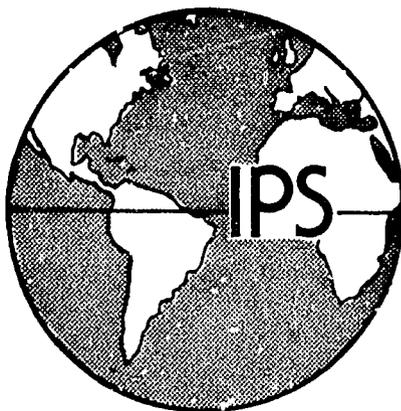




**Increasing Agricultural Production
in Peru and Paraguay:
The Role of Incentives**

by

Clyde Eastman



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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iii
ACKNOWLEDGEMENTS	iv
INTRODUCTION	1
COCA PRODUCTION IN PERU	2
Peruvian Agriculture in the 1970's: An Overview	2
Coca Production	4
COTTON AND SOYBEAN PRODUCTION IN PARAGUAY	9
Paraguayan Agriculture in the 1970's: An Overview ...	9
Cotton Production	14
Soybean Production	17
IMPLICATIONS	22
FOOTNOTES	27
REFERENCES CITED	28

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Peru: production by commodity, value and indices of total agricultural and food production, average 1961-65, annual 1970-79	3
2	Paraguay: principal agricultural exports, 1970 and 1977	11
3	Production, area harvested, and yields for major crops, in Paraguay, 1961, 1970, 1973, 1976	12
4	Soybean production and yields in Brazil and Paraguay, 1952-69	18

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INTRODUCTION

The original focus of this study was spontaneous colonization in two locations each in Paraguay and Peru. As so often happens in the course of an investigation, other phenomena emerged which partially redirected the investigator's attention. During the course of visiting the colonization sites in Peru and Paraguay, the investigator noted that three crops differed from the rest of the commodities produced in these areas. Coca, cotton and soybeans provide three diverse examples of rapidly increasing production, the former in eastern Peru, the latter two in eastern Paraguay. Production of the three expanded rapidly through the decade of the seventies while the rest of agriculture in both countries was less dynamic. Comparing and contrasting the distinctive features of the expansion of each of these commodities provides valuable insights into the development process.

In this paper a brief overview of the national agricultural situation in each country precedes a detailed examination of the production increase in each commodity. Mosher's paradigm of agricultural development is applied systematically to identify the common and unique elements in the development process of each commodity. The paper concludes with a working hypothesis and a discussion of implications for future development projects. Materials for this study were assembled from official documents, published works, personal interviews with agricultural experts and farmers in January and February, 1981, plus the author's previous experience and observations dating back to 1963 in Peru and to 1972 in Paraguay.

COCA PRODUCTION IN PERU

Peruvian Agriculture in the 1970's: An Overview

The overall performance of the agricultural sector in Peru during the decade of the 1970's can be described as lackluster at best, disappointing many participants and observers who had reason to expect much more. By the end of the 1960's Peru had developed a substantial, sophisticated agricultural science capability in its National Agrarian University and in its Ministry of Agriculture (4). The thorough-going agrarian reforms which began in 1969 did not, in the first years, disrupt long-established trends of very gradual increases in agricultural production (5, p.29). However, as the decade of the 1970's wore on, the production figures became less encouraging. Production of several important staple commodities such as potatoes and indices of total food production actually declined toward the end of the decade (table 1). Declining food production coupled with a steadily growing population resulted in steadily declining per capita food production. In 1979, Peru produced only 65 percent as much food per capita as it did in the 1961-65 base average period which, with one exception, was the poorest performance in Latin America (6, p. 79).

What caused this poor performance? A severe drought reduced the 1980 sugar crop to about 23 percent below the already depressed 1979 level (table 1). Whether climate can be blamed for recent declines in other commodities is problematic. One veteran agricultural observer noted that "Peru has always had droughts" and asserted that factors other than weather were responsible.¹ After being promulgated in 1969 and vigorously implemented

Table 1. Peru: production by commodity, value and indices of total agricultural and food production, average 1961-65, annual 1970-79

