GLOBAL CASSAVA RESEARCH

AND

DEVELOPMENT

The Cassava Economy of Latin America:
A Food Staple in Transition

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PREFACE

The accompanying manuscript on the "Cassava Economy of Latin America: A Food Staple in Transition" is a work still in the process of being written. The work is not complete but is distributed at this early stage for comment and to share preliminary findings with those monitoring the evolving role of cassava in Latin America. The research (data collection and analysis) underlying the study of cassava in the region is essentially complete; however, the write-up has been constrained by other commitments of the lead author.

The projected study will be divided into two, interrelated parts, analogous to a two-dimensional matrix. The first part develops various themes on the status of cassava within the Latin American agricultural economy, taking a cross-country comparative approach to each issue. This section has principally a market focus and sets cassava within the grain-livestock sector of tropical Latin America. The second part is a country-by-country analysis of the current status and future potential of cassava in the various producing countries. These chapters have a defined focus on locating cassava within the policy framework of the particular country and on detailed analyses of current and potential markets within the country.

The first section is still largely incomplete and contains the outline and two of the projected eleven chapters. These are two of the most important chapters and give an overview of cassava food markets and the potential of cassava as an animal-feed source in Latin America. This first section is being prepared by John Lynam, an economist in the CIAT Cassava Program. The country studies in the second part were contributed by a variety of authors. Dr. Carlos Ibañez-Meier of CIAT led the Brazilian study and was assisted in this effort by Dr. Vander Gontijo of EMBRAPA and Dr. Willem Janssen of CIAT. Dr. Luis Sanint of CIAT authored the chapters on Colombia, Venezuela, Peru, and Paraguay. He also was responsible for the research on Ecuador, which is not included here. Finally, Dr. Roberto Saez of CIAT was responsible for the research on Mexico, Panama, the Dominican Republic, and Jamaica. Unfortunately, there was no time to translate these chapters from Spanish to English and they could not be included.

The current volume thus gives a rather skeletal view of the economic study of cassava in Latin America. However, sufficient information is included to make judgements on the present and future potential of cassava in the region. Moreover, the studies have already played a functional role in guiding research planning by both CIAT and national cassava programs and in the development of integrated cassava projects in many of the countries. The studies have already proved their worth, and they provide the first step at compiling a consistent picture of cassava in the region and the data base on which to build future field-level studies of cassava production, marketing, and demand.

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Unlike other parts of the developing world, Latin America does not depend on a single carbohydrate staple as the backbone of its diet. Thus, while rice is the basic staple in tropical Asia, wheat in temperate Asia and the Near East, maize in East Africa, and cassava in Central Africa, all these starchy staples including potato are important in Latin America, yet none dominate over the whole region. The reasons for this are many but two stand out. First, a staple achieves a dominant role in the diet because of its low relative cost, especially as an energy source. In rural areas cost advantage is usually determined principally by yield advantage, and thus agroclimatic conditions tend to be a principal determinant of food subsistence patterns. Because agroclimatic conditions are quite variable in Latin America and because at least three major starchy staples (cassava, maize, and potato) were domesticated in the region, each starchy staple achieved its own niche in the diet and cuisine of rural societies in Latin America.

The other distinguishing characteristic of Latin America, when compared to Africa or Asia, is that the population of the former is predominately urban. The urbanization process has a distinct impact on food consumption patterns. First, relative prices of food staples change between rural and urban areas. Second, convenience in food purchase and preparation becomes a principal concern in urban-family time allocation. Third, income growth in an urban setting, while leading to some increase in quantity consumed, principally is reflected in an augmented diversity in the diet. Finally, urban areas, at least in South American countries, draw migrants from rural areas where different staples dominate. Although buffered by the other influences, food habits are transferred to an urban setting. The result is significant diversity in consumption patterns both within and across major urban areas.

Staples exist but are not defined at the continent level and only rarely at the country level. Thus, only in Mexico, Honduras, Guatemala, and El Salvador does a single commodity, maize, make up more than 35% of average national calorie consumption. Rather, the food staple in a Latin America context is defined at the regional level, rural residence, and income strata. It is at this level that the current role of cassava as a food staple will be discussed. Moreover, this analysis will provide the setting for a discussion in future chapters of the role cassava can play in the agricultural economy in the context of diversification of the diet and the declining role of the staple in Latin American, food consumption patterns.

Highly Protean Cassava: The Diversity of Consumption Forms

Cassava is consumed in Latin America in three principal forms: as the fresh root which is either boiled or fried: as a roasted flour, "farinha de mandioca"; and as a type of unleavened bread, casabe. Consumption of the processed forms is culturally defined. Casabe is only consumed in the Caribbean Basin, particularly the island countries of Haiti, the Dominican Republic, and Jamaica (where it is known as bammies), and on the continent from eastern Venezuela through Guyana and Suriname. Consumption of farinha de mandioca is almost soley confined to Brazil, although it is also found to a limited extent on the border areas in Paraguay and northern Argentina and among the indigenous Indian population in the Amazon basin areas of Venezuela, Colombia, Ecuador, and Peru. Although all are identified as cassava, their consumption form makes them distinctly different foods. Analogues for other starchy staples are bread and pasta in the case of wheat, and choclo and tortillas in the case of maize.

Consumption form is a dominant factor in the role cassava currently plays in the diet and its future prospects, especially in urban food consumption. Form influences preferences, marketing costs, consumer convenience, and utilization within the meal. The functional role of form in production, marketing, and consumption of cassava is best analyzed if the fresh root is distinguished from the processed products.

Fresh cassava has all the salient characteristics of the root and tuber crops. The cassava root is about two-thirds water, although this still results in a starch content significantly higher than all the other major root and tuber crops. In its cooked form cassava has as high or higher an energy density as polished rice. The disadvantage of high water content comes in the higher marketing and storage costs for this bulky, low value product. These costs are exacerbated by the very short shelf-life for cassava roots. When exposed to oxygen, usually as a result of wounding during harvest, the roots develop a blue-black pigmentation in the vascular tissue accompanied by the dessication of the starch containing cells (Janssen and Wheatley, 1985). From 24 to 72 hours after harvest, this process makes the fresh root unacceptable for human consumption. Costs thus increase dramatically the further the consumption point is from the production point. Although consumption of fresh roots is found throughout tropical Latin America, consumption is high only in rural areas where cassava production is widely diffused.

Processing eliminates the water, stabilizes the product, and vastly improves its marketing characteristics. Consumption of processed products is thus more diffused through the food economy although still limited by its cultural boundaries. Processing also reduces the cyanide (HCN) content of the roots, a necessity where varieties are "bitter," i.e., have cyanide levels in the parenchyma exceeding 100 mg/kg (on a dry weight basis). The production of casabe and farinha de mandioca are, to a very large extent, based on "bitter" varieties. Both casabe and farinha de mandioca are of ancient origin; archaecological finds in Venezuela of clay griddles for making casabe have been dated to between 3000 and 7000 B.C. (Renvoize, 1972). A reasonable hypothesis would be that processing to eliminate the HCN was necessary for the domestication of the crop. However, Lathrap (1973) and Spath (1973) both argue that the genesis of cassava processing was not to remove the HCN per se but rather to support trade networks in the Amazon and Orinoco basis.

From the earliest times the raison d'etre for processing has principally been to improve cassava's marketing characteristics and not necessarily to improve its consumption characteristics. A reverse pattern is found in grains. Processing of grains takes place nearer to the consumption point than the production point and the reason is principally to transform the grain to a form that is usable by the consumer. Rice milling, the production of wheat flour, or the grinding of maize meal or dough (Nixtamal in Mexico) are prime examples of forward linkages between grain staple production and industrial development. In cassava those linkages are forged at the production point. Unlike the grains, production and processing of cassava has developed as an integrated system. The marketing system that results is thus specific to the cassava product that is produced.

Form is essential to understanding the role of cassava in the agricultural economy. It is also essential to understanding cassava consumption. Although fresh roots, farinha de mandioca, and casabe are the principal forms in which cassava is marketed and consumed, a large number of other forms also exist. Tapioca pearl is produced in Brazil and is used to make a large wafer called "beiju." In Para state in Brazil "farinha de tapioca" is produced. This is a puffed tapioca pearl and is eaten in the larger cities of the Amazon Basin. Artisanal production of starch also occurs in many areas of Latin America. In Colombia the starch is fermented and together with cheese used to make a bread called "pandebono." In Paraguay the unfermented cassava starch forms the basis of a bread form called "chipa." As reviews by Schwerin (1971) and Lancaster et al. (1982) will attest, the forms in which cassava is consumed are multifarious and all follow from variations in the form of processing.

The antiquity and multiplicity of consumption forms and the relatively well-defined boundaries on the consumption of each raise the issue of what has constrained their diffusion throughout the whole of Latin America and conversely whether there is potential for the consumption of these products in areas where they are not currently eaten. There are no definite answers to these questions and only hypotheses will provide clues. Since cassava is grown throughout tropical Latin America, there is no lack of knowledge concerning production of the crop. The processing technology is simple and easily transferable, and certainly a sufficient amount of intercourse between regions to facilitate the transfer of knowledge would be a reasonable supposition. The answer seems to derive most logically from a certain rigidity in preferences for the basic carbohydrate staple. Indigenous cuisine evolved in the rural areas and was developed around the caloric staple. Differences in food preparation methods, complementary foods, and the structure of the meal reflect in large part the particular characteristics of the staple. The difference between Mexican cuisine based on the tortilla and the food habits of the Brazilian northeast, where the base is farinha de mandioca, are illustrative of first the central role of the staple and second the difficulty in substituting another staple. How rice and wheat have come to play a larger role in urban diets is discussed later but the conclusion here is that traditional cassava products, that is casabe and farinha de mandioca, will not be consumed outside their current areas of influence.

Current Patterns of Cassava Consumption

Identifying where cassava is consumed will define both its current role in the diet and present constraints on increased consumption. By 1980 (Table 1) cassava was a dominant caloric staple on a national basis in only one country, Paraguay. In that country it was second only to maize as a calorie source and contributed 13% of total food energy supplies. In Brazil and Colombia cassava is an important but not dominant carboydrate

Table 1. Daily calorie consumption (in calories) derived from principal starchy staples, in Latin America, 1979-81.

Country	Total calories	Cereals			Roots and Tubers	
		Wheat	Rice	Maize	Cassava	Potato
Mexico	2890	323	56	1061	22	2
Costa Rica	2653	303	371	208	3	20
Honduras	2135	130	75	878	5	5
Guatemala	2138	205	36	977	2	9
Panama	2338	201	480	207	36	10
Cuba	2796	565	481	-	56	42
Dominican Rep.	2130	194	442	47	37	3
Haiti	1905	218	145	258	66	3
Jamaica	2544	556	204	101	23	7
Brazil	2578	350	418	207	183	24
Colombia	2494	140	387	289	118	108
Ecuador	2114	199	255	176	41	60
Peru	2195	386	297	219	42	140
Bolivia	2082	463	108	277	69	159
Venezuela	2646	351	251	339	28	24
Paraguay	2839	277	128	445	372	5

SOURCE: FAO. 1984.

source in the national diet, contributing over 5% of national calorie requirements. Cassava is of minor importance in the maize-based diets of Mexico and Central America. In all the rest cassava adds a significant component to the diversity of the national diet but does not reach the importance of the three principal grains--maize, rice, and wheat.

Disaggregating consumption gives a clearer picture of cassava consumption distribution. The pattern that emerges in Table 2 is of very distinct differences in consumption levels depending on agroclimatic conditions and on rural-urban residence. For fresh cassava the highest consumption levels are consistently found in the rural areas. High rates of consumption are found in the jungle areas of Ecuador and Peru, extending into the Santa Cruz area of Bolivia. The highly populated eastern part of Paraguay has possibly the highest per capita consumption of fresh cassava in Latin America and this belt of fresh cassava consumption extends across northern Argentina and also into southern Brazil and Mata Grosso do Sul, although consumption levels are less than those that exist in Paraguay. The third belt of fresh root consumption extends across the Atlantic coast of Colombia into the western part of Venezuela and in Colombia extends from the coastal region up the Magdalena river valley into the Santanderes.

In all these areas fresh root consumption declines dramatically moving from rural areas to towns and finally to large metropolitan areas. An in depth study on the Atlantic coast of Colombia (Janssen, 1986) found that this relationship characterized root crops in general (Table 3), but was especially marked in cassava. The cost of moving a bulky, perishable product significantly increases retail prices, causing consumption levels to be lower.

Consumption patterns of farinha de mandioca are more influenced by regional preferences in Brazil than by rural-urban residence. Thus, farinha consumption declines dramatically moving from north to south and rather more moderately moving from rural to urban areas. Farinha is the major calorie source in the north and northeast of Brazil and makes up about a quarter of the average daily calorie intake. Even in urban areas in the north and northeast, farinha is a major calorie source, contributing 25% of average daily calorie intake in Belem, Para and 16% in Salvador, Bahia. Thus, in the poorer regions of Brazil cassava has become a dominant staple, essentially by linking cassava's high productivity under marginal conditions with processing at production points.

The Ravages of Time: Trends in Cassava Consumption

Per capita consumption of cassava as a direct food source has declined in Latin America over the past two and a half decades. Cassava is not alone in this regard. Consumption of beans and maize for direct human consumption has also declined. Historical analyses of consumption trends of caloric staples in countries such as the United States and Japan suggest that this is a natural tendency in the process of development. Rising incomes and the urbanization process lead naturally to a greater demand for diversity in the diet. Almost by definition, the food that declines as a percentage in the diet is the principal carbohydrate source.

Table 2. Annual per capita consumption (kg) of cassava by region and rural-urban status in Latin America.

