87	201.69
1975	23.84	48.35	11.23	23.26	27.15	53.34	187.17
1976	23.04	65.06	10.45	20.98	25.81	54.83	200.19
1977	22.48	79.07	12.34	22.00	27.99	48.69	210.12
Mean	15.60	59.94	12.97	28.83	30.71	48.92	196.96
SD	3.10	9.49	2.02	4.81	2.72	7.72	18.41

SD = Standard deviation.

In 1975, the proportion of white corn produced to yellow corn was about one to four. White corn flour is highly preferred for food. Feed use has been decreasing as grain sorghum has replaced corn as the major feed. Productivity is very low, a consequence of the marked "duality"--the existence of large numbers of small-scale traditional farmers side-by-side with a limited number of large commercial farms--in Venezuelan agriculture. Over 90 percent of the farmers have 5 hectares or less and produce about 40 percent of the total corn crop (48). Average yields grew at only 1.1 percent per year from 1959 to 1977. Although corn had a high support price (above U.S. Gulf price), this price incentive apparently was not effective in stimulating production. Corn imports expanded, particularly after 1964. From 1964 to 1977 corn imports grew to an annual rate of 14.6 percent. Between 25 and 30 percent of the imports came from the United States.

Production growth rates for potatoes, plantains, and cassava were substantially below the population growth rate. Potato production exhibited a modest rate of growth of 2 percent per year from 1959 to 1977, while yields increased by 2.4 percent per year. Production of plantains, at 2.4 percent per year, expanded only slightly faster than potatoes, with yields increasing at 2.7 percent annually. Cassava, a traditional crop which plays an important role in subsistence agriculture, exhibited no significant trend in production. The overall increase of 0.9 percent per year over the period masks a very atypical behavior in cassava yields. The yield pattern resembles a bell-shaped curve, with yields increasing rapidly from the late fifties to a maximum of 13.68 kgs/ha in 1963 and then declining after 1966. Yields in 1977 were 9.46 kgs/ha. Area planted also varied, particularly after 1970.

Domestic wheat production is a minute portion of Venezuela's wheat consumption (1,000 out of 706,000 tons of apparent consumption in 1977). Yields fell to a very low level, around 400 kgs/ha by 1977. The cost-price squeeze pushed many farmers away from this crop. The Central Bank of Venezuela calculates that a minimum yield of 850 kgs/ha is needed to break even on wheat production, even at highly subsidized farm prices. There is no government financing for this crop. The large and growing gap between production and consumption is filled by wheat imports, of which 97 percent came from the United States in 1977.

Prices and
Consumption

Internal real prices of wheat and rice declined substantially during the period (table 10). The 48-percent drop in the price of rice reflected the sharp increases in production, while the declines in wheat price were due to subsidies that were part of a policy to maintain low food prices for the urban population. Real prices of corn, cassava, and plantains increased concurrently while potato prices showed no trend at all. Relative to rice, the prices of these other staples rose sharply through the period, with the exception of the price of wheat flour which remained roughly constant (table 11).

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Table 10--Venezuela: Real retail prices of selected food items, in 1968 prices

Year	Rice	Corn	Potatoes	Cassava	Plantains	Wheat	Beef	Beans
				Bolívares/kg				
1956	1.45	0.47	0.99	0.58	0.40	0.87	6.88	1.66
1960	1.81	.41	.71	.54	.35	.75	6.29	1.75
1965	1.84	.56	.99	.55	.57	.64	6.03	1.77
1970	1.50	.53	.90	.60	.49	.67	5.52	1.75
1975	1.18	.71	.88	.72	.60	.51	8.64	2.62
1976	1.22	.76	.87	.79	.65	.47	6.68	1.61
1977	.95	.71	.69	.78	.54	.72	8.57	1.68
Mean	1.60	.57	.93	.62	.52	.68	6.58	1.84
SD	.21	.06	.10	.05	.07	.06	1.03	.44

SD = Standard deviation.
Source: (47), deflated by the Consumer Price Index for food items.