Commodity	Price	Average	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980 ^{2/}
	Weight	1961-65											
-----1,000 metric tons-----													
Dollars													
Wheat	68	150	125	122	140	145	150	143	148	130	90	95	90
Rice, paddy	76	324	587	591	552	451	426	473	570	547	424	440	--
Corn	69	490	615	616	589	616	600	625	700	720	550	609	450
Barley	54	185	170	159	160	165	168	168	165	170	175	175	150
Millet	40	25	9	8	8	8	8	8	10	8	8	8	--
Sorghum	40	2	15	18	20	22	18	30	40	50	80	90	60
Beans, dry	155	39	53	48	47	37	35	36	36	38	40	40	--
Potatoes	56	1,487	1,929	1,968	1,750	1,713	1,722	1,640	1,667	1,600	1,560	1,400	--
Cassava	25	436	498	482	490	460	469	470	402	410	410	425	--
Sweet potatoes	27	148	178	168	170	155	146	150	167	165	165	160	--
Sugarcane	5	7,373	7,530	8,291	8,582	8,746	9,179	8,928	9,560	9,410	7,970	7,050	5,428
Tobacco	325	3	3	2	3	4	5	5	4	3	3	3	--
Cotton	575	140	91	77	73	84	88	73	57	58	76	90	--
Cottonseed	75	233	159	122	115	149	160	132	102	139	150	150	--
Coffee	545	48	59	62	62	60	54	54	57	62	66	76	--
Cattle imports ¹	120	76	113	101	87	30	10	10	10	5	0	0	--
Beef and veal	420	91	85	111	96	85	95	91	84	85	83	81	74
Mutton and lamb	290	38	33	33	47	34	36	32	32	33	33	33	33
Pork	360	43	46	54	47	45	55	55	53	52	52	55	54
Wool, greasy basis	560	11	10	11	8	9	9	9	9	9	8	8	--
-----million dollars at constant prices-----													
Aggregates of production													
Crops		345.7	374.3	369.0	352.3	351.5	351.0	360.1	346.8	344.9	328.7	335.0	--
Livestock		61.9	53.9	69.7	58.5	63.2	73.9	71.1	67.5	68.4	67.7	67.9	--
Livestock feed deduction	.14	-8.6	-7.5	-9.7	-8.1	-8.8	-10.3	-9.9	-9.4	-9.5	-9.4	-9.5	--
Total agriculture		399.0	420.7	429.0	402.7	405.9	414.6	401.3	404.9	403.8	387.0	391.4	--
Total food		285.3	329.6	344.0	321.4	318.6	328.0	323.3	334.7	330.6	301.8	294.7	--
----- (1961-65 = 100) -----													
Indices of production													
Crops		100	108	107	102	102	102	98	100	100	95	97	
Total agriculture		100	105	108	101	102	104	101	101	101	97	99	
Total food		100	116	121	113	112	115	113	117	116	106	103	
Per capita agriculture		100	86	85	78	76	75	71	69	67	63	62	
Per capita food		100	94	96	87	84	83	80	80	77	68	65	
Index of population													
1961-65 population = 10,902,000		100.0	122.3	126.0	129.8	133.7	137.9	142.1	146.3	150.6	155.0	159.4	

¹ In 1,000 head.

² Price per head.

³ Provisional figures.

Source: Agricultural Attache, U.S. Embassy, Lima.

by the Velasco regime during the early 1970's, enthusiasm for agrarian reform waned in the Morales-Bermudes administration during the last half of the decade. Declining support and assistance for production cooperatives and other enterprises under the new Belaunde regime could be having a further negative impact on agricultural production.

The ministry of Agriculture was divided into two separate Ministries, Agriculture and Alimentacion (Food), during the 1970's and then recombined into one entity. These massive reorganizations almost surely reduced its ability to function effectively during much of the period. During much of the same period, university salaries were depressed as a conscious policy of the Velasco administration, causing many of the well-trained faculty of the National Agrarian University at La Molina to leave for more lucrative positions elsewhere. Thus, much of the national academic/administrative infrastructure declined in capacity, and the government's capacity to formulate and implement coherent, effective agricultural policies probably has been impaired. The flow of new technology to producers may have slowed as well. Whatever the causes may be, it is clear that Peruvian agriculture was not performing very well at the turn of the decade, which makes the performance of one star commodity even more brilliant.

Coca Production

Coca has been produced along the 'ceja de la selva' (eyebrow of the jungle) since the time of the Incas. Until recently it was all marketed legally, either in the Sierra, to an international beverage company, or to the legitimate pharmaceutical industry. The leaves are chewed with a pinch of lime by Sierra Indians much as tobacco or alcohol is used, and the mild narcotic effect has been traditionally appreciated by lower class laborers. While coca leaves were

available in most Sierra markets, few outside the laboring class paid them any attention until the early 1970's.

Around 1973, international interest in cocaine began to create an effective demand among producers in Peru. Producers found they had an additional outlet for their coca at very attractive prices, and although no official figures are available, observers agree that production has increased steadily since that time. The U.S. Agricultural Attache estimated current illegitimate Peruvian production at 20,000 metric tons worth \$100,000,000 wholesale.² The area around Tingo Maria, while not the only producing area, is the largest producing area in Peru, and much attention is focused there (figure 1). It is estimated that 20,000 hectares of coca are produced in a zone which also produces some 8,000 hectares of corn, 2,500 of rice and 2,000 each of coffee and cacao. Since it is produced on the steeper slopes and poorer soils, coca does not compete with other crops for land, but probably competes for production capital, management and labor. Coca production remains traditional: the perennial is planted, clean cultivated at least once a year, and picked clean of leaves in a once-over harvest operation. Some application of pesticides and fertilizer appear to be the only new technology used. Production increases have thus been achieved mostly by expanding the area and, to a lesser extent, by applying new technology.