Country and region	Rural (kg)	Urban: Town (kg)	Urban: City (kg)	Average (kg)
Colombia (1981)				
Atlantic Coast	72.7	42.3		54
Eastern region	39.0	23.5		31
Bogota	-	7.2		7
Central region	35.4	12.5		20
Pacific	17.3	8.3		12
Peru (1971-72)				
North coast	11.0	10.6	9.7	11
North Sierra	18.0	7.5	-	17
Central coast	n.a.	n.a.	n.a.	4
Central Sierra	n.a.	n.a.	n.a.	2
South coast	n.a.	n.a.	n.a.	5
South Sierra	n.a.	n.a.	n.a.	1
High jungle	82.2	14.2	-	71
Low jungle	101.8	78.6	15.5	65
Metro Lima	-	-	4	4
Brazil (1975)				
Fresh Cassava				
North	n.a.	1.8	0.4	2
Northeast	5.2	3.4	1.9	4
Southeast	4.7	2.8	1.7	3
South	23.2	7.0	5.7	16
Center-west	n.a.	8.2	2.6	16
Farinha				
North	n.a.	49.0	45.5	54
Northeast	55.0	31.9	21.4	44
Southeast	10.5	3.3	2.2	5
South	4.4	3.2	0.5	4
Center-west	n.a.	3.7	2.2	4

SOURCE: Sanint, et al. 1985; Casas Moya. 1977; IBGE. 1977.

Table 3. Annual per capita consumption (kg) of root crops by residence on the Atlantic Coast of Colombia, 1983.

Residence	Consumption Yam (kg)	Consumption Cassava (kg)	Cassava price (US$/kg)
Cassava producer	85.7	170.4	0.10
Rural village	41.9	82.9	0.21
Intermediate town	30.8	53.5	0.27
Metropolitan area	30.5	30.5	0.44

SOURCE: Janssen. 1986.

Charting the size of the changes in cassava consumption is difficult, given the unreliability and scarcity of data on cassava. The weakest data source is food balance sheets, essentially because they depend on accurate production estimates as a starting point and for cassava these are known to be highly unreliable. However, these estimates probably do represent basic trends and by comparing 1960 to 1980 figures (Table 4), the tendency over the period was a consistent decline in cassava consumption. These rather crude approximations, nevertheless, are supported by those few cases where food budget surveys can be compared over time (Table 5). In Peru per capita consumption between 1965 and 1972 declined moderately in every sector except the urban areas of the eastern rainforest. There as road infrastructure improved, cassava was obviously developing as a major food source suppling the expanding cities in the region. In Colombia on the other hand, cassava consumption in all the principal metropolitan areas declined between the late 1960s and early 1980s. Finally, in Brazil between the early 1960s and 1975, except for fresh cassava in urban areas in the south, consumption of both farinha and fresh cassava have declined, especially farinha in the south and southeast of the country.

At issue then is not the fact that cassava consumption has been declining in Latin America but rather the reasons behind these trends. From an understanding of causes, a prognosis can be made about the future of cassava as a food source in the Latin American diet. Cassava has long been painted as an inferior food and a food of the poor but there has been little rigorous analysis to test this hypothesis. Moreover, income effects on consumption in many cases may be dominated by other factors, especially substitution due to changes in relative prices and the effects of urbanization. The discussion, thus, turns to an analysis of these issues.

The Inferior Good Debate: In Search of an Elasticity

The most direct means of estimating price and income elasticities is through the use of time-series data. In cassava this is restricted by the quality of the national supply and utilization estimates. Nevertheless, though absolute values may be unreliable, relative change from year to year is probably more accurately captured within the series. Estimates of demand functions (Table 6) for cassava using national, time-series data were attempted for a number of countries (Sanint, 1986). Besides income, own price and the price of substitutes, an urbanization variable was also included. Urbanization, in those countries where cassava is consumed in the fresh form, is expected to have a particularly strong impact on national demand for cassava, essentially because of the difference in relative price of cassava and caloric substitutes in rural versus urban settings.

The results of these estimates are remarkably good, since all the elasticities are of a theoretically correct sign and the majority are statistically significant. Not too much stock should be put in the absolute value of these estimates but the overall picture that arises is correct (to be supported later by additional analysis). The first conclusion that can be drawn is that cassava in these countries is not in general an inferior good. Only in Paraguay, where consumption levels virtually approach a biological limit, is the income elasticity negative. In Ecuador and Colombia the data would suggest that cassava is even income

Table 4. Trends in the per capita consumption (kg) of cassava derived from food balance sheet estimates in Latin America.

Country	1964-66 (kg)	1979-81 (kg)
Costa Rica	6.2	1.3
Cuba	21.8	19.0
Dominican Republic	27.4	13.5
Brazil	107.4	79.9
Colombia	25.8	49.4
Peru	29.6	17.0
Bolivia	24.7	27.8
Venezuela	25.1	11.5
Paraguay	180.8	156.6

SOURCE: FAO. 1969; FAO. 1984.

Table 5. Changes in consumption of cassava as portrayed in food budget surveys in Latin America.

Country and region	Annual per capita consumption 1960s (kg)	1970s (kg)
Colombia (1968 and 1981)		
Bogota	10.4	7.2
Medellin	13.4	9.8
Cali	18.2	7.3
Barranquilla	29.4	27.2
Peru (1964 and 1971)		
Coast		
Rural	11.5	8.4
Urban	7.3	5.5
Sierra		
Rural	n.a.	6.2
Urban	2.8	1.5
Selva		
Rural	111.6	89.2
Urban	10.9	20.4
Brazil (1960 and 1975)		
Fresh Cassava		
North		
Cities	0.04	0.4
Northeast		
Rural	10.3	5.2
Towns	n.a.	3.4
Cities	1.1	1.9
Southeast		
Rural	15.8	4.7
Towns	3.6	2.8
Cities	3.7	1.7
South		
Rural	68.7	23.2
Towns	4.1	7.0
Cities	1.6	5.7
Farinha		
North		
Cities	58.9	45.5
Northeast		
Rural	69.6	55.0
Towns	n.a.	31.9
Cities	26.2	21.4
Southeast		
Rural	19.1	10.5
Towns	4.9	3.3
Cities	4.3	2.2
South		
Rural	16.2	4.4
Town	5.6	3.2
Cities	3.0	0.5

SOURCE: National food budget surveys.

Table 6. Time-series estimates of demand elasticities for fresh cassava in Latin America in the period 1965-84.

	Colombia	Ecuador	Paraguay	Peru
Own price	- 0.30	- 2.08	- 0.10	- 0.20
Income	1.60	1.38	- 0.13	0.03
Urbanization	- 0.16	- 0.99	- 0.13	- 1.03
Wheat price	n.s.[a]	0.45	0.07	0.11
Rice price	n.s.	2.42	-	0.64

a. n.s. = not significant.

SOURCE: CIAT estimates.

elastic. This result follows essentially because demand has been corrected for the effects of urbanization, which are all negative and, except in Colombia, highly significant. Unlike grains, urbanization completely changes the structural nature of the cassava market. Most of these elasticities are high. In Paraguay urban consumption levels are high because of a well-developed marketing system for cassava and here the effects of urbanization are not as pronounced.

The own price elasticity for cassava is generally low but highly significant. However, even more than the own-price response, cassava demand responds significantly to changes in the price of other caloric substitutes. Any decline in the price of grain substitutes, for example due to technical change or to policy intervention, as well has a significant impact on consumption of cassava. In summary, then, the declining consumption of cassava is not due to the fact that the commodity is an inferior good, but rather to more fundamental changes in the overall economy and the structure of food demand, which in turn has influenced the pricing of competing grain staples.

A more reliable data base on which to base elasticity estimates is consumer budget surveys. Unfortunately, those with national coverage that include both expenditure and quantity or price data are rare. Colombia has most recently carried out such a survey. Elasticity estimates for cassava based on this survey (Sanint, et al., 1985) support the cross-section estimates (Table 7), that is, cassava is not an inferior good and in general demand is relatively price responsive. The income elasticity (also corrected with dummy variables for rural-urban residence) is somewhat lower and the price elasticity significantly higher in absolute value, when compared to the time series estimates for Colombia. Though these estimates give a truer picture of the value of the elasticities, they nevertheless support the conclusions drawn from the time series estimates.

Moreover, the cross-sectional data allow estimates by income strata; as expected, the income elasticity varies significantly between income strata. Cassava is very income elastic in the two lowest income quintiles and only in the highest income stratum does the income elasticity become slightly negative (although this coefficient is not significantly different from zero). Thus, all but the most wealthy will increase cassava consumption with rises in income. The poor, who still have calorie consumption levels below minimum standards (Sanint, et al.), are especially responsive to changes in income and will increase their consumption of cassava at a greater rate than the rate of increase in income.

The responsiveness of cassava consumption of the poor to changes in price and income is supported by results from the Dominican Republic (Musgrove, 1985). Per capita cassava consumption on average is higher in this country than in Colombia, and here the poor are much more responsive to cassava price changes than income changes, though the response to income is still significantly positive. The Colombian and Dominican Republic results are suggestive of a general tendency for cassava consumption to be more responsive to income rather than price changes, the lower the existing level of per capita consumption. Also, although the data are limited, at higher general levels of consumption consumers are more responsive to price, suggesting a marked tendency to substitute for other caloric

Table 7. Cross-section estimates of demand elasticities for fresh cassava by income strata in Colombia, 1981.

Income quintile	Fresh cassava	
	Price	Income
1	- 0.84	1.47
2	- 0.92	1.23
3	- 0.93	0.27
4	- 0.92	0.64
5	- 0.83	- 0.04

SOURCE: Sanint, et al. 1985.

staples. This result is particularly characteristic of the greater diversity in the Latin American diet, since, for example, in Asia this degree of substitution does not occur in rice, the dominant staple, even at high consumption levels.

Purchase and consumption of different foods is contingent on those commodities meeting more basic consumer needs, such as taste, nutrient needs, minimal preparation time, or diversity in the diet. This fact gives rise both to differences in preferences between commodities and to perceived differences in quality for most food commodities, for which there are in turn price differentials. Thus the consumers' perception of cassava in many countries is not in terms of a single, generalized commodity with quality gradations as is the case for rice. Rather, farinha or casabe are distinctly different food commodities from the fresh root. In any analysis of demand for cassava where different products are consumed it is critical that the different products be analyzed independently, before making an assessment of future demand for cassava as a whole.

The need to discriminate between cassava products is particularly important in Brazil, where both the fresh root and the processed product, farinha de mandioca, are major items in the diet. In Brazil the distinction between products is maintained from production to consumption. Farmers distinguish between the low-cyanide or sweet varieties, called "aipim", and the high-cyanide or bitter varieties, called "mandioca." They are kept separate, virtually as distinct crops, from production through marketing and consumption. Farinha is the major consumption item, essentially because of its storability and lower marketing margins, and is the principal source of calories in the northeast.

Farinha behaves as the classic staple. Because it is significantly cheaper than any other carbohydrate source, consumption levels are high among the poor. However, as incomes increase, consumers diversify their source of calories. Farinha in Brazil does have a negative income elasticity (Table 8). Yet, in the lower income strata consumers will still eat more farinha with increases in income. In Brazil, particularly in the northeast, incomes levels among the poor are not sufficient to maintain adequate levels of calorie consumption. Thus, with increasing income the poor will still consume higher levels of farinha. However, these same consumers are very responsive to changes in farinha prices, again indicating a desire to diversify when the opportunity arises. The substitution process is further supported by the significant cross-price elasticity between farinha and wheat flour. A particular issue in the Brazilian case in evaluating commodity substitution is to separate substitution due to short-term swings in relative prices of caloric staples from the impact of a long-term change. The introduction of the subsidy on wheat in the early 1970s resulted in a long-term shift in the relative price of calories between farinha and wheat products. The impact has been to speed up the substitution process and through more basic structural changes in tastes and the diet, to limit potentially the degree of reverse substitution should the subsidy be lifted.

Demand parameters for fresh cassava in Brazil, however, follow a similar pattern to those presented for other countries. That is, fresh root consumption responds positively to increasing income, with the lower

Table 8. Income and price elasticities[a] for farinha by income strata in Brazil.

Elasticity[b]	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Income							
Lowest income group	-0.2703	0.3236	-0.8612	0.3236	0.0026	-0.0254	0.3670
Second income group	-0.3441	0.0037	-0.7111	0.0037	-0.1813	-0.1893	0.0976
Third income group	-0.4180	-0.3163	-0.5610	-0.3163	-0.3651	-0.3532	-0.1719
Fourth income group	-0.5156	-0.7393	-0.3627	-0.7393	-0.6081	-0.5699	-0.5280
Highest income group	-0.5656	-0.9562	-0.2609	-0.9562	-0.7327	-0.6811	-0.7107
Own price							
Lowest income group	-1.3984	-2.1398	-0.3085	-2.1398	-0.6734	-0.5306	-0.0037
Second income group	-1.1371	-1.1451	-0.2480	-1.1451	-0.6451	-0.4897	-0.1679
Third income group	-0.8758	-0.1503	-0.1875	-0.1503	-0.6169	-0.4488	-0.3321
Fourth income group	-0.5304	0.0000	-0.1075	0.0000	-0.5796	-0.3947	-0.5492
Highest income group	-0.3533	0.0000	-0.0664	0.0000	-0.5604	-0.3670	-0.6606
Price of rice							
Lowest income group	1.1079	0.8977	2.5697	0.8977	0.6524	0.3622	1.3133
Second income group	0.9213	-0.3869	2.2233	-0.3869	0.1959	0.2762	1.0589
Third income group	0.7347	-1.6715	1.8770	-1.6715	-0.2606	0.1901	0.8045
Fourth income group	0.4881	-3.3696	1.4191	-3.3696	-0.8641	0.0764	0.4683
Highest income group	0.3616	-4.2407	1.1842	-4.2407	-1.1736	0.0181	0.2958
Price of wheat							
Lowest income group	1.5431	2.0210	1.5332	2.0210	.0000	-0.5599	0.7813
Second income group	0.9480	1.3265	1.1311	1.3265	0.0550	-0.1411	0.1220
Third income group	0.3530	0.6321	0.7291	0.6321	0.5006	0.2777	-0.5373
Fourth income group	-0.4336	-0.2860	0.1976	-0.2860	1.0896	0.8313	-1.4089
Highest income group	-0.8371	-0.7569	-0.0750	-0.7569	1.3917	1.1153	-1.8560

a. Elasticities were estimated using cross-sectional data and employed a translog functional form.

b. Elasticities were evaluated at the following income levels: Lowest = ½ minimum salary; second = 1 minimum salary; third = 2 minimum salaries; fourth = 5 minimum salaries; and highest = 8 minimum salaries.

income strata being particularly responsive. Moreover, consumers are very responsive to price changes in fresh cassava, as exhibited in the estimated price elasticity of -1.9. Thus, in Brazil a duality of sorts exists in the demand for cassava; farinha exhibiting the characteristics of an inferior good and fresh cassava the characteristics of a normal good. Since farinha makes up about 90% of human consumption of cassava, farinha dominates in the overall food demand for cassava in Brazil.