Table 11--Venezuela: Relative prices of selected food items
with respect to the price of rice

Year	Corn	Potatoes	Cassava	Plantains	Wheat	Beef	Beans
			Bolívares/kg				
1956	0.32	0.68	0.39	0.28	0.59	4.74	1.14
1960	.22	.39	.29	.19	.41	3.46	.96
1965	.30	.53	.30	.31	.34	3.27	.96
1970	.38	.60	.39	.32	.44	3.67	1.16
1975	.60	.74	.61	.50	.43	7.30	2.21
1976	.62	.71	.64	.53	.38	5.44	1.31
1977	.75	.73	.82	.57	.76	9.03	1.77
Mean	.38	.60	.41	.34	.44	4.37	1.21
SD	.07	.08	.09	.05	.10	1.70	.45

SD = Standard deviation.
Source: Table 10.

These factors changed the patterns of carbohydrate consumption.
By 1977, corn had replaced wheat as the single most important
commodity in the diet. It represented 36 percent of the
consumption (by weight) of the six, up from 22 percent in 1959.
This was followed by wheat (23 percent, down from 25 percent),
plantains (13 percent, down from 21 percent), rice (11 percent,
up from 5 percent), cassava (10 percent, down from 16 percent),
and potatoes (6 percent, down from 9 percent). Cereals have
been clearly replacing plantains, cassava, and potatoes in
Venezuelan diets (table 12). The following analysis identifies
cause-effect relationships through the price and income
mechanisms in the economy which underlie these changes.

Grain import policies were significant forces behind these
changes. Almost all the wheat and over a third of the corn
consumed was imported. Per capita wheat imports grew at an
annual rate of about 1 percent, with 95 percent coming from the
United States. The Government of Venezuela has long maintained
control over wheat and corn marketing. The stated purpose of
this intervention was to compensate for deficiencies of food
production.

Until 1973, when private sector wheat importers handled over
half of the trade, wheat imports were subject to prior
licensing and a small tariff of 20 bolivares per ton. This
tariff represented US$4.65 in terms of the 1973 exchange rate,
about 2.5 percent of the c.i.f value. At the same time,
importers were subsidized through foreign exchange mechanisms
and direct payments to encourage wheat imports in support of
the low food price policy.

Table 12--Venezuela: Percentage of selected carbohydrates to annual
consumption of carbohydrates

Year	Rice	Corn	Potatoes	Cassava	Plantains	Wheat
				Percent		
1956	2.10	28.59	6.95	16.34	21.36	24.66
1960	5.42	24.21	9.69	21.97	19.53	19.18
1965	10.24	24.22	8.46	16.76	15.76	24.55
1970	8.07	27.45	6.11	13.46	15.71	29.19
1975	12.73	25.83	6.00	12.43	14.51	28.50
1976	11.50	32.51	5.22	10.48	12.89	27.38
1977	10.69	36.46	5.87	10.47	13.32	23.17
Mean	7.80	30.00	7.00	15.00	16.00	25.00
SD	1.40	3.40	.80	1.90	2.30	3.40

SD = Standard deviation.

After 1973, the government suspended private wheat imports and controlled trade through its central marketing organization (CMA). Since 1977, the private sector again has become involved in wheat importing.

Corn imports were not restricted through licensing but were subject to a duty of about 1,200 bolivares per ton (6). This represented a US$280 per ton duty in terms of the 1977 exchange rate, more than twice the c.i.f. value of corn. The duty clearly made private sector imports uneconomical. However, from 1964 to 1977, public sector imports grew at an annual rate of 14.6 percent. Most of these imports were white corn which is highly preferred for food by Venezuelans and comes largely from South Africa. Only 25 to 30 percent of corn imports came from the United States. This was mostly for feed use. The use of corn in feed formulas increased and feed demand more than quintupled. But, beginning in 1970, grain sorghum became relatively more important as the ratio of sorghum to corn in feed formulas went from 1.8 in 1970 to 5.0 in 1977. In 1959, feed use of corn represented 16.6 percent of internal corn production, compared with 10 percent in 1977.

While corn and wheat imports amounted to US$206 million in 1977, they represented only 17.3 percent of the total c.i.f. value of agricultural imports.