Five hectares is a big coca planting; most fields contain only one or two hectares, although a very few plantings may be as large as 20 to 40 hectares. A family can care for up to five hectares with hired labor only at weeding and harvest time. Gross annual returns for one hectare is estimated to be as much as \$5,700.³ By comparison, gross returns for one hectare of corn would be, at most, only a few hundred dollars. While production budgets are not available,

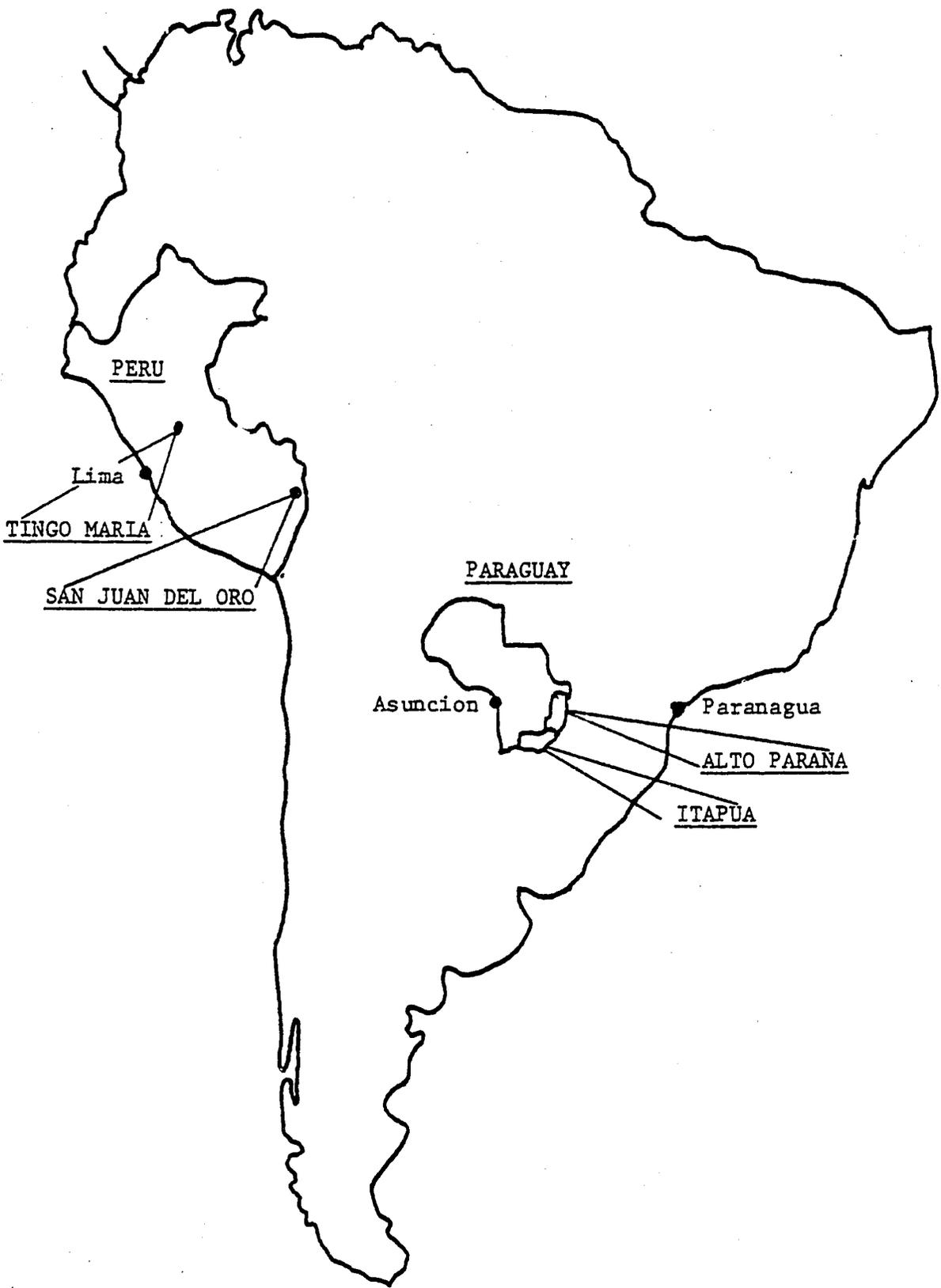


Figure 1 Colonization Sites in Peru and Paraguay

coca is clearly a very profitable crop to the producer as well as to those who process and distribute it. For a crop with few natural risks and whose cultivation is well established and understood, the rewards are very substantial. Apparently no legitimate crop even approaches coca in profitability in the Tingo Maria area. Official Peruvian policy, with much U.S. prodding, has been to destroy illegitimate plantings. However, actual enforcement has been only half-hearted, and many clearly visible fields dot the mountainsides around Tingo Maria. Understandably, coca producers respond to efforts to limit production with about the same degree of enthusiasm that American tobacco farmers respond to the Surgeon General's report on smoking.

What would account for the marked increase in coca production in Peru, particularly in the context of an otherwise stagnant agriculture? Mosher's paradigm of agricultural development provides a simple systematic framework for analyzing the development process. According to this paradigm, five elements essential to increasing agricultural production are transportation, inputs, technology, markets, and incentives. Five additional elements may stimulate development but are not absolutely essential. These are education, credit, group action by farmers, land development, and planning (7, pp. 182-184).

Which elements, if any, have been responsible for the increase in coca production? Transportation between the Tingo Maria area and Lima has improved slowly but steadily during the past several decades. Ground transport now requires less time and demands less wear and tear on both vehicles and bodies than was formerly the case. Air service is more frequent and, judging from the dress of the passengers, available to those with even moderate incomes. Thus, transportation of coca may take a little less time, may be smoother, and may cost a little less in real terms in the 1970's than it did in the 1960's through the

established transportation network. One must also recognize the clandestine international air "service" which transports a good portion of the volume north through Colombia and on into the U.S. and Europe. But this "service" has arisen out of the illegitimate nature of the traffic and does not seem to be due to any inadequacy in the regular transportation system. Changes in transportation do not seem to have caused the increase in coca production in Peru.