Is cassava then an inferior good in Latin America? In a very narrow sense the answer is yes. Farinha de mandioca in Brazil does have a negative income elasticity, and since farinha makes up 90% of cassava consumption as a food source in Brazil and Brazil in turn makes up about 75% of food consumption of cassava in Latin America, then a weighted income elasticity for cassava as a food source in Latin America would likely be slightly negative. This conclusion, however, extends a result based essentially on the extreme importance of farinha in the north and northeast of Brazil (these two areas account for 86% of Brazilian consumption of farinha) to cassava in Latin America as a whole. Outside this limited area the conclusion does not hold that cassava is an inferior good because cassava is consumed principally in a fresh form. The available evidence suggests that there is significant elasticity in the demand for fresh cassava. Thus, to explain the decline in the consumption of fresh cassava requires a more in depth analysis of the effects of urbanization and of changes in relative prices.

The Urbanization of Cassava Consumption: The Price Paid to Marketing

The most striking feature about consumption patterns of fresh cassava is the very large differences in consumption levels between rural and urban areas. Not only is the pattern universally consistent but the differences in per capita consumption levels are indeed large (Table 9). The pattern is most clear at the level of a particular region, especially where cassava can be compared with other starchy staples. Such data exist for the Atlantic Coast of Colombia (Table 3). In this region cassava consumption declines precipitously from the point of production, so that consumption in the large cities is less than 20% of that of cassava producers. Neither plantain nor rice show such differences, and potato, an imported commodity in the region, exhibits the opposite pattern. These differences in cassava consumption based on residence are not due to any significant difference in the manner of utilization in the home (Table 10). Cassava is eaten virtually in the same meals and prepared in the same manner. The differences arise from the number of meals per week at which cassava is served and the size of the portion per serving. The primary factor resulting in these differences in consumption of cassava are price and convenience. Cassava is more than five times more expensive in metropolitan areas than the opportunity cost to cassava producers. Moreover, implicit costs in buying cassava daily in urban areas make cassava a far less convenient food than say rice.

The price difference between cassava producer and metropolitan consumer reflects the very significant marketing margin for the crop. These margins derive from a marketing structure which must move a bulky and perishable crop from many small-scale producers to consumers who buy their cassava in small lots at convenient locations. A comparison of implicit

Table 9. Estimates of average per capita, rural and urban consumption (kg) of fresh cassava in Latin America.

Country	Consumption Rural (kg)	Consumption Urban (kg)
Brazil (1975)	10.6	3.1
Colombia (1981)	41.1	17.2
Peru (1972)	18.3	5.6
Paraguay (1986)	340.0	120.0
Venezuela (1975)	27.4	5.0
Dominican Republic (1975)	42.3	20.0

SOURCE: Lynam and Pachico. 1982.

Table 10. Distribution of cassava consumption in different meals, by rural-urban residence on the Atlantic Coast of Colombia, 1983.

Variable	Metropolitan urban areas	Intermediate urban areas	Rural areas	Producers
Percentage of cassava consumed at breakfast	30.0	53.5	50.2	42.3
Most important form of preparation	boiled	boiled	boiled	boiled
Percentage of cassava consumed at lunch	69.0	43.6	39.7	49.1
Most important form of preparation	in soup	in soup	in soup	in soup
Percentage of cassava consumed at dinner	1.0	3.0	10.0	8.6
Most important form of preparation	boiled/ fried	boiled/ fried	boiled/ fried	boiled/ fried
Number of meals per week with cassava	4.9	6.3	8.3	11.0
Average portion of cassava served per person (grams)	118	158	191	313
Price (US$/kg)	0.45	0.27	0.26	0.08
Number of observations	80	80	160	160

SOURCE: Janssen. 1986.

marketing margins for cassava versus rice in major Latin America cities (Table 11) shows that the price that cassava consumers must pay for marketing services are in general higher than that for rice on an absolute basis. Considering that the marketing margin for rice also includes a milling component, the costs of cassava marketing are high indeed. On a relative basis (i.e., as a percent of the retail price) the cost of marketing services is significantly higher for cassava. From 50% to 90% of the eventual consumer price for fresh cassava is allocated to marketing services. These margins essentially reverse the relative price of cassava and competing starchy staples between rural and urban markets. In rural production zones cassava is normally the most inexpensive source of calories, especially compared to grain crops. In urban areas, on the other hand, fresh cassava is significantly more expensive on a per calorie basis than competing grains. Clearly, consumption levels adjust to this market change in relative prices.

The implication of the high price for urban cassava on trends in aggregate consumption have been markedly negative in the rapidly changing economic environment that has existed in Latin America throughout the post-war period. During that time Latin America shifted from being principally a rural-based economy to being an urban-based economy. Very high rates of rural-urban migration have shifted the population distribution in Latin America from almost 60% in the rural sector in 1950 to 30% rural in 1985. The urbanization process has completely changed the structure of starchy staple consumption in Latin America, with consumption patterns shifting from staples such as cassava, maize, plantains, and potatoes to distinctly urban staples such as rice and wheat. With rural population barely growing in most countries and urban population growth at very high rates, aggregate per capita consumption of cassava has declined over time.

The negative effect of the urbanization variable in the time-series, demand estimates is thus clearly supported by a fuller understanding of cassava in rural versus urban environments. Nevertheless, total demand for cassava should continue to increase, although at a rate lower than that suggested solely by growth in population and income. Disaggregating the growth components in total demand, as is done for Colombia in Table 12, clearly shows the importance of the consumption weights on growth in total demand. More importantly, however, though total demand may be growing at a modest rate, the data would suggest that demand for marketable surpluses is growing at a very rapid rate indeed. As cassava consumption shifts from principally a subsistence orientation to one based on purchased roots, the implication is that market demand is growing very rapidly indeed. Thus, aggregate trends in cassava consumption can significantly mask the dynamics of actual cassava markets. However, because of the nature of the crop, there is little available data on marketed surpluses, and therefore little scope for rigorous price analysis in fresh-cassava markets.

The consumption of fresh cassava in Latin America is in transition. Because of rapid urbanization, the locus of consumption is shifting from rural areas where per capita consumption levels are high to urban areas where per capita consumption is relatively low. Cassava in most Latin American countries is thus shifting from being a starchy staple to being more of a vegetable crop, that is with significant elasticity in demand.

Table 11. Marketing margins for fresh cassava and rice in principal countries of Latin America.

Country and region	Fresh cassava: Retail price (currency/kg)	Fresh cassava: Marketing margin[a] (currency/kg)	Fresh cassava: Margin as % retail price (%)	Rice: Retail price (currency/kg)	Rice: Marketing margin[a] (currency/kg)	Rice: Margin as % retail price (%)
Brazil (1983)						
Pernambuco	125.2	110.9	89	326.5	146.5	45
Rio de Janeiro	163.2	143.4	88	353.7	176.7	50
Sao Paulo	175.0	161.3	92	319.5	131.5	41
Rio Grande do Sul	112.7	89.1	79	320.2	167.2	52
Paraguay (1983)						
Country average	28.0	18.0	64	143.0	60.0	42
Venezuela (1983)						
Caracas	3.6	2.1	59	5.0	2.6	51
Panama (1983)						
Country average	0.31	0.23	75	0.71	0.35	50
Dominican Republic (1984)						
Country average	0.50	0.30	61	0.91	0.24	27
Jamaica (1986)						
Country average	1.89	0.93	49	2.84[b]	0.88	31
Colombia (1981)						
Bogota	24.9	19.2	77	40.2	18.8	47

a. Marketing margin is the difference between the farm-level and retail price.
b. Maize instead of rice.

SOURCE: CIAT data files.

Table 12. Disaggregation of demand parameters for fresh cassava in rural and urban areas of Colombia, 1981.

Parameter	Rural		Urban		
Population growth	- 0.1		3.7		
Income elasticity	0.28		0.38		
Per capita income growth	2.5		1.4		
Demand growth	0.6		4.2		
Weighted average[a]	0.51 (0.6)	+	.49 (4.2)	=	2.4

a. Distribution of total consumption between rural and urban areas in 1981.

Thus, while aggregate trends are downward, markets for fresh cassava tend to be quite dynamic. However, this conclusion is seemingly contradicted by the decline in urban, per capita consumption levels that have apparently occurred in Colombia, in southeastern Brazil and in coastal Peru. To evaluate this the discussion turns to the last factor influencing cassava demand, the price of substitutes.

Cassava and the Political Economy of the Urban Staple

Urban food prices entered the Latin American political arena during the rapid urbanization and industrialization process of the post-war period. Urban poverty and malnutrition, the felt need to control upward pressure on urban wages, and the politics of managing inflation, all induced most Latin American governments to implement controls on prices of major urban staples. These controls focused on grains, especially those where imports could be used as a means of either controlling prices or reducing subsidy costs, that is where domestic production was also supported. Maize in Mexico and wheat and rice in other Latin American countries were the principal markets in which governments intervened. In general, mechanisms were developed to support domestic producers of these grains. Policies, however, were not implemented for domestic producers of carbohydrate substitutes, especially cassava.

Because of the significant cross-price elasticities between cassava and prices of major grains, the interventions in grain markets can have a significant impact on cassava consumption. Retail price trends in Latin American countries bare out this scenario. In virtually all Latin American countries over the past decade and a half, the real price of fresh cassava at the retail level has been rising (Table 13). This rising trend at least partially supports the relatively dynamic nature of cassava markets, resulting in some upward pressure on cassava prices. On the other hand, prices of competing grains have been falling. In some cases for rice, such as in Colombia, this has been due to the introduction of new technology. However, in the majority of cases the principal cause has been price policy, aided in the case of wheat by a falling international price and a tendency to overvalue exchange rates. However, because governments intervene in wheat markets and because subsidies are utilized in wheat in a large number of countries, declining international prices aided governments in effecting policies but were not the principal cause of declining domestic prices

Prices of both cassava and substitutes have played a dominant role in cassava consumption trends. This is clearly shown in both the time-series and cross-sectional demand estimates. Moreover, the effect of prices is clearly portrayed when consumption estimates over time are matched with changes in relative prices. In the case of Cali, Colombia (Table 14) per capita consumption has declined as a result of changing relative prices of cassava and rice. The most dramatic case, however, is that of farinha in Brazil (Table 15). Not surprisingly, farinha consumption has declined as relative prices with wheat flour went from 0.6 to 3.0. While farinha consumption halved, wheat consumption doubled; principally motivated by a massive subsidy on wheat consumption.

Table 13. Annual percentage change in retail prices (in constant prices) of fresh cassava, wheat flour, and rice in Latin America.

Country	Fresh cassava (%)	Wheat flour (%)	Rice (%)
Colombia (1960-84)	1.7	- 3.0	- 3.4
Venezuela (1965-84)	3.8	3.0	- 0.5
Peru (1966-83)	0.2	- 0.8	- 1.5
Paraguay (1968-83)	1.4	- 2.1	- 1.2
Ecuador (1970-84)	2.5	- 0.4	- 0.2
Brazil (1969-85)	- 0.2	- 1.6	- 0.1

SOURCE: CIAT data files.

Table 14. Changes in real retail price and average per capita consumption in Cali, Colombia, 1970-1982.

Commodity	Change in price 1970-82 (%)	Change in consumption 1970-82 (%)
Chicken	- 12	267
Wheat	- 10	109
Potato	3	104
Beans	25	16
Rice	36	13
Beef	54	0
Pork	93	- 51
Maize	162	- 61
Cassava	191	- 53

SOURCE: Pachico, et al. 1983

Table 15. Relationship between farinha de mandioca and wheat flour prices and consumption in Brazil, 1960-80.

Variable	1960	1970	1980
Farinha consumption (kg/capita)	26.3	23.5	12.0
Wheat consumption (kg/capita)	26.2	25.2	45.5
Farinha/wheat consumption	1.00	0.93	0.26
Farinha/wheat prices	0.61	0.64	2.95

Cassava is virtually invisible to policy-makers; little data or market analyses exist for the crop. Cassava is outside the control of government marketing agencies and cassava producers can muster no political voice to defend their interests. If no one yells, nothing must be wrong. Either cassava must be brought into the political arena or the crop will slowly disappear from the food basket in tropical Latin America. This conclusion, however, is not a plea for subsidies or an admission that cassava cannot compete in rapidly expanding markets for carbohydrates. The irony is that the decline in cassava is being attributed to a lack of effective demand, when that lack is due to discriminatory policies rather than consumer choice. There is rather a need for consistency in the setting of price policies, which implies that cassava should be brought into the agricultural political economy of Latin America.

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THE MEAT OF THE MATTER:
CASSAVA POTENTIAL AS A FEED SOURCE IN TROPICAL LATIN AMERICA

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Latin American economies have gone through a period of profound structural change in the postwar period, accompanied by a number of adjustment problems, as reflected in strains on urban services, high inflation rates, malnutrition among a significant portion of the urban population, a rising external debt, and high rates of unemployment. Virtually all of these adjustment problems have antecedents in, or implications for, the agricultural sector--a fact which has motivated heavy policy intervention in this sector. The focus of these interventions was the grain and livestock sector, as governments strived to balance policies focused on low urban food prices with the maintenance of incentives to domestic farmers. The following discussion will review the interaction between changing demand conditions, policy interventions, and production response for meat and grains. This will then provide the context for an evaluation of the opportunities for cassava to play a more fundamental role in this sector. The arguments cover a wide terrain and are schematically presented in Figure 1.