ANALYSIS OF DEMAND CHANGES

The changes in food policies and production technology were reflected in the prices of the six staple foods to consumers in both Colombia and Venezuela. This in turn affected the way consumers allocated their incomes among the six. The analytical approach employed permits the impact of an individual variable on consumption to be estimated in isolation from the impact of other changes occurring at the same time. The following discussion concentrates on the effects on consumption of the changes in three selected variables; price of rice, price of wheat, and change in per capita income.

The single most important price change was the one attributable to the increase in the availability of rice, which caused real rice prices to fall by nearly 42 percent in Colombia and 48 percent in Venezuela during the years studied. The second most significant set of events affecting demand related to wheat pricing and import policies. Retail wheat flour prices dropped by about 30 percent in Colombia and 27 percent in Venezuela during the years studied. The third most important factor affecting consumption was growth in incomes.

Colombia

The analysis indicated that the six staples did not substitute readily for one another when their relative prices changed. In some cases a lower price of one resulted in lower consumption of another, in some it resulted in higher consumption, and in others there was no significant change. This seems to be consistent with the importance of these foods in the diets. It is not unusual for Colombian families to serve two, three, or four different carbohydrate foods at a single meal.

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The 2.6-percent annual decline in the price of rice directly stimulated its own consumption at an annual average rate of about 1.8 percent when the effects of income and other prices are ignored. The drop in the price of rice also affected the average annual per capita consumption of the other carbohydrates.

If the decline in rice prices had been the only change during the study period (if other prices and income had remained constant), the estimated annual impact would have been:

Decreases in consumption:

Corn--by 0.2 percent
Plantains--by 0.1 percent

Increases in consumption:

Wheat flour--by 0.5 percent
Potatoes—by 1.5 percent
Cassava--by 1.5 percent

The gross substitution effect (decreases in consumption given only a decrease in price of rice) is small when compared with the increases in consumption of rice and other commodities. A possible explanation of the gross complementarity of rice with wheat, potatoes, and cassava is that the income effect resulting from lower prices of rice allowed people to increase consumption of these basic foodstuffs (particularly because the percentage of additional income spent on these products is quite high at low levels of income). So, the income effect of a reduction in rice prices offsets the substitution effect expected from lower prices.

A significant result is that, due to the nature of the government intervention policies in Colombia, the lower real price of rice did not have a cause-effect impact on the decline of per capita wheat consumption nor on its imports. The decline in wheat consumption is mostly explained by an artificial constraint imposed on wheat imports by the government reflecting a self-sufficiency policy in food production. So, the increased rice production had, at most, an indirect adverse effect on wheat consumption, assuming that the increases in domestic rice production allowed the government to restrict wheat imports.

In the case of corn for food, consumers chose to substitute lower priced rice for corn in their diets. However, the impact was notably small especially compared with the effect on corn consumption due to increased income.

The 1.7-percent annual decline in the price of wheat flour, ignoring other prices and income changes, would have resulted in a net annual increase in wheat consumption of 0.5 percent. The associated annual impact of the decline in wheat flour

price on the consumption of the other commodities would have been:

Decreases in consumption:

  Corn—by 0.2 percent
  Potatoes—by 1.1 percent
  Plantains—by 0.2 percent

Increases in consumption:

  Cassava—by 1.0 percent

Rice consumption was not significantly affected by changes in wheat prices.

In the 21-year period, real per capita income grew at an annual rate of 2.4 percent. The impact of this increase on average annual consumption was calculated for each commodity as follows:

Increases in consumption:

  Rice—by 2.2 percent
  Potatoes—by 1.1 percent
  Cassava—by 1.6 percent
  Wheat—by 0.6 percent

Decreases in consumption:

  Corn—by 0.6 percent
  Plantains—by 0.1 percent

Corn and plantains were clearly inferior goods for direct human consumption in Colombia; less of these foods were consumed when higher incomes enabled expanded expenditures. 4/

Venezuela

The substitutions resulting from changes in real prices were somewhat different than in Colombia. There were 15 cases of substitutes, 8 of complements, while the rest did not change significantly in response to price changes of related commodities. 5/

The 3.6-percent annual drop in the real price of rice was associated with an annual average increase in its consumption of 2.1 percent during the 18-year period. The associated changes in consumption of other carbohydrate foods resulting from that price drop (other prices and income held constant) were also calculated.