Production inputs such as fertilizer and pesticides were available for purchase in Tingo Maria in the 1960's. While the range of materials may have been somewhat greater in the 1970's, there is no evidence of any breakthrough or significant change in availability, particularly with respect to coca inputs. Changes in the availability of inputs do not seem to have contributed much to the increase in coca production.

Technology of coca production is apparently little changed from the pre-boom period. The only change in the traditional practices seems to be a somewhat greater use of fertilizer and insecticide, although even this change is modest. Those intimately familiar with the production process of coca have mentioned no new varieties, no technology that might make mechanization possible on the steep slopes, nor any other technological change.⁴ Production increases have been achieved by applying essentially traditional production techniques to more hectares.

Reports in the mass media corroborated by local observers indicate that a new market for cocaine developed in the 1970's (8, pp. 9-12). The world's illegitimate drug users developed a liking for cocaine. Buyers with hard cash began to appear in coca-producing areas, and coca producers were presented with a new market outlet for their product. Every observer indicated that coca production was highly profitable and the limited data support that

assertion. It is widely reported that coca profits finance purchase of appliances such as televisions and refrigerators, plus major durables, such as tractors, automobiles and houses (ibid.).

What else might account for this production increase? There was no extension or other educational program on coca, no official production credit program, no apparent action by any farm group, and no planning by any agency. However, unoccupied and suitable land was available for greater extensions of coca, which meant that existing crop patterns need not be disturbed. Readily available and suitable land made planting feasible and relatively easy.

Thus Peruvians substantially increased coca production in the context of a generally stagnant agriculture. The weight of the evidence indicates that, in Peru, the essential elements of transportation, input availability and technology were not prior limiting factors. The fourth essential element, the new market outlet, appeared in the 1970's. New buyers paid very high prices for coca, providing the fifth essential element--an effective incentive to producers. Farmers increased coca production because they found it profitable to do so. They had material wants for appliances, motor vehicles, and houses which the additional income could be used to purchase. This leads one to suspect that lack of effective incentive could be a key factor limiting production increases in other commodities.

COTTON AND SOYBEAN PRODUCTION IN PARAGUAY

Paraguayan Agriculture in the 1970's: An Overview

As the decade of the 1970's began, beef was the premier agricultural commodity in Paraguay. Cotton and soybeans lagged well behind beef as export

commodities. After a sharp but brief rise in beef prices in the early 70's, prices declined. Paraguay was hurt by Common Market policies restricting beef imports, so that by 1977 beef exports had fallen to third place in the rank ordering of agricultural exports (see Table 2).

Paraguayan beef production never reached a consistent level of technological sophistication. While a few scattered operations used most of the available technology to obtain high production of quality beef, most producers relied on simpler, more traditional methods (3). Similarly, and perhaps to an even greater extent, crop producers also relied on traditional techniques. Paraguay could easily produce enough food to meet the domestic demand without using modern technology and, because the country was far from export markets, there was little reason to produce more.

Table 3 shows that wheat, rice, sugar cane, and mandioca (manioc) production declined somewhat during the 1970's after having experienced increases in the previous decade. Corn and bean production increased by roughly 50 percent during the 1970's. Tobacco production more than doubled between 1970 and 1976; however, by the end of the decade, production had fallen below 1970 levels. Paraguay produced and exported black tobacco until world demand shifted to lighter types. Since the curing process is different for lighter tobacco, producers have experienced difficulties in making the switch. For that reason, tobacco production declined by decade's end.⁵ Cotton production almost tripled from 1970 to 1976 and then doubled again by 1980. Soybean production more than quintupled between 1970 and 1976, then more than doubled again by 1980. By any standard, cotton and soybeans were the star performers in Paraguayan agriculture.

In addition to the boom in two agricultural commodities, Paraguay has experienced another of the very few economic booms in its history. The

Table 2. Paraguay: principal agricultural exports, 1970 and 1977

Commodity	1970 ¹	1977 ²
	----- U.S. dollars ----- (000)	
Beef (processed and live)	15,245	34,323
Lumber and logs	12,641	19,912
Tung and coca oil	6,401	30,365
Tobacco	5,765	13,658
Cotton (fiber)	4,048	80,487
Cowhides	1,600	2,246
Soybeans	761	58,854

Source: ¹ Henry D. Ceuppens, Paraguay Ano 2,000, p. 73, Table 19, Asuncion: No publisher listed, 1971.

² Food and Agriculture Organization of the United Nations, 1978 FAO Trade Yearbook, Vol. 32, Rome, 1979.

Note: This is not an exhaustive listing of agricultural exports. Since dollar figures are not constant, comparisons among crops are valid only for one time period. At least part of the increase in dollar volume, from 1970 to 1977, is probably due to inflation.