Meat as a Wage Good? The Legacy of a Land Surplus Economy

The structure of agricultural output in Latin America is heavily weighted towards livestock products, especially if compared with either Africa or Asia (Table 1). Livestock production is larger in value terms than the combined production of cereals and other starchy staples. In the livestock sector beef cattle form the largest component and in turn command significant land resources. In particular, permanent pastures in Latin America cover three times more area than the land devoted to annual and permanent crops (FAO, 1985). There are historical, structural, and economic reasons for the preeminent role that cattle play in the Latin American agricultural economy. Moreover, this importance in the agricultural sector is translated into a dominant role for beef in food consumption patterns.

Cattle were one of the more important plant or animal introductions into Latin America by the early Spanish, and it was Christopher Columbus who made the first introduction into the continent by landing cattle on both Cuba and Hispaniola (Rouse, 1973). In the development of the "encomienda" system in 16th century Spanish America, Keith (1980) points out that "stock raising was generally the first economic activity ... which was taken up by the encomenderos. [However,], stock raising remained the primary sector of the colonial economy only where geography or the absence of nearby markets left no alternative. Elsewhere it was usually one element in a mixed agrarian system, an element which was valued less for the size of the profits derived from it than from their security." Stock raising in this period was in many ways a subsistence enterprise adapted to a land surplus agricultural economy. Markets, however, were needed for cattle to achieve economic significance, and in many areas cattle were valued only for the hides.

Nevertheless, the 16th and 17th centuries did provide the structural features on which the future development of the livestock industry would be

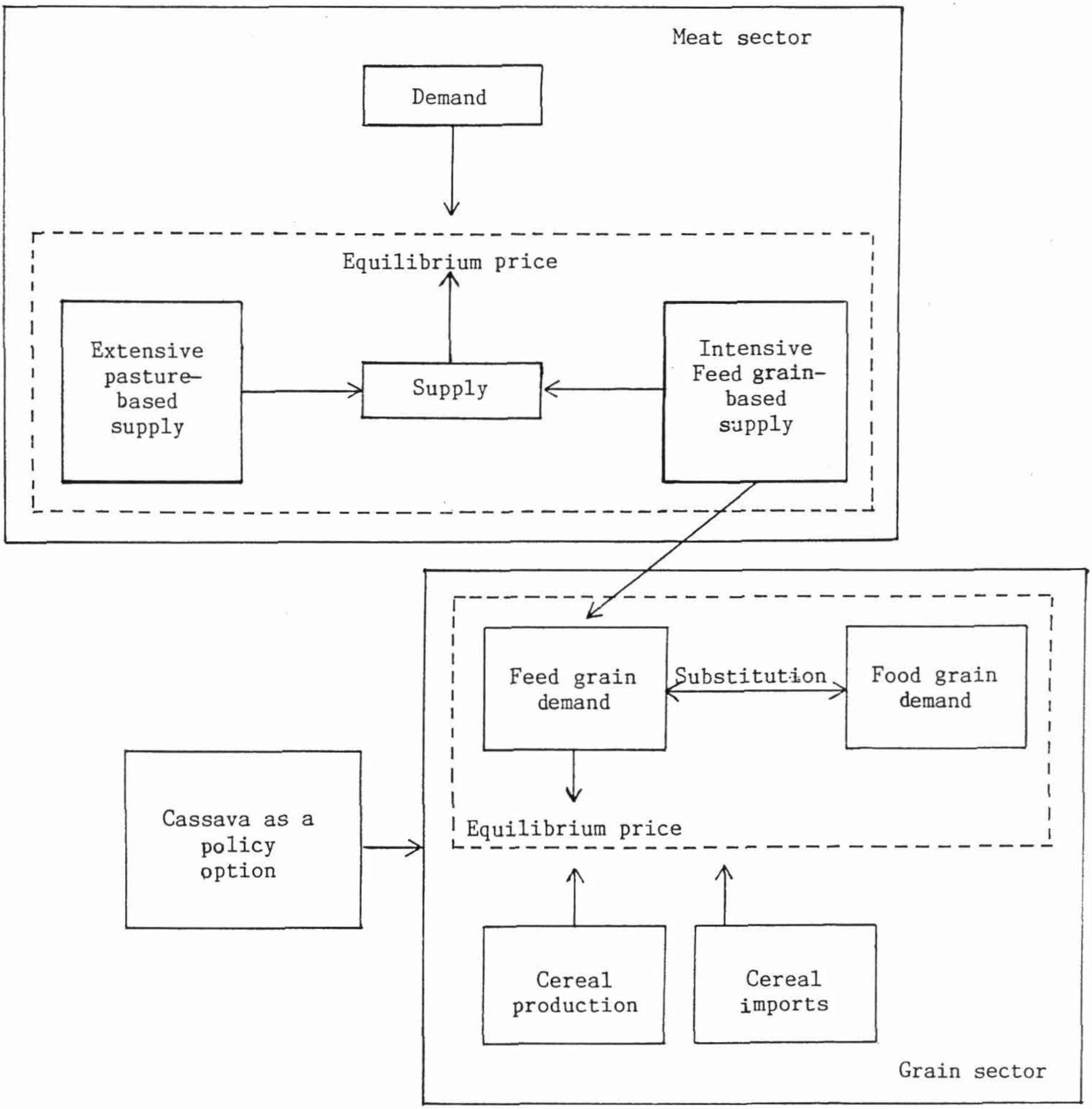

Figure 1. Schematic of the analysis of cassava within the Latin American grain-livestock sector.

Table 1. Structure of agricultural output by region, 1976-80.

Region	Cereals (%)	Other staples (%)	Livestock (%)	Other foods (%)	Nonfoods (%)
Latin America	17	9	33	31	11
South Asia	45	9	13	27	7
Southeast Asia	44	10	12	26	8
Africa	17	27	18	25	14

SOURCE: World Bank. 1982.

based, that is, the hacienda which developed as a response to limited markets. As Grindle (1986) summarizes the point, the "hacendados" "often acquired land in order to limit production of commodities where prices might decline as a result of increased output, and to limit competition from other haciendas or from the Indian communities. Most centrally, monopoly over land made available a surplus labor force that served to subsidize low levels of production in a context of generally low prices for agricultural commodities." The resultant, skewed farm size distribution would be the key to the future expansion of the livestock industry, when markets became established.

The market stimulus for livestock production came in the 18th century with the rise of the sugar plantation. Cattle were needed not only for draft power in field transport and to run the sugar mills but also as a food source. In many of the large sugarcane-growing areas such as northeast Brazil, Cuba, and the Colombian coast, the development of the sugar plantation coincided with the rise of large stock raising enterprises. The greater requirements for draft power in turn led to the importation into Cuba in the 19th century of zebu cattle from India, which in turn provided the basis for shipments to Colombia and Brazil. The zebu stock would eventually supplant the original "criollo" cattle in much of lowland, tropical Latin America, and become the future basis for meat production.

Low-cost beef production required extensive amounts of land with a low opportunity cost. In Latin America this was provided by the abundant land available, which was in turn accentuated by the farm size distribution. Profitable beef production, however, required markets and these would have to wait, except for the export industry in the Southern Cone, for the rise of towns and major urban areas. Beef was not a major consumption item in rural areas. Most of the rural population lived on small-scale farms and depended on starchy staples. Because of the lack of storage or refrigeration, apart from the dried beef of northeast Brazil, swine and poultry were a more appropriate meat source for farm families. A minimal population density was necessary to make possible beef consumption on a regular basis.

This feature of beef consumption is reflected in current expenditure and consumption patterns for meats (Tables 2 and 3). Expenditure on, and consumption of, beef is almost universally lower in rural areas than in urban areas. In the coastal areas of Ecuador and Colombia where the rural settlement pattern is based on villages, per capita consumption of beef is higher than in other parts of Latin America. In countries such as Brazil, consumption of pork is much higher in rural areas than in urban areas. Overall meat consumption is significantly higher in urban compared to rural areas in Latin America. This is possibly due to the generally higher income levels in urban areas but just as probable are the differences in refrigeration and meat retailing. In villages of Colombia consumers must wait for the red flag raised in the morning signifying that an animal has been slaughtered.

The importance of beef in tropical Latin American economies can thus be seen as a 20th century phenomenon, whose genesis lay in the economic history of the continent. Urbanization of Latin American economies

Table 2. Shares of the total food budget spent on the principal caloric staple (highest expenditure) and the major meats, Latin America.

Country	Caloric staple		Beef	Pork	Chicken
	Commodity	Share (%)	(%)	(%)	(%)
Peru (1971-72)					
North coast					
Cities	Wheat	8.3	11.2	9.1	5.1
Towns	Wheat	7.8	13.6	9.1	3.3
Rural	Wheat	8.6	7.3	9.2	2.2
Central Sierra					
Cities	Wheat	12.5	12.8	10.8	n.a.
Towns	Wheat	11.4	3.0	9.8	n.a.
Rural	Potato	20.6	3.2	7.2	n.a.
Low Selva					
Cities	Wheat	10.0	9.6	12.4	10.0
Towns	Wheat	8.6	8.6	9.0	7.5
Rural	Cassava	9.7	1.4	5.8	6.2
Brazil (1975)					
South					
Cities	Wheat	8.2	17.6	1.2	4.8
Towns	Wheat	9.7	14.0	2.3	5.3
Rural	Rice	9.7	6.6	4.7	4.8
Sao Paulo					
Cities	Wheat	7.6	13.0	2.1	5.1
Towns	Rice	9.4	12.4	3.2	4.8
Rural	Rice	16.7	7.2	3.8	4.7
Northeast					
Cities	Wheat	12.7	18.8	1.5	6.3
Towns	Wheat	11.3	19.1	4.0	3.8
Rural	Cassava	9.1	17.8	7.2	0.8
Colombia (1981)					
Urban	Wheat	5.9	17.7	1.1	1.6
Rural	Rice	7.2	14.3	0.5	0.8
Panama (1980)					
Urban	Rice	9.6	21.0	1.8	11.7[a]
Rural	Rice	20.0	10.6	2.2	9.0[a]

a. Includes eggs.

SOURCES: Lizardo de las Casas Moya, 1977; Instituto Brasileiro de Geografía e Estatísticas (IBGE), 1977; Sanint et al., 1985; Franklin et al., 1984.

Table 3. Per capita consumption of meats disaggregated by region and rural-urban residence, Latin America.

Country	Beef (kg)	Pork (kg)	Chicken (kg)
Peru (1971-72)			
North coast			
Cities	12.8	20.2	6.4
Towns	15.7	20.3	3.7
Rural	6.7	17.3	1.9
Central sierra			
Cities	15.7	19.1	n.a.
Towns	4.7	18.3	n.a.
Rural	2.7	10.4	n.a.
Low Selva			
Cities	11.0	20.3	6.7
Towns	8.4	11.8	3.9
Rural	0.6	4.8	2.3
Brazil (1975)			
South			
Cities	31.1	1.8	10.8
Towns	21.0	3.8	9.8
Rural	7.8	7.1	10.9
Sao Paulo			
Cities	19.0	2.9	11.0
Towns	15.9	4.2	8.9
Rural	8.2	4.2	7.1
Northeast			
Cities	17.9	1.6	10.5
Towns	15.4	4.5	4.7
Rural	6.7	5.3	3.1
Colombia (1981)			
Atlantic coast			
Urban	46.0	1.7	3.0
Rural	30.0	1.5	1.4
Central region			
Urban	31.9	2.6	2.2
Rural	30.6	1.2	1.1
Eastern region			
Urban	34.9	0.4	1.4
Rural	23.0	0.2	1.0

SOURCES: Lizardo de las Casas Moya, 1977; Instituto Brasileiro de Geografía e Estatísticas (IBGE), 1977; Sanint et al., 1985.

provided the markets, and the skewed land distribution and historical accumulation of cattle stocks provided, in a sense, a latent capacity for livestock production that awaited only market development. Cheap beef found ready markets in urban Latin America and because of its relative price, it became a major item in the food budget. It is tempting to call it an urban staple, a wage good.

Beef is a staple with a significant difference from what that term normally implies. In general, it is the major component in the food budget of urban consumers in Latin America. This gives it an important weight in consumer price indexes and therefore makes it of political interest to governments trying to hold back inflation. The difficulty with beef as a staple, and therefore in a policy context, is that demand for beef is not highly inelastic with respect to either price or income. The point is made in Table 4, which shows beef consumption by income strata. Beef is important in the food budget of the poor, but, and the but should be emphasized, caloric staples such as rice in Brazil, Colombia, and the Dominican Republic, wheat in Brazil and Peru, and maize in Mexico are usually as important or more important. On the other hand, beef is far more important in the food budget of the rich. Beef is thus not a classic wage good; any benefits from interventions to control beef prices are directed principally at the higher income strata and moreover, because of the relatively higher price and income elasticity (Rivas, et al., 1986) attempts at controlling prices will either be marginal or extraordinarily expensive. For short-term policy interventions focused on maintaining cheap urban staples, caloric sources have been and will continue to be the appropriate wage goods in a Latin American context.

On the other hand, the magnitude of consumer expenditure for beef and consequently the magnitude of the welfare gains for the whole society to be accrued through increased beef supplies explains the high priority assigned by governments to policies related to this commodity. Additionally the magnitude of the beef expenditure share of the low income groups implies that the absolute welfare gains of price reductions in this commodity will ceteris paribus be above the ones achievable with almost any other commodity. Given the difficulties of administering market interventions, policies have increasingly been targeted at influencing the supply side. Here research policies to induce technical change in beef production play a major role.

Supply side interventions in beef, especially where the focus is on research, entail significant lags before there is a production response. The rapid growth in incomes in the 1970's resulted in a major increase in the demand for beef and entailed the search for more short-term solutions to the breech between demand and supply for beef. Rising real prices for beef, however, provided a market stimulus to a search for substitutes. If beef could be substituted for, then there was potential for controlling meat prices.

A Chicken in Every Pot: The Poultry Revolution in Latin America

The last quarter of a century has witnessed major divergences in the demand for and actual consumption of beef (Table 5). Between 1960 and 1985 growth in beef production has slowed down and per capita consumption levels have

Table 4. Shares of the food budget spent on the principal caloric staple and beef by income strata, Latin America.