4/ When per capita consumption of one commodity declines (increases) as income increases, the commodity is called an inferior (superior) good.

5/ The words "substitutes" and "complements" as used here are equivalent to the concepts of gross substitutes and gross complements as used in the economic literature.

Decreases in consumption:

Potatoes—by 2.3 percent
Cassava—by 2.2 percent
Plantains—by 0.3 percent

Increases in consumption:

Corn—by 0.8 percent
Wheat—by 0.5 percent

In contrast with Colombia, corn consumption was not reduced by the increased availability of rice in the country; both corn and wheat increased. This was due in part to government policies to supply cheap food to the urban population that was heavily dependent on wheat and corn imports. On the other hand, the lower real prices of rice had an adverse effect on consumption of the locally produced staples—potatoes, cassava, and plantains.

The 1.7-percent annual decline in wheat flour price through the 18-year period, made possible by government subsidies, stimulated wheat consumption at an average annual rate of 0.5 percent and that of rice at 1.1 percent. Consumption of corn, potatoes, plantains, and cassava was not significantly affected by changes in wheat flour prices.

The consumer response to increases in income suggested that among the six carbohydrates, rice, corn, and wheat were superior commodities while cassava and plantains were adversely affected by higher incomes. The 2.3-percent annual growth in real disposable income had diverse effects on the annual average per capita consumption levels.

Increases in consumption:

Corn—by 0.8 percent
Rice—by 1.3 percent
Wheat—by 0.5 percent

Decreases in consumption:

Plantains—by 0.1 percent
Cassava—by 0.6 percent

Potato consumption was not significantly influenced by income changes.

CONCLUSIONS   This study indicates that consumers adjusted their dietary patterns in response to the greater availability and lower real price of rice. In Colombia, the degree of direct substitution of rice for other commodities was rather small. Instead, the increase in rice consumption appears to be the result of its own declining price and large propensity on the part of Colombian consumers to spend additional income on rice consumption. The direct substitution of rice for other

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commodities was stronger in Venezuela, but for locally produced potatoes and plantains rather than wheat and corn.

For U.S. agriculture, the most significant finding was that the direct substitution of rice for wheat and corn was either minimal (as in Colombia) or nonexistent (as in Venezuela). This finding for both countries was rather unexpected and implies that a rapidly expanding domestic production of a food grain need not mean a decline in import demand for other food grains. As a matter of fact, Venezuelan imports of wheat and corn expanded considerably during this period of rapid increase in domestic rice production. Even in the Colombian case, where the government managed wheat imports for internal policy purposes, there was a general trend toward increased wheat imports over most of the study period. The evidence from this study suggests that growing import demand for food grains (such as corn and wheat) can exist side by side with rapid expansion in domestic production of another grain (such as rice) which has been traditionally regarded as a close substitute for imported grains in the consumer's diet.

The increased availability of rice from internal production, which was made possible by initially high price supports and significant increases in yield and irrigation, stimulated some similar and different reactions in the two countries. In both, the real price of rice declined to become cheaper with respect to other staples and per capita consumption more than doubled between 1956 and 1977.

The substitution effect that accompanied lower rice prices was greater in Venezuela than Colombia and affected the locally produced foods--potatoes, cassava, and plantains--more. In Colombia, this effect was felt directly on plantain and corn consumption and indirectly (through government rationing of wheat imports) on wheat.

The effect of income growth also varied; starchy foods (potatoes and cassava) are superior commodities in Colombia but not so in Venezuela. Corn on the other hand is a superior and quite an important staple in Venezuela while it is considered inferior in Colombia. The income effect was in the same direction for rice, wheat, and plantains in both countries.

Given the extraordinary developments in rice production technologies in the past 15 years (both for irrigated and upland rice), it seems likely that several other countries could start adopting them. Tentative generalizations allow us to affirm that the more urbanized a country becomes, the more likely it will increase its dependence on cereals (like Venezuela did) and that an increase in rice production will have an adverse effect on the production of perishable foods. Similarly, the higher the emphasis of a given country to achieve self-sufficiency, the more likely an increase in rice production will have an adverse impact on food imports.

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