Table 3. Production, area harvested, and yields for major crops, in Paraguay, 1961, 1970, 1973, 1976

		Total Production (1,000 MT)	Total Land Area (1,000 Has.)	Average Yield (kg.)
Corn:	1961	206.3	171.4	1,200
	1970	258.7	187.4	1,380
	1973	246.0	185.6	1,326
	1976	370.5	285.0	1,300
Wheat:	1961	11.0	13.4	800
	1970	31.4	34.3	914
	1973	23.0	20.3	1,132
	1976	25.3	28.5	1,124
Rice: (Irrigated)	1961	31.7	15.2	2,100
	1970	45.2	22.9	2,100
	1973	33.9	15.7	2,151
	1976	40.6	17.1	2,374
Soybeans:	1961	2.4	2.1	1,100
	1970	52.1	39.7	1,311
	1973	122.5	81.4	1,508
	1976	272.6	169.9	1,604
	(1980) ¹	(650)		
Cotton:	1961	27.2	35.4	800
	1970	39.6	46.9	844
	1973	85.3	81.1	1,051
	1976	112.1	115.0	975
	(1980)	(230)		
Tobacco:	1961	13.4	10.0	1,300
	1970	17.7	13.5	1,312
	1973	26.7	20.4	1,310
	1976	38.6	27.9	1,380
	(1980)	(16.0)		
Sugar cane:	1961	863.1	28.7	30,000
	1970	972.6	26.0	37,000
	1973	758.9	17.7	42,860
	1976	787.7	20.7	37,920
Mandioca:	1961	1,510.5	112.0	13,400
	1970	1,782.2	127.3	14,000
	1973	1,107.9	79.6	13,938
	1976	1,573.3	106.5	14,773
Beans:	1961	36.6	52.6	696
	1970	34.9	54.4	641
	1973	34.2	43.4	788
	1976	52.3	66.8	783

¹Comparable data for 1980 were obtained from the Ministry of Agriculture for only soybeans, cotton and tobacco.

Source: Agency for International Development, Paraguay, Project Paper, Small Farm Technology, AID/LAC/P-015, Project No. 526-0109, Washington, D.C., May 5, 1978.

hydroelectric projects on the Parana River, financed by Brazil and Argentina, provide jobs and good incomes for thousands of Paraguayans. This income has helped double Paraguay's G.N.P. and nearly triple the per capita income in the last six years (7, p. 46). The hydroelectric projects have significantly lowered unemployment in Paraguay and have been responsible for a two or threefold increase in the price of agricultural labor, at least in the departments near the construction sites. There has long been a substantial underemployment of agricultural labor in that subsistence farmers were not really occupied to their full potential. That buffer together with labor-extending mechanization has provided the manpower required for increased production without drawing on nonagricultural labor. Another indication of the expanding economic activity is that both Encarnacion in Itapua and Puerto Presidente Stroessner in Alto Parana have branches of six or eight major international banks including Bank of London, Bank of America, Citibank, plus several Brazilian and Argentinian banks.

Until the 1950's nearly all of Paraguay's commerce had been transported through Argentina to world markets. Most of it went via the Parana River through Buenos Aires. In the 1950's the Friendship Bridge was constructed across the Parana River, and a paved road linked Asuncion and eastern Paraguay to a new outlet, the freeport of Paranagua in Brazil (figure 1). The city of Puerto Presidente Stroessner was hacked out of the forest around the bridge. Residents who have moved to the capital of Alto Parana from all over Paraguay like to point out how the city has grown and developed in just 24 years. The population is currently estimated at 100,000 and is supported by commerce, the Itaipu hydroelectric project, and agriculture.

Paraguay has one of the largest extensions of unused but suitable agricultural lands in the hemisphere, giving it the potential to become an

important supplier for the world food market. The red lateritic soils of Itapua and Alto Parana have proven to be very fertile, at least for the first few years after the removal of the original forest cover. Corn, cotton, soybeans, wheat, and a wide variety of subsistence food crops do very well. Since the soils are acidic and tend to tie up phosphorus, they may be expected to respond to applications of lime and fertilizer after a few years of cultivation.

Cotton Production

Cotton has long been produced in Paraguay in modest quantities for both domestic use and export. However Paraguayan cotton was very heterogeneous and of irregular quality because seed was purchased in Argentina, Brazil or elsewhere without much concern for type of fiber.⁶ A national cotton program to improve cotton production was launched with French assistance. By crossing African varieties with western upland varieties, new hybrids adapted for conditions in Paraguay were developed. These hybrids yield well and produce high-quality fiber that commands premium prices in the world market.

With the exception of the Mennonite Colonies in the Chaco, nearly all Paraguayan cotton is harvested by hand. Labor supply problems seem to be limiting the area per grower to a few hectares. While a small producer can mobilize enough family labor to harvest one or two hectares, larger growers would have to compete with the hydroelectric projects for labor or use expensive mechanical cotton pickers. Few, if any, large-scale growers have yet emerged.

During the harvest season farmhouse porches and living rooms piled high with cotton bales are a common sight. The bales are picked clean of trash and packed into very large burlap bags for shipment to the gins. New private and cooperative gins have been built around the country to handle the increased volume of production.