Country	Caloric staple		
	Commodity	Share (%)	Beef (%)
Peru (1971-72)			
Lima			
Lowest decile	Wheat	11.2	5.1
Second decile	Wheat	10.0	5.3
Third decile	Wheat	9.6	7.8
Highest decile	Wheat	10.3	15.7
Brazil (1975)[a]			
Porto Alegre			
Lowest strata	Wheat	10.6	14.0
Second strata	Wheat	11.2	13.2
Third strata	Wheat	10.1	14.5
Highest strata	Wheat	4.3	16.2
Sao Paulo			
Lowest strata	Rice	13.9	8.4
Second strata	Rice	12.6	11.6
Third strata	Rice	10.7	12.6
Highest strata	Wheat	4.5	13.5
Recife			
Lowest strata	Wheat	15.2	13.2
Second strata	Wheat	14.7	14.8
Third strata	Wheat	15.5	15.4
Highest strata	Wheat	9.3	19.6
Colombia (1981)			
Urban			
Lowest quintile	Sugar	12.0	14.2
Highest quintile	Rice	4.2	16.6
Mexico (1977)			
National Level			
Lowest decile	Maize	30.6	4.4
Second decile	Maize	24.3	5.6
Third decile	Maize	19.6	7.2

a. Nine strata are defined.
SOURCES: Lizardo de las Casas Moya, 1977; Instituto Brasileiro de Geografía e Estatísticas (IBGE), 1977; Sanint, et al., 1985; Lustig, 19890.

Table 5. Beef and veal: annual growth rates of potential domestic demand and production by country (average 1970-81), Latin America.

Region and country	Annual growth rate Demand (%)	Production (%)
Tropical Latin America	5.3	2.2
Brazil	6.1	1.5
Mexico	4.4	3.3
Bolivia	4.9	4.9
Colombia	4.9	3.5
Ecuador	8.9	5.3
Paraguay	4.4	-1.1
Peru	3.0	-1.3
Venezuela	4.2	5.4
Cuba	4.5	-2.6
Dominican Republic	6.0	3.4
Central America and Panama	4.0	3.3
Costa Rica	4.8	6.3
El Salvador	3.9	3.4
Guatemala	5.2	3.9
Honduras	3.6	5.2
Nicaragua	1.6	-1.1
Panama	3.5	1.3
Caribbean	3.2	2.0
Guyana	1.5	-1.1
Haiti	4.5	2.7
Jamaica	-0.6	2.0
Trinidad and Tobago	5.1	2.3

SOURCE: Centro Internacional de Agricultura Tropical (CIAT), 1985.

declined in tropical Latin America. Given the respectable growth in per capita income levels, declining per capita availabilities has resulted in a widening divergence between growth in consumption and growth in demand, a situation that puts upward pressure on prices. Beef prices have in general increased, but not enough to explain the difference in demand growth (Table 6).

Price increases have occurred in a period when many governments have had a clear policy objective of controlling inflation. In most countries real beef prices have increased but at a lower rate than suggested by demand growth. In some cases governments have intervened in the beef market in order to control variability and increases in beef prices. This intervention is clearest in Brazil, where until 1982 the government bought and stored refrigerated beef. On average, 10% of annual beef production went into government controlled freezer storage (Rivas et al., 1986), a program which was very costly to operate and which in the end was counterproductive within the context of beef cycles (Jarvis, 1986).

However, a far more dominant influence on beef prices over the past 25 years was the rapid rise in poultry production. Production of chicken meat has grown at a sustained annual rate of about 9% in tropical Latin America over the 1968-84 period. In Brazil, poultry production--or at least, its commercial production--grew at an annual rate of 26% from 1960 through to 1983. Such growth, even from a relatively small initial level, is rare and reflects the dynamism that can arise when technological change is linked to an expansive market. As a result, per capita consumption of chicken meat in tropical Latin America increased from 4.8 kg in the 1969-76 period to 8.2 kg in the 1978-85 period, a level that is now well over half the per capita consumption level of beef (14.0 kg). Chicken meat thus allowed an expansion in total meat consumption, that is, beef, pork, and chicken, increasing its relative share from 18% to 29%.

Increasing consumption at such rates was motivated by the declining real price of poultry meat, which in turn was possible because of declining costs due to technical change. Moreover, the price of chicken declined even more relative to the reference meat, beef (Table 7). In countries such as Brazil, Colombia, and Peru chicken was more expensive than beef in the 1960s and in the early 1970s chicken became cheaper, with the price difference widening through the 1970s and 1980s. In other countries, such as Mexico, Venezuela, Jamaica, and the Dominican Republic beef and chicken were similarly priced in the early 1960s. However, again the tendency was for chicken to become increasingly less expensive relative to beef. Declining prices and increased incomes certainly induced increased consumption levels of chicken. The question, however, is whether changing relative prices caused a substitution of beef by increased chicken consumption.

Income growth was not the dominant force influencing consumption trends in meats; rather, prices played a much more significant role. Based on the study by Rivas et al. (1986) the own-price elasticity for beef varies between .05 and .78, with four of the seven countries having a price elasticity below .25 (Table 8). Beef consumption is moderately inelastic with respect to price, a finding that reflects the relatively high consumption levels for the meat. For chicken, on the other hand, the

Table 6. Comparison between growth in excess demand and real price[a] increases for beef, 1970-81, Latin America.

Country	Production growth (%)	Demand growth (%)	Growth in excess demand (%)	Growth in real prices (%)
Brazil	1.5	6.1	4.6	3.0
Colombia	3.5	4.9	1.4	-0.7
Ecuador	5.3	8.9	3.6	3.0
Paraguay	-1.1	4.4	5.5	-0.4
Peru	-1.3	3.0	4.3	3.1
Venezuela	5.4	4.2	-1.2	6.7
Dominican Republic	3.4	6.0	2.6	-1.1[b]
Panama	1.3	3.5	2.2	2.7

a. Retail prices.

b. 1974-84.

SOURCES: Centro Internacional de Agricultura Tropical (CIAT), 1985; national statistical (price) sources.

Table 7. Growth rates of retail prices for meats, 1965-84, Latin America.

Country	Beef (%)	Chicken (%)
Colombia (1960-84)	-0.4	-3.6
Brazil (1960-82)	2.4	-2.7
Ecuador (1970-84)	2.7	-0.1
Peru (1966-83)	2.3	-4.1
Venezuela (1965-84)	2.2	-2.4
Panama (1960-84)	1.7	-2.1
Dominican Republic (1974-84)	-1.1	-2.9

SOURCE: Centro Internacional de Agricultura Tropical (CIAT) data files derived from national statistical sources.

Table 8. Estimates of demand elasticities for beef and chicken meat, Latin America.

Country	Beef			Chicken		
	Income	Own price	Cross price	Income	Own price	Cross price
Colombia	0.72	- 0.69	0.42	0.88	- 0.46	0.61
Peru	0.85	- 0.42	0.40	0.75	- 1.19	0.66
Venezuela	0.37	- 0.05[a]	- 0.33	1.09	- 0.92	0.44
Brazil	0.32	- 0.23	0.50	1.69	- 1.26	0.03[a]
Mexico	0.37	- 0.78	0.74	0.74	- 0.62	0.22
Dominican Rep.	0.77	- 0.14[a]	- 1.12	0.00[a]	-0.12	0.19[a]
Jamaica	0.67	- 0.12[a]	-0.20[a]	0.80	-1.72	1.27

a. The estimate is not significant at the 10% probability level.

SOURCES: Rivas et al., 1986.

own-price elasticity varies from .12 to 1.72 but with the elasticity being greater then .90 in four of the countries. Consumption of chicken meat is thus very responsive to price changes, a fact reflected in the declining price trends and the high growth rates in per capita consumption. However, what is particularly salient is that the cross-price elasticity, measuring the substitution of beef by chicken, is either similar to or in the case of Brazil, significantly larger than the own-price elasticity for beef[1]. In general, a change in the chicken price will have as much influence on beef consumption as an equivalent change in the beef price itself. These cross-price elasticities vary between .4 and .74. Then considering the very significant rates of decline in chicken prices, the substitution effect played a significant role in holding down beef prices--this is clearest in Brazil (Table 9). During the seventies the major effect on demand came from price changes (both own-price and substitution effects). Given the fact that relative prices have tended to stabilize in the 1980's, the importance of incomes as determinants of the demand for individual meats will increase in the coming years.

Consumer budget surveys from Peru and, especially, Brazil give a more detailed look at changes in meat consumption. What is apparent in major metropolitan areas of Brazil between 1960 and 1975 is the declining consumption of beef and the rising consumption of poultry. Consumption of chicken meat increased across all income strata, while that of beef tended to decline across all income strata (Figures 2 and 3). These trends again support the dominance of the price effect over the significant growth in income during the period.

The most significant substitution of chicken for beef was among the lower income strata. Chicken was rarely eaten by the urban poor in the 1960s. By 1975 chicken was virtually on a par with beef, as the principal meat eaten by the lower income strata. As significant, however, was the decline of the total consumption of meat by the poor over the same period in northeast Brazil. Vergolino (1980) presents data for Recife to show the consistency of this trend (Table 10). Rising beef prices were squeezing the meat consumption of the poor, even though there was a significant switch to chicken. Finally, the data for Peru (Table 11), suggest how rapidly substitucion can take place when the change in relative prices is so marked.

The rapid increase in the proportion of chicken in total meat consumption in tropical Latin America was due to both a major restructuring

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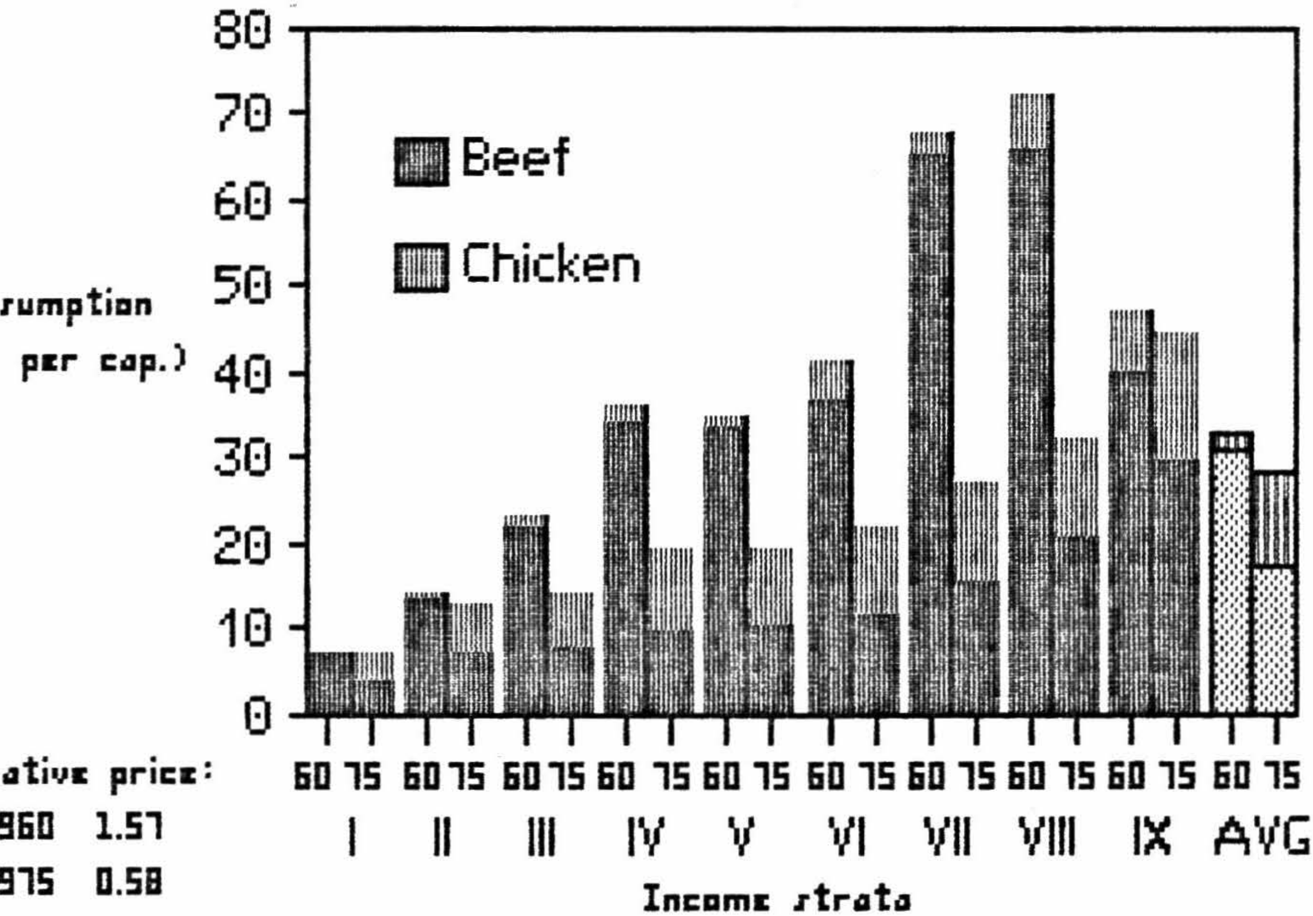
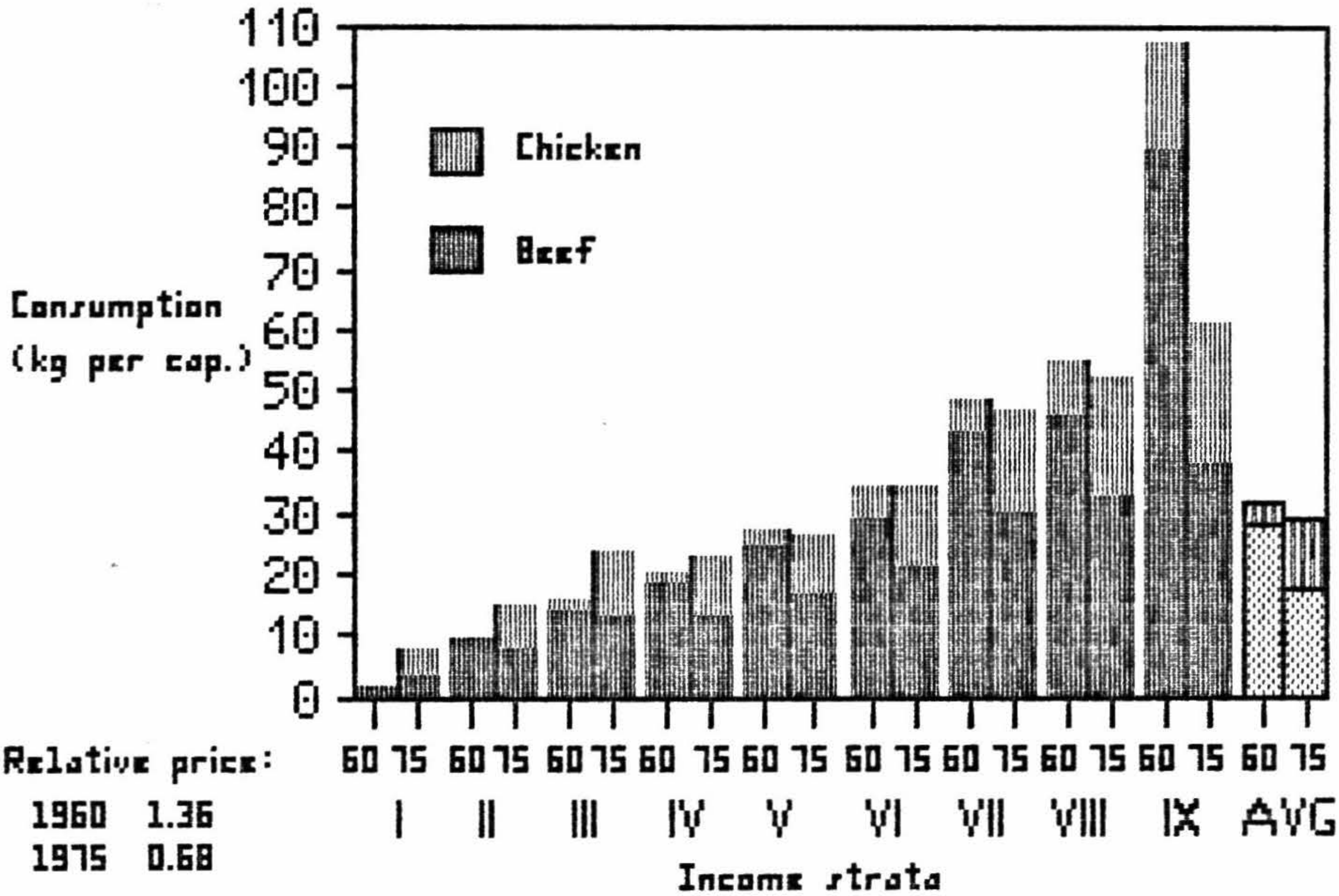
1. In Jamaica, Venezuela, and the Dominican Republic the cross-price elasticity was either not significant from zero or negative, the latter indicating complementarity, which is nevertheless doubtful. The cross-price elasticity of chicken consumption with respect to beef prices was in all cases positive. Such nonsymmetry in sign is not possible. In all, these countries the own-price elasticity for beef is not significant from zero and moreover, chicken is a large consumption item, with per capita consumption levels being higher than beef in Jamaica and the Dominican Republic. Under such circumstances the structural model was not able to distinguish between the effect of the two prices on meat consumption.