Maybe because cotton producers are small operators, a distinctive "patron" system seems to characterize the production/marketing process. Reportedly, one major buyer in each locality also extends credit and supplies against the crop from planting time through the growing season. He buys the unginned crop and recovers the money owed to him at that time. Since not enough production credit is available from government sources, this is the principal way by which private capital participates in cotton production. Whether this "patron" system is important in other commodities is not clear, but one hears about it mostly in relation to cotton.⁷

In addition to planting hybrid varieties, there is substantial evidence that cotton farmers are using fertilizer, pesticides and machinery at levels unknown in the 1960's. Commercial establishments selling fertilizers, chemicals and machinery have proliferated, even in the smaller towns. The technology is being applied by small-scale producers, many of whom have so little formal education they can barely speak Spanish. This is happening in a country where even the premier export commodity, beef, was produced by largely traditional methods in the early 1970's (3). Field days sponsored by private companies to field-test and demonstrate sophisticated new technology to small farmers are becoming common. For example, Cooper Paraguay, S.A., demonstrated a newly developed process to apply ultra-low volumes of insecticides to farmers in the Department of Caaguazu. Using a simple electrodynamic process, one half liter of material would cover a hectare of cotton, which would normally require 15 backpack sprayers of conventional insecticides. This reduces the time required to spray one hectare from one day to 2½ hours. In this case, Paraguayan growers were being exposed to technology "just out of the laboratory" as early as were farmers in the developed world. Several Ministry of Agriculture officials and

about 25 local farmers attended the two-hour demonstration which was followed by a barbecue with live entertainment.

We may now apply the Mosher paradigm to Paraguayan cotton. Transportation has certainly improved in Paraguay during the 1970's. As was noted above, a new route was opened to world markets. However, it was impossible to identify any particular event in the improvement of transportation which would coincide with or account for the large increase in cotton production.

Production inputs are also more widely available than before. However, most of the same inputs, e.g. fertilizer, some pesticide and machinery, could be applied to many other crops, but have not been so applied. One suspects that the wider availability of inputs is a concomitant and not a precipitating factor in increasing cotton production.

New technology was certainly an important element. Only when Paraguay could produce a high-quality fiber was it able to attract world attention as well as a premium price. Without the high-quality and productive hybrids, there is little reason to expect that any major increase in cotton production would have occurred.

The marketing system is the most traditional element in this equation. The money lender/buyer or "patron" is much more commonly associated with traditional rather than modern agriculture. However, the patron not only provides a market outlet, he also provides production credit. In a country where credit is limited, this is a valuable service.

Although no production budgets were available and it was well beyond the scope of this project to generate any, it was clear that cotton production is profitable to the farmer. Farmers, local merchants, and agricultural experts all indicated that it was cotton and soybeans which were responsible for the

current economic boom. Cotton sales provide cash to purchase all manner of consumer goods as well as capital for the farm business.

Among the accelerator elements, production credit and the expanding land base were probably most important in this case. There was little evidence that group action by farmers contributed much to cotton expansion. Some planning may have occurred; at least there was a national program out of which the hybrid varieties emerged. The Extension service did some educational work, but its impact is limited by the small number of agents and their lack of mobility.

The most persuasive explanation of the sharp increase in cotton production would appear to hinge primarily on two essential interacting elements: the high-quality hybrid variety coupled with incentives. Production credit, both public and private, and the expanding land area probably also helped facilitate the expansion. Paraguay produces a high-quality cotton fiber which commands a premium price on the world market. Cotton is now more profitable than it once was; therefore, more is produced.

Soybean Production

Soybean expansion outstripped even that of cotton in Paraguay during the 1970's. In contrast to cotton, which is produced throughout most of the country, soybean production has been concentrated in eastern and southeastern Paraguay in the Departments of Alto Parana and Itapua. The state of Parana, Brazil, immediately across the border to the east, is part of the major soybean producing region in Brazil. As Table 4 shows, soybean production increased in Brazil before it did in Paraguay. Paraguay is in effect an extension of the Brazilian soybean belt. Since climate and soils are similar on both sides of the

Table 4. Soybean production and yields in Brazil and Paraguay, 1952-69

Year	Brazil		Paraguay	
	Yield 100 Kg/Ha	Production 000 MT	Yield 100 Kg/Ha	Production 000 MT
1952	13.0	78	----	--
1953	14.0	88	----	--
1954	17.2	117	----	--
1955	14.5	107	----	--
1956	14.2	115	----	--
1957	12.6	122	15.0	1
1958	12.5	131	15.0	1
1959	13.3	152	13.6	2
1960	12.0	206	17.3	2
1961	11.2	271	16.2	2
1962	11.0	345	16.1	3
1963	9.5	323	16.0	7
1964	8.5	305	16.0	10
1965	12.1	523	16.0	18
1966	12.1	595	14.0	20
1967	11.7	716	14.0	18
1968	9.1	654	16.1	14
1969	11.7	1,057	20.0	22

Source: Food and Agriculture, Organization of the United Nations, World Crop Statistics: Area Production and Yield, 1948-64, Rome, 1966, p. 315; Production Yearbook, 1969 and 1970, Vols. 23 and 24, pp. 228 and 230.

Parana River, production technology required in Paraguay is identical to that required in Brazil.

During the 1970's Brazilians began buying agricultural land in Alto Parana and planting soybeans; multinational corporations and wealthy individuals have also invested in soybean production in the region; and Paraguayan farmers with large, medium, and small operations have planted soybeans. Thus nearly everyone involved in agriculture seems to be participating in soybean production, and plantings range from a few to hundreds of hectares.

While it is quite possible to plant and tend small plots of soybeans with the oxen or horses and simple tools which Paraguayan farmers ordinarily own, harvest is tedious when done completely by hand. Mechanized harvest takes two forms: small stationary threshing machines and large self-propelled combines. The threshing machine only separates the grain from the rest of the plant. The soybean plants must first be cut and transported to the threshing machine, which is still a very labor intensive operation. The large and expensive combines are only feasible for very large operations or for custom work. Custom operators can be hired for 40 to 50 U.S. dollars per hectare, and at least some small producers harvest in that manner.

The same commercial suppliers of inputs to cotton producers also service soybean producers. In fact many of the same implements, fertilizer, and pesticides are used on both crops. Soybeans, usually grown in larger extensions than cotton, would seem to be providing more of the impetus for purchase of tractors and other machinery.

Of the two departments where most soybeans are produced, Itapua has been settled much longer. There are numerous colonies of German, Ukrainian and Japanese origin which were settled in the first decades of this century.

Manifestations of the ancestral culture can still be seen in implements, e.g. a typical flared-box, four-wheel European farm wagon, and in a preference for the German language even among the second- and third-generation descendants of the original settlers. While these colonists differ from their native Paraguayan neighbors in many particulars, most seem to have operated at about the same subsistence-plus-petty-commercial level before the current boom; i.e., they produced most of their own food plus a small surplus of several saleable commodities. Now they, too, are planting cotton and soybeans.

The experience of one Paraguayan resident seemed to be typical of Itapua farmers. His widowed mother and brother remained on the small family landholding near Asuncion when he moved to Itapua in 1950. He found it easier to start farming in Itapua as land was cheaper, more abundant and more productive than in Asuncion. Buying a few hectares at a time, often with Development Bank loans, he gradually acquired 30 hectares on which which he operated a modestly prosperous combination of livestock and crop enterprises. In the 1980-81 crop year, he had 12 hectares of soybeans, 2 of cotton, 2 of upland rice, a hectare or so of mandioca, watermelons and other subsistence crops, plus 6 or 8 head of cattle and an assortment of horses, pigs, and barnyard fowl. Now in his fifties, he has expanded his operation about as much as he wants. A grown son who is working at home wants to expand further and buy a tractor.

When asked what had happened to the people who sold the small plots to him, the farmer indicated that they had moved to more remote parts of the Department or to Alto Parana where land was cheaper and more plentiful. As the road paralleling the Parana River is pushed northeast toward Puerto Presidente Stroessner, new lands are being cleared of forest and brought under cultivation. The two separate zones will soon become a continuous belt paralleling the Parana River.

The expanding road network is opening both Alto Parana and Itapua to commercial agriculture. The all-weather, paved road through Puerto Presidente Stroessner across the Friendship Bridge to the freeport of Paranagua, Brazil, is the route Paraguayan soybeans travel into the world market. Soybeans were not a significant crop until the route was opened. When we apply the Mosher paradigm to Paraguayan soybeans, it becomes apparent that while transportation is a necessary element, it is not sufficient to determine why soybeans and not corn, manioc or commodity "x" became a boom crop.

As with cotton, input availability seems to have expanded concurrently with the crop output. There was no evidence that any breakthrough in this area preceded or precipitated the sharp increase in soybean production.

As was indicated above, technology for soybean production seems to have moved across the Rio Parana by a kind of osmosis. Since production conditions are much the same as in neighboring Parana, Brazil, no major local adaptation of technology has been necessary.

Paraguay has a market for soybeans. Large trucks carry the soybeans from elevators in the producing areas to the ocean port of Paranagua some 650 Km from the Paraguayan border. Local elevators, some cooperatively owned and others privately owned, are appearing in advance of extensions of the paved roads. This marketing system is developing concurrently with soybean production.

While Paraguayans grumble about price fluctuations and low prices like farmers everywhere, everyone indicates that soybeans are profitable in Paraguay. With figures of 1,500 to 3,000 Kg/Ha (22 to 44 bu/A) cited as common, yields are comparable to those in the U.S. cornbelt. Prices ranging from 18 to 35 guaranies per kilo (approximately \$3.50 to \$6.75/bu at the current rate of exchange) are somewhat below U.S. cornbelt prices. Again, no production

budgets were available. However, that farmers have been able to finance purchases of more land, tractors, major home appliances such as refrigerators and televisions, and even trucks is compelling evidence of profitability.

If there was some extension work in soybeans, some credit available, some planning, and some organization, there is no compelling evidence that these precipitated the rapid increase in soybean production. Vast extensions of unused lands, very suitable for soybean production, has been a vital element in facilitating increased production. However, soybean production has expanded in older areas as well as in the new ones.

Once the new transportation route was open and new agricultural lands became more accessible, those barriers to increased production were removed. Why did soybean production increase rather than production of corn, manioc, or crop "x"? The most persuasive explanation is that soybeans are more profitable and are expanding for that reason.

IMPLICATIONS

There is nothing new or earth-shaking about farmers responding to price incentives. Historical accounts of American agriculture are full of producers planting different crops which they believed would be more profitable (1). However, very few development projects focus any attention on production incentives. This has been especially true in Peru and Paraguay. Technical assistance projects introduced new genetic material and adapted technology in commodity after commodity, specializing in beef in Paraguay and in a wider range of commodities in Peru. Much new technology was developed, and marketing studies fill thousands of pages; but production in most commodities increased very slowly if at all (4).

Coca, cotton and soybeans provide examples of rapidly increasing production in otherwise unspectacular agricultural sectors. It is probably no coincidence that production increases in all three have been exported. Producers are responding to world market prices and not to domestic prices, which are much more frequently controlled.