Table 9. Disaggregation of factors influencing the growth in beef demand, 1960-82, Brazil.

Demand component	1960-67 (%)	1968-75 (%)	1976-82 (%)	Average (%)
Actual per capita consumption	-1.2	1.3	-2.8	0.3
Income effect (= .32)	0.8	2.7	0.8	2.0
Growth in excess demand	2.0	1.4	3.6	1.7
Implied price change (= -.23)	8.7	6.1	15.7	7.4
Actual change in beef price	2.9	8.2	3.3	2.4
Actual change in poultry price	-2.3	-0.6	-6.3	-2.7



gure 2. Comparison of consumption of beef and chicken by income strata, 1960 and 1975, Recife, Brazil.



gure 3. Comparison of consumption of beef and chicken by income strata, 1960 and 1975, Sao Paulo, Brazil.

Table 10. Trends in annual per capita consumption of beef and poultry in Recife, Brazil.

Year of consumer survey	Average consumption		Low income strata[a]	
	Beef (kg)	Poultry (kg)	Beef (kg)	Poultry (kg)
1961-62	31.6	1.3	n.a.	n.a.
1967-69	28.4	5.2	14.5	0.5
1973	23.0	13.0	8.9	3.7
1975	17.9	10.5	4.4	2.5

a. Families with income less than one minimum salary

SOURCE: Vergolino, 1980.

Table 11. Consumption changes for beef and poultry by income strata in Lima, 1972-1979, Peru.

Year	Consumption per family				Real prices (1973 = 100)	
	Low income strata		Medium income strata			
	Beef (g/day)	Poultry (g/day)	Beef (g/day)	Poultry (g/day)	Beef (Sols/kg)	Poultry (Sols/kg)
1972	136	126	241	177	44.9	75.7
1976	56	318	75	425	65.3	45.9
1979	29	210	90	290	50.5	47.6

SOURCE: Ministerio de Agricultura. 1985.

of poultry production and marketing systems and to insufficient supply response by beef producers during a period of rapidly rising demand for meat. Since much of the productivity gains in chicken meat production per se (a discussion of feedgrain productivity is left to the next section) have been achieved, an issue is at which level the weight of chicken in total meat consumption will eventually stabilize. This depends critically on what will happen on the supply side, which turns the analysis to a discussion of production.

The Intensive Versus the Extensive Frontier

Comparatively little meat moves in international trade. Transport costs are such that domestic production usually has an advantage over imports, even in the case of east Asia where the bulk of the feed ingredients must be imported. If the major portion of increasing demand for meat in Latin America is to be met by domestic production and if the different meats are substitutable to a relevant degree, then the policy question revolves around the production options that can meet the increasing demand for meat. This leads naturally to a consideration of the potential for expanding and/or intensifying beef production systems versus the potential for expanding and/or intensifying swine or poultry production systems. The central question for Latin America is whether these two options are complementary to a relevant degree or whether at some point they become competitive.

Beef production systems in Latin America are land extensive. Some countries, such as those in the Caribbean which do not have the land resources or such as Peru which lacks extensive grasslands, have met rising meat demand by dependence on pork and poultry production. All the other countries of tropical Latin America have extensive grasslands. Growth in beef production in tropical Latin America to date has depended principally on increasing pasture area (Table 12), that is, growth through expanding extensive production systems. Only Brazil and Venezuela have managed a consistent increase in the carrying capacity of its pastures. In these two cases there was a reliance (more so in the case of Venezuela) on natural savanna with a low carrying capacity. Only recently have both countries reached levels similar to other Latin American countries.

The potential for meeting the increasing demand for beef purely by horizontal expansion in most countries is limited. During the 1970s and 1980s countries such as the Caribbean countries, Mexico, Ecuador, El Salvador, Guatemala, and Peru reached a situation where any expansion in pasture had to compete with cropland. These countries depended on quite significant rates of growth in poultry production to meet rising meat demand. There is some potential to bring additional land under grazing in the rest of Latin America but only in Brazil, Venezuela, and Colombia does the potential exist to meet rising beef demand purely by horizontal expansion. In these countries the issue is more what factors will be responsible for inducing growth, especially when there is continued growth in poultry consumption and when, to a more limited extent, pork is also an option.

Table 12. Changes in cattle stocks, pasture area, and stocking rate in selected producing countries, 1950-1980, Latin America.

Country and year	Cattle stock (thousands of head)	Pasture area (ha in thousands)	Pasture cultivated (%)	Stocking rate (head/ha)	Pasture area as % of total farm area
Brazil					
1950	47,089	107,633	13.9	.44	46.4
1960	57,102	122,335	16.4	.47	49.0
1970	78,562	154,139	19.3	.51	52.4
1975	101,674	165,652	24.0	.61	51.1
1980	118,086	174,500	34.7	.68	47.8
Venezuela					
1950	5,769	13,501	12.1	.43	61.0
1961	6,519	16,608	16.6	.39	63.9
1971	8,678	16,080	31.8	.52	60.7
1980	10,791	17,471	32.4	.62	n.a.
Panama					
1950	570	552	77.4	1.03	47.6
1961	763	818	83.5	.93	45.3
1971	1,260	1,141	84.6	1.10	46.0
1980	1,345	1,296	78.4	1.04	57.4
Costa Rica					
1950	608	617	40.0	.98	34.5
1963	1,051	937	42.7	1.12	35.1
1974	1,694	1,558	47.0	1.09	49.9
Colombia					
1960	14,781	14,606	n.a.	.66	53.6
1971	19,808	17,930	n.a.	.70	57.1

SOURCES: Agricultural censuses for the various countries; data for Colombia is from Hertford and Nores (1982).

Technical change in beef production systems is critical to determining the future share that beef will have in overall meat consumption in tropical Latin America. This is a particularly complex issue on which volumes have been written, but what is relevant in the current context is some speculation about the overall determinants that will induce increased productivity in beef production systems and a delineation of the policy choices. Two principal points dominate in such an analysis. First, technological change within beef production systems usually requires an interacting complex of changes within the overall production system. Technical change in tropical beef systems must also anticipate both an adoption sequence within an overall technological package and significant interactions between management and the return on the investment required in applying the technology.

Second, tropical beef systems, while implying a significant capital investment, are nevertheless low-input, low-productivity systems. Capital is the constraining factor in the system. Investment in new technology will usually be recouped by a future stream of benefits and therefore will, in general, depend on an improved, initial cash flow. Incorporation of a cropping component or milking can be a critical element in developing the cash flow that will sustain the investment program. However, again this implies a significant increase in management resources devoted to the overall enterprise. Empirical evidence from the Colombian llanos shows that even without crops or milk production, pasture technology can be profitably adopted. While return to management is low in traditional livestock systems based on extensive pastures, these returns increase with the incorporation of new technology, in many cases inducing the hiring of more management resources.

These issues can be extended to a macro-scale by analyzing the case of Brazil. What is found in Brazil is a significant structural change in the location of beef production. There has been a basic shift in beef production out of the south and southeast and into the central west and, to a lesser extent, the north (Table 13). Cattle herds in the northeast increased at about the same rate as the overall rate in Brazil as a whole. There are two elements to this process. First, in the period there was a dynamic increase in crop area in the south and southeast, especially soybeans and wheat in the south and sugarcane, citrus, and soybeans in the southeast. This put a brake on the expansion in pasture area in the two regions. Neither increasing productivity nor rising beef prices were sufficient to motivate a significant production response in that region. This, in turn, opened a window for the expansion of beef systems into the cerrados of the central west. This expansion, however, depended on the sowing of pasture, given the low carrying capacity (0.2 animal units per hectare) of the natural savannas. The whole expansion in pastures in the central west depended on increases in the area in planted pastures -- the area in natural savanna utilized for pasture actually declined slightly in the 1970-80 period. The area planted to pastures in the central west increased from 9.1 million hectares in 1970 to 24.6 million hectares in 1980; at the same time the area planted to crops increased from 2.3 to 6.1 million hectares. The ratio between crop area and planted pasture in the two periods remained absolutely constant at 25%. This expansion in crop area was supported by the very significant credit and transport subsidies given to first rice and then maize production in this region. Crop

Table 13. Changes in the distribution of cattle and pastures by major regions, 1970-80, Brazil.

Year and region	Cattle				Pasture area		
	Beef (thousands of head)	Milk (thousands of head)	Dual purpose (thousands of head)	Total (thousands of head)	Total (thousands of ha)	Cultivated (%)	Stocking rate (head/ha)
North							
1970	1,346	131	206	1,706	4,428	14.4	.39
1975	1,684	142	299	2,130	5,281	29.8	.40
1980	3,555	307	123	3,989	7,722	48.8	.52
Northeast							
1970	7,328	3,701	2,466	13,806	27,875	20.6	.50
1975	11,307	3,507	3,012	18,041	30,624	22.3	.59
1980	15,572	4,283	1,502	21,506	34,159	30.3	.63
Southeast							
1970	10,431	13,148	2,995	26,845	44,739	23.8	.60
1975	17,803	11,749	5,540	35,237	47,277	24.4	.75
1980	20,199	11,633	2,949	34,835	43,639	37.1	.80
South							
1970	11,694	5,506	1,545	18,953	21,613	16.8	.88
1975	14,499	3,935	2,483	21,516	21,160	21.0	1.02
1980	18,721	4,710	909	24,495	21,313	26.4	1.15
Central west							
1970	12,699	2,726	1,774	17,252	55,483	16.4	.31
1975	20,446	1,622	2,669	24,750	61,310	24.9	.37
1980	29,258	2,821	1,178	33,261	67,666	36.5	.49
Total							
1970	43,498	25,213	8,986	78,562	154,139	19.3	.51
1975	65,739	20,956	14,003	101,674	165,652	24.0	.61
1980	87,306	23,754	6,661	118,086	174,500	34.7	.68

SOURCES: Instituto Brasileiro de Geografía e Estatísticas (IBGE), 1974, 1979, and 1984.

production during the period was a component of beef systems in the cerrados (Vera and Sere, 1985) and supported the sowing of pastures. Thus, a dynamic crop sector in traditional production zones and policy support (through crop subsidies) to pasture establishment in the cerrados, resulted in an overall shift in the locus of beef production to the central west.

The other factor influencing the rate of growth in beef production in the "frontier" is the structure of the expansion process itself. This growth process is portrayed in Table 14 and supports the dominance of capital rather than labor inflows as the engine of growth in the central west region. In the 1970-80 period the number of cattle farms of less than 100 ha. barely increased (7.3% increase for the whole period) while cattle farms larger then 100 ha. increased from 70.4 thousand farms to 91.4 thousand farms 1974 and (IBGE, 1984). While proportionately this represented a 30% increase, an annual net increase of 2 thousand farms in this region is miniscule in relation to overall migration rates in Brazil, emphasizing the role of capital as the key to the rate of expansion in pasture and beef production in the frontier. That is, to make the move to the central west profitable, average farm-size has to be large and since the profitability of the enterprise depends on planted pastures, tractors must be added to the investment in stock.

Maintaining an adequate rate of growth in planted pasture is key to basing future beef supply in Brazil on the cerrados. In having to base this expansion on larger farms, the structure of the process has sacrificed some efficiency gains in the utilization of those pastures, as seen in the declining stocking rate in the range of farms from 100 to 5000 hectares, even though the percentage of planted pasture remains constant. In summary, the key to understanding the future rate of pasture establishment (and thus future growth in beef production) is the effects of changes in crop policy in Brazil on these systems and the availability of more productive pasture species leading to enhanced profitability.

The case of Brazil brings into sharper focus the determinants of growth in beef production in the other two countries with major areas in underexploited, natural savanna, that is Colombia and Venezuela. Much like Brazil both Venezuela and Colombia have as well reached the demographic transition point, where the rural population starts to decline absolutely. The rate of expansion in beef production in the llanos areas of these two countries will as well depend on intensification of beef production systems through policies affecting capital investment rather than labor migration into the region. As in Brazil, intensification of the "frontier" of Colombia and Venezuela will depend in part on the crop-livestock competition in the longer-settled agricultural regions and in part on crop, input and transport pricing policies. In Venezuela in the 1980's significant subsidies on fertilizer and transport and relatively high support prices for grains have provided the potential for introducing a crop component into livestock systems in the llanos, where few existed before (Vera and Sere, 1985). However, data do not yet exist to evaluate the effect of these policies on pasture establishment in the llanos. In Colombia the expansion of rice into the better soils of the Piedmont area has led to a major increase in planted pastures. However, little crop technology yet exists for the llanos proper and there has been no major

Table 14. Brazil: Distribution of pasture area and cattle stock by farm size and selected productivity measures in the Center-West[1], 1980.

Farm Size Strata (ha)	Pasture Area (1000 ha)	% Pasture Cultivated (%)	% Increase Pasture Area 1970-1980 (%)	Cattle Stock (1000 head)	Stocking Rate (head/ha)
Less than 50	924	48.9	- 4.3	1,128	1.22
50-100	1,479	44.5	10.3	1,349	.91
100-200	2,990	41.3	19.6	2,140	.72
200-500	7,182	41.5	17.8	4,785	.67
500-1000	7,342	42.8	25.0	4,324	.59
1000-2000	8,697	43.5	33.7	4,755	.55
2000-5000	12,363	41.5	29.5	5,827	.47
5000-10,000	8,131	34.6	19.4	3,190	.39
10,000-100,000	15,055	25.9	5.9	5,028	.33
More than 100,000	3,373	15.0	123.0	542	.16
Total	67,537	36.4	22.0	33,195	.49

[1]Includes Goias, Mato Grosso and Mato Grosso do Sul.

SOURCE: IBGE(1984).

growth in crop production in the traditional beef production area of the Atlantic Coast. The rate of expansion in beef production in the Colombian llanos will depend on establishing new pastures without a crop component and on the relative profitability of beef production between the Atlantic Coast and the llanos proper.

Outside these three countries crops and/or milking are becoming a more integrated feature of beef production systems as market pressures, a more manageable farm size, and the complementarities between crop production and pasture establishment contribute to increased productivity. However, this expansion in feed grain and, to a certain extent, oilseed production is a response to the even faster development of the "intensive frontier" in the tropical Latin American meat sector. Expansion of the intensive frontier is well represented by the evolution of the poultry industry in tropical Latin America and the swine sector in southern Brazil, Venezuela, and parts of Mexico and Paraguay. In fact, the poultry revolution in Latin America, as in Asia, represents not so much an intensification of current production systems as a complete restructuring of the sector. The impetus was the rising demand for meat, aided by rising beef prices and urbanization. Whereas traditional production was oriented to rural consumption, the rise of large-scale broiler operations, often vertically linked to feed concentrate manufacturers, was oriented to the development of urban markets. Marketing of chicken followed the development of supermarkets as a major form of food retailing and the rise of "fast food" chicken restaurants. The whole poultry sector was transformed from retailing, through production and provision of feed sources. This restructuring allowed for significant gains through economies of scale at all levels.

Economies of scale were probably even more important in the decline of poultry prices than was technical change, which is not to diminish the role played by new technology. Balanced feed technology together with new breeds, often introduced from the United States, resulted in a significant decline in the amount of feed needed to produce a kilogram of meat. Mortality measures were reduced by antibiotics, the time-to-slaughter weight declined, and slaughtering technology allowed factory-scale operations. The impact was a significant reduction in per unit costs and just as importantly an ability to adjust production levels very quickly to changes in profitability, whether due to output or feed price changes. For those governments concerned about the inflationary impact of meat prices, the poultry industry allowed much more control over market prices. As the weight of chicken meat increased in the consumers' budget, in some cases to a parity with beef, the supply responsiveness and weight in the consumer budget drew meat sector policies toward the poultry industry.

Feed is the dominate cost in the production of poultry meat, making up to 80% of the total (Table 15). It is this switch from land devoted to pasture to land planted to feed crops that forms the basis of the development of the intensive frontier. The feed concentrate industry has in most instances been the lead sector in the development of the poultry industry. It is the growth node, with forward linkages to poultry producers and backward linkages to feed grain producers. The dynamism of the balanced feed industry establishes the limits on poultry expansion and establishes the market growth for feed ingredients. This industry has been

Table 15. Cost distribution (as a percent of total production costs) in the production of broilers, Peru and Brazil.[a]

Cost component	Minas Gerais, Brazil May 1978 (%)	Lima, Peru May 1986 (%)
Feed	65.6	77.6
Day-old chicks	19.5	15.6
Vaccine	0.5	1.5
Litter	0.2	0.7
Disinfectant	0.8	0.4
Water	0.9	2.2
Labor	3.8	0.9
Other	8.7	1.1
Total (%)	100.0	100.0
(Cost/kg)	Cr$12.07	Intis 12.94

a. Costs for Brazil are based on a lot size of 5000 birds; that for Peru is based on a lot size of 100,000 birds.

SOURCES: Informe Agropecuario, 1978; Malarin, 1986.

dynamic indeed, with annual growth rates in almost all countries of well over 10% (Table 16). The major portion of feeds are directed to poultry but swine feeds form a significant component in countries such as Mexico and Venezuela. There has been little difficulty in drawing investment resources into the industry at rates sufficient to maintain growth rates. To date only government interventions have limited growth in the concentrate industry. Examples are the price controls on eggs and poultry meat in Mexico and Peru, often creating a cost-price squeeze, and the controls on imports of feed ingredients in Colombia and to a certain extent, Ecuador. On the other hand, feedgrain pricing policy has in some cases favored the poultry industry. Low feedgrain prices have been a consistent policy in Mexico and Venezuela, a topic taken up in the next section.

The expanding concentrate industry precipitated a rapid rise in the demand for feed components, especially carbohydrate sources. This resulted in significant demand-led growth in the feed grain sector. In some countries, feed grain demand was met by the expansion of an already existing maize production base; in other countries sorghum expanded rapidly as a new crop. In no tropical Latin American country, except for Paraguay, was the expansion in production always able to meet the increases in demand. All these countries turned to imports of feed grains, with import volumes growing rapidly in all but a few cases. At this point the analysis turns to a closer evaluation of the determinants of the supply of carbohydrate components for animal feeds.

The Grain Divide: The Choice of Carbohydrate Source in Feed Demand

A rapidly expanding feed concentrate industry, led by the increasing demand for animal products, can create either a very dynamic domestic grain sector, rising real prices of grains or increasing grain imports. A dynamic grain sector creates obvious positive benefits but rising grain prices or imports can raise significant policy problems. Increasing demand for maize as a feed source, particularly, has significant implications for countries in Latin America where maize is a primary food source and which often intervene in maize markets to keep consumer prices low to poorer segments of the population. Yotopopoulos (1983) argues that the rising income of the middle income classes leads to rising demand for income elastic foods, particularly meat, which in turn can bid grain prices up; the latter obviously can have a negative effect on the nutrition of the poor, who depend on such grains as a primary calorie source in their diet. However, in Latin America governments have taken steps to minimize this competition, enhancing natural segmentation in grain markets based on price and quality factors.

Grains are substitutable, one for each other, in balanced feed rations --factors such as carotene, tannins, and amino acid content do result in price differentials but do not hinder substitution--but not in the human diet. Substitution between rice, wheat, and maize does occur but to a more limited degree. Sorghum is not seen as a food except in very small, rural areas of Central America and Haiti. What is also clear in Latin America is that food uses will always draw grains away from feed uses, not vice versa. Rice is rarely used in animal feeds and wheat only slightly less often in Latin America, principally because the nutrient content is too expensive

Table 16. Characterization of the mixed feed industry, Latin America.

Country	1984 production (t in thousands)	Poultry (%)	1970-84 growth rate (%)
Brazil	10,824	67	11.0
Colombia	1,536	76	18.6
Peru	595	73	4.6
Venezuela	2,244	66	9.9
Mexico	8,500	53	5.8
Jamaica	227	62	n.a.[a]

a. n.a. = not available.

SOURCE: Associations of feed manufacturers in the individual countries.

relative to alternatives. Moreover, in countries where hard (dent or flint) maize is a major food source, sorghum is normally the principal grain used in feed rations. This is certainly the case in Mexico, Nicaragua, Venezuela, and Colombia--in the latter country maize is only of regional importance in human diets. There is a natural evolution to that grain which does not compete in the food economy, essentially because too often the food grain becomes too expensive or too scarce to sustain the animal feed industry.

In countries such as Brazil, Dominican Republic, Jamaica, Ecuador, Peru, and Panama maize is the principal grain in feed rations. In all these countries rice and/or wheat is the major food grain. In most of these countries root crops and plantains are also important calorie sources. In Ecuador and Peru soft or floury maize is a regionally important food source but this is a distinct commodity from the hard maize. In all these latter countries hard maize is a minor food item when there are readily available supplies of more preferred grains. In such a food economy, changes in overall food demand for maize will have little impact on its price. Competition between the food and feed markets in these countries are thus minimized by the structure of grain preferences and relative prices.

Minimizing competition on the demand side does not necessarily translate to a minimum of competition for resources on the supply side. For relatively homogenous production inputs like fertilizer and credit there will be natural competition, determined by relative profitability. Competition for land is probably the more relevant factor and here differential adaptation to agro-climatic conditions provides a significant degree of segmentation in the competition for land. Certainly wheat in tropical Latin America does not compete with feedgrains, except possibly for wheat and maize in Paraguay. Irrigated rice and feedgrains also do not compete for land. Upland rice and maize do compete for land in the Center-West of Brazil, but land is really not the relevant constraint in these areas. Sorghum and maize for human consumption is the only real area where there is significant competition for land but this occurs really only in the irrigated areas of Mexico. Competition in Mexico, however, is a relatively moot point because of CONASUPO's control over both consumer and producer prices and the heavy reliance on imports of both commodities.

The above would appear a workable solution to food-feed competition were it not that many governments heavily subsidize the consumption of key grains, for example, maize in Mexico or wheat in Brazil, Peru, and Ecuador. In such cases, food grains become price competitive in feed rations, and governments try to maintain the independence of the two markets through elaborate administrative rules on imports, domestic sales, and subsidy payments. In all cases a national grain marketing agency administers much of the domestic marketing of the subsidized grain. Nevertheless, in all these countries there is evidence of some leakage of the subsidized food grain into use by feed compounders. The clearest case is wheat flour in Brazil (Table 17), where flour prices to the consumer were kept exceptionally low.

Intervention in food grain markets in many cases precipitated later interventions in feed grain and poultry markets. The policy objectives

Table 17. Difference between wheat flours sold by flour mills and actual human consumption, August 1974-July 1975, Brazil.

Region	Sales by mills (t)	Flour consumption (t)	Absolute difference (t)
Rio de Janeiro	447,244	292,113	155,131
Sao Paulo[a]	1,005,645	584,951	470,694
South	721,556	769,365	-47,809
Minas Gerais and Espirito Santo	310,646	279,665	30,981
Northeast	676,660	511,943	164,717
Federal District	23,297	18,970	4,327
North	168,924	145,645	23,279
Total	3,353,972	2,552,652	801,320

a. The major portion of the mixed feed industry is located in Sao Paulo. The consumption estimate is based on the national food budget survey.

SOURCE: Companhia de Financiamento da Producao (CFP), 1981.

varied somewhat but all major feed grain producing countries, apart from Carribean countries, intervened to support farmer incomes and to provide sufficient incentive to increase production. How this was done varied depending on whether food grain consumption was subsidized. In countries such as Mexico, Venezuela, Peru, and Brazil, where food grains were subsidized, governments normally intervened with input subsidies, particularly fertilizer and credit, and attempted to keep output prices at around import prices (in many cases this failed due to a progressive overvaluation of the exchange rate and producer prices moved above import prices). On the other hand, countries such as Colombia and Panama did not subsidize food grain consumption and in turn maintained support prices for feed grains well above import prices, through a government marketing agency and import controls. Through the 1970s most countries intervened to some degree in feed grain markets, almost always to the advantage of feed grain producers and only rarely neglecting the interest of the feed concentrate industry.

Striking a balance between the interests of feed grain producers and feed concentrate manufacturers often required either subsidies or the strategic use of imports which often entered on the basis of overvalued exchange rates. Each country managed incentives to the two groups through a state marketing agency. This agency maintained the producer support price by buying in the domestic market when necessary, controlling the price and supplies to the feed compounding factories, and managing imports. In some cases, for example, Peru and Venezuela, the marketing agency would sell to the factories at a lower price than the domestic price, in effect balancing the loss by imports that were even cheaper. Peru and Venezuela also eventually moved to a system of allocating import quotas at import prices to factories on the basis of purchases of domestic production at the higher support prices.