In many countries, Peru and Paraguay included, the price of staple foodstuffs is controlled in an attempt to keep prices low for consumers. An interesting example is provided by evaporated milk, which had just reappeared on retail shelves in southern Peru in February, 1981, after a period of absence. The official price was raised at that time from 90 to 150 soles per can. Retailers began to put their allotment on their own shelves again instead of sending it as contraband to nearby Bolivia where it could be sold for much more than the controlled Peruvian price. Not only may low fixed prices drive any given commodity into international contraband, they may also discourage its production in the first place. One factor contributing to the unspectacular performance of Peruvian and Paraguayan agriculture over the years could have been low prices, often controlled.

The analysis lends support to the following tentative hypothesis: Inadequate incentive to the producer is a major factor limiting increased food production. One should not conclude that this is true in every commodity or even in most commodities. However, the evidence is compelling enough in these cases to demonstrate the importance of incentives.

Peruvian coca farmers were generally very traditional operators. Paraguayan farmers, lacking access to world markets, produced for themselves and sold a modest surplus to raise some cash. Even their principal commercial product, beef, was produced in largely traditional manner. It is, therefore,

especially remarkable to see such traditional producers respond and change with such alacrity. Further, some increases were obtained with little or no government help, the crop-breeding program in the case of cotton being the exception. There was little apparent assistance in the case of soybeans and even some official resistance in the case of coca. At the same time, millions were spent promoting other commodities with little success.

The implication for development programs is clear: incentives to the producers require the same attention that technology, transportation, input availability and markets receive. There are good reasons why producer incentives do not always receive the attention they require. In many cases, disincentives in the form of low prices are consciously adopted. In a free market system incentives means prices. High commodity prices mean high food prices, and there the issue gets politically explosive. The spectre of housewives rioting at the palace gates for lower food prices must cause even otherwise secure dictators some pause. There are powerful reasons to keep food prices down; however, in so doing, food production is very likely being suppressed.

Paraguayans do not like high petroleum prices any more than do consumers elsewhere. High prices there are as burdensome, particularly to the poor, as anywhere. Since Paraguay imports all of its petroleum, gasoline prices there are very high. Paraguayans grumble and complain, but they pay \$4.00 per gallon for premium gasoline, \$3.00 per gallon for regular, and \$1.50 for diesel fuel. Bus fares cost $2\frac{1}{2}$ times as much in Asuncion as in Lima. The price of mobility in Paraguay is high. In the free market, food also has its price. It may also be much more than many consumers find convenient to pay.

Monetary returns are not the only incentives which motivate people. Centrally planned economies set production goals and heap medals and praise

on those who achieve or exceed them. Leaders from both centrally planned and free market economies appeal to the divinity and the flag to inspire more production. In Paraguay, the President, who is a fairly influential individual, occasionally decrees production increases in this or that commodity, most recently yerba mate and wheat. The Minister of Agriculture is then dispatched to the major producing areas to promote the commodity. Without impugning either the religiosity or the patriotism of Paraguayan farmers, casual observation indicates a greater response to the coin of the realm than to either the divinity or the flag. If recent experience is a reliable guide, a general price increase will more effectively sustain farmers as they plow more, plant more and attempt to harvest more. Moreover, if world trade figures are an accurate guide, medals and praise have produced less food than many communists would like to eat. Non-monetary incentives apparently need further perfection and refinement to be adequate to the task.

Figures on the distribution of profits from increased production of coca, cotton, and soybeans were not available. It is apparent that producers are receiving substantial benefits in the form of attractive prices. We may only speculate on the profits to the processors and traders in the three commodities. Reports in the world press indicate enormous profits are made in the processing and distribution of coca. Given the nature of the Paraguayan body politic, it would be surprising if a small group had not found ways to profit handsomely from the cotton and soybean trade. Thus, even with a substantial "trickle down" of benefits to the producers, there could be some concentration of wealth stemming from these commodities.

In many cases, increases in export crop production have accompanied or caused declines in domestic food production. This appears not to have been the case in either Paraguay or Peru for two reasons. There were substantial

numbers of underemployed laborers in agriculture, and suitable uncultivated land has been available in both countries. In Paraguay, at least, the smaller of the new commercial farmers still plant their plots of mandioca and other subsistence crops and still raise a full complement of barnyard livestock. All evidence indicates that commercial soybean and cotton have been added to previous subsistence production. New technology in the form of machinery and chemicals supplements the extra labor inputs to produce much greater output. In Peru, the coca-producing regions are too small to be responsible for the mediocre performance of the total agricultural sector.

FOOTNOTES

¹ Douglas Horton, Chief Economist, International Potato Center, personal interview, Lima, Peru, January 1981.

² Richard Barnes, U.S. Agricultural Attache, personal interview, Lima, Peru, January 1981.

³ Werner Bartra, Ministry of Agriculture, personal interview, Tingo Maria, Peru, January 1981.

⁴ Ibid.

⁵ Ministerio de Agricultura y Ganaderia, personal interview with various officials, Asuncion, Paraguay, February 1981.

⁶ Atilio Centron, Dean, Facultad de Ingenieria Agronomica, Universidad Nacional de Asuncion, Paraguay, personal interview, February 1981.

⁷ Ministerio de Agricultura y Ganaderia, op. cit.

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