However, by far the more usual subsidy was for transport costs. In this case both support prices and sales prices to the factory were fixed at a single price for the whole country. This was little problem for a country such as the Dominican Republic or Panama but had profound implications for large countries such as Mexico, Peru, and Brazil. In Brazil the Companhia de Financiamento da Producao (CFP) would sell at market prices in the region but often with a transport subsidy. In all these countries surplus feed grain production areas were often far removed from deficit demand areas. In Brazil and Peru this was a direct subsidy to foster feed grain production in frontier areas which, in Peru, were in the Selva and in Brazil, in the central west, cerrado areas. Transport subsidies in these cases were large and shifted comparative advantage to those areas where transport costs would be prohibitive.

Brazil is a case where transport subsidies absorbed by CFP can shift comparative advantage away from local production. Table 18, showing the regional structure of maize production and demand, clearly highlights that maize must move from the south and central west to the deficit areas of the northeast and southeast. The comparison of relative costs (Table 19) clearly shows the importance of transport costs in the supply of feed grain markets in Brazil. Subsidies are often necessary to keep the central west areas competitive in maize production, often at the expense of the

Table 18. Regional surpluses (+) or deficits (-) in the production of maize and animal feed, 1983, Brazil.

Region	Maize (t in thousands)	Animal feed (t in thousands)
North	19.3	-28.7
Northeast	708.0	-199.3
Southeast	1212.1	-139.9
South	600.1	346.6
Central west	1559.1	30.8
	As a percent of total consumption	
North	7.4	-39.1
Northeast	44.0	-22.1
Southeast	16.6	-3.0
South	6.2	6.7
Central west	186.5	9.5

SOURCES: Conpanhia de Financiamento da Producao (CFP); Sindicato da Industria de Racoes Balanceadas.

Table 19. Private and social costs of supplying maize and dried cassava in the northeast, 1986, Brazil.

Item	Private costs		Social costs	
	Absolute (Cr$/t)	Cassava/maize (%)	Absolute (Cr$/t)	Cassava/maize (%)
Locally produced maize	1517	86	1405	88
Maize from south	1616	81	1468	84
Maize from central west	2494	52	2130	58
Imported maize	1705	77	1675	73
Locally produced cassava	1306		1231	
Maize price	1690	77	1690	73

SOURCES: Conpanhia de Fianciamento da Producao (CFP), Centro Internacional de Agricultura Tropical/Empresa Brasileira de Asistencia Técnica e Extensao Rural (CIAT/EMBRATER) survey.

development of production in the northeast--a point to which the discussion will return when considering the potential for cassava in feed rations.

Feed grain production has responded to the expanding markets and policy interventions, except in Panama and Peru (Table 20). In Peru maize supply has depended on the relative support price of maize to rice, with rice having a clear advantage until 1985. Basic differences in technology between maize and sorghum bring into sharp focus how these production increases were achieved. In the case of sorghum, production increases were achieved by expanding the area planted with the use of an imported technology based on hybrid seed and mechanized production in all stages from planting to harvesting. This technology was appropriate for expansion only on large farms. In the case of maize, however, the production structure in most tropical Latin American countries has been skewed toward the small-scale producer. Moreover, the increase in production, especially in the last decade, has been due more to increasing yields, except in Paraguay, than increasing area. The implication, however, that small farmers were able to capture the major portion of the benefits of this expanding market are not supported by the limited data on the subject. In Ecuador the small-scale producer of floury maize in the Sierra remained isolated from the change in the market for yellow, dent maize. This was captured by large-scale, mechanized producers on the Pacific coast. In Brazil (Table 21), both area and yields expanded in farms of over 50 hectares, as both mechanical and yield-increasing technologies were adopted by large-scale farmers. Those farmers with farms from 5 to 50 ha in size, increased yields but with declining area planted to maize. Farms of 5 ha or less were effectively marginalized as yields remained static and area declined markedly. Large farmers have a clear advantage in being able to take advantage of both labor-saving and yield-increasing technologies, drawing on the technology developed in U.S. agriculture over the last two to three decades. In general, the small farmer has lost the comparative advantage he had in management--normally reflected in higher yields--together with the fact that he often does not have the same access to the subsidized inputs and credit that have fueled this expansion in feed grains.

Nevertheless, even rapid rates of growth in feed grain production were not sufficient to meet expanding domestic demand. Imports (Table 20) were necessary both to meet deficits and in many cases to support price policies for grain supplies to feed manufacturers. The rising trend in feed grain imports in many countries, however, was affected in the 1980s by the external debt crisis in Latin America. The ratio of debt-servicing to exports rose significantly (Figure 4), precipitating major devaluations, fiscal stringency, and declines in domestic demand. Agricultural imports are a significant component of the import bill and were increasing as a percentage of total imports (Table 22). The devaluations and the need to cut back government spending, especially on subsidies, forced many countries to expand efforts to increase self-sufficiency in basic commodities. With recent changes in domestic price policies and (because of devaluations) the domestic price of feed grain imports, there is opportunity to develop a more diversified strategy in meeting carbohydrate demand in the feed sector. In particular, there is an incentive for governments to evaluate the potential of cassava to meet the expanding demand for feed sources.

Table 20. Characterization of the feed grain sector, 1966-85, Latin America.

Country	Production			Net imports		
	Volume 1983-85 (t in thousands)	Growth 1966-75 (%)	Growth 1975-85 (%)	Volume 1966-68 (t in thousands)	Volume 1976-78 (t in thousands)	Volume 1983-85 (t in thousands)
Sorghum						
Mexico	5,557	10.0	4.0	-177	517	2,766
Colombia	574	19.8	4.6	1	60	127
Venezuela	475	10.7	15.3	1	513	546
Maize						
Brazil	20,638	3.6	3.0	-760	-529	-72
Dominican Republic	97	2.2	-0.3	0	93	185
Ecuador	257	4.3	1.3	-1	20	10
Paraguay	473	5.8	4.3	-4	-8	-12
Peru	689	1.2	0.2	22	212	255
Panama	72	-5.7	0.3	1	4	29
Jamaica	4	9.6	-12.5	47	166	177

SOURCE: Food and Agricultural Organization of the United Nations (FAO), 1986.

Table 21. Change in area planted and yield of maize by farm size during the period 1970-1980, Brazil.

Farm size strata (ha)	1980 Area (ha in thousands)	1980 Yield (t/ha)	Increase 1970-1980 Area (%)	Increase 1970-1980 Yield (%)
Less than 5	979.6	0.93	-23.9	8.1
5-10	972.4	1.45	-18.9	21.8
10-20	1,638.8	1.63	-12.9	28.3
20-50	2,353.0	1.61	-9.5	27.8
50-100	1,275.6	1.52	5.9	27.7
100-200	1,026.0	1.54	19.3	28.3
200-500	1,005.1	1.62	19.4	29.6
500-1000	504.9	1.67	31.6	21.9
More than 1000	583.2	1.64	41.5	15.5
Total	10,338.6	1.52	-3.1	26.7

SOURCE: Instituto Brasileiro de Geografia e Estatísticas (IBGE), 1974 and 1984.

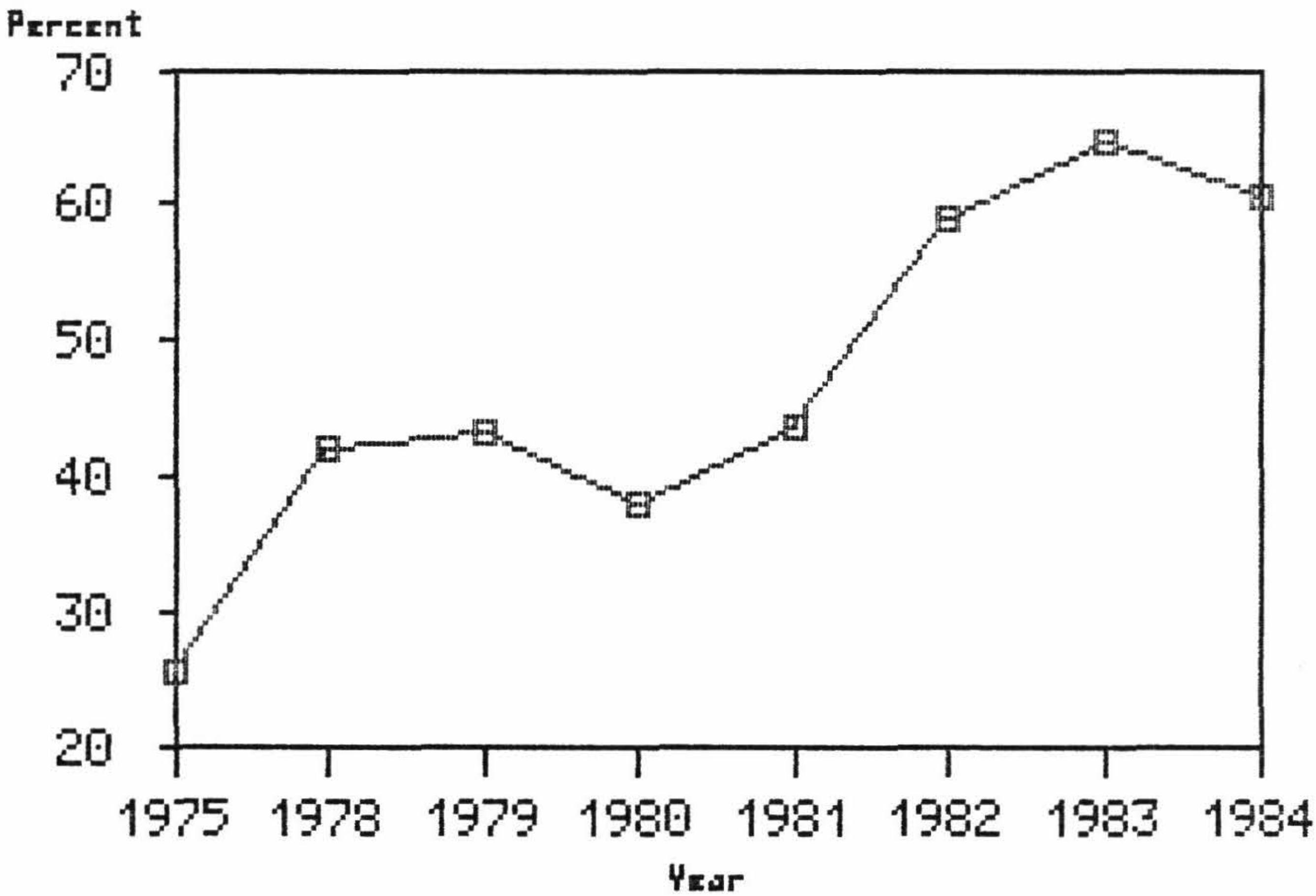


Figure 4. Debt service to export ratio,
Latin America.

Table 22. Agricultural imports as a percent of total imports, Latin America.

Country	1980	1981	1982	1983	1984
Brazil	9.9	9.1	8.5	8.7	11.0
Mexico	16.1	13.5	12.8	26.3	20.8
Colombia	11.5	9.5	10.3	10.9	8.3
Ecuador	8.1	7.8	9.1	14.9	12.1
Peru	20.4	20.4	18.0	17.5	15.7
Venezuela	16.2	17.0	15.2	11.6	20.7

SOURCES: Inter-American Development Bank (IDB), 1986; Food and Agricultural Organization of the United Nations (FAO), 1986.

The Cassava Option in Meeting Feed Demand

The rapid expansion in the demand for feed components changes the whole dynamic of demand for certain starchy staples as an economy urbanizes and incomes increase. In general, direct food demand for grains, and starchy staples in general, increases until an income level of about US$1000 (1978 prices) and then declines somewhat afterward (Monke, 1983). However, at about that point derived demand for carbohydrate sources for animal feeds begins to grow. For commodities such as maize, sorghum, and cassava, and occasionally soft wheats, this market transition provides an opportunity to maintain a significant elasticity in total demand for the commodity. Few agricultural commodities face such continual increases in demand throughout the growth process, and only flexibility in end uses and relatively cheap production costs allow a commodity such as cassava to move from being primarily a food staple to becoming a commercial crop supplying a growing industrial demand. Adapting to shifting end markets and changing market structure is the key to a modernizing agriculture, where expanding marketable surpluses lead to increasing farmer incomes and thereby helping to moderate rural-urban migration.

Cassava is basically a starch source and, since carbohydrate or energy sources are the principal component in balanced feeds, dried cassava has the potential for forming a significant percentage of the complete ration. Mixed feed technology allows the incorporation of high protein sources to compensate for cassava's lack of protein. Least-cost feed formulation models allow factories to produce a balanced ration with the lowest cost mix of ingredients. Experience with using cassava in Europe, especially in the Netherlands, has shown cassava to have few negative nutritional characteristics. Aflatoxin is usually nonexistent because of cassava's low protein content. If properly dried, HCN toxicity is not a factor in animal nutrition. For poultry there is some concern with the energy density of the diet if cassava assumes a high percentage, but this can be overcome by pelleting and the addition of a small percentage of animal tallow or vegetable oil. In general cassava can fully replace grains in swine and dairy rations and can take up 20% to 30% of poultry rations.

The movement to use balanced feeds in animal nutrition is also associated with structural changes in animal production, with the locus of production shifting from integrated crop-livestock systems on individual farms to large-scale, specialized production units, normally close to major urban markets. This structural transformation is clearest in the case of broiler and egg production. In swine, on the other hand, farm production is often able to resist the movement to large integrated units, due essentially to lower cost feed sources and the diminished scale economies in swine production. For the farm operation, however, the difficulty is to maintain balanced nutrition from onfarm sources, especially adequate protein levels. Technical change in swine production in Latin America, first phase, has taken the form of a shift of breeds to a leaner carcass and the purchase of protein concentrates to mix with energy sources produced on the farm. In the second phase, in a few countries, particularly Mexico and Venezuela, large-scale specialized swine production systems have also developed.

Cassava as an animal feed in Latin America develops first as an onfarm feed source. Throughout tropical Latin America cassava is fed to animals raised on the farm. Normally this is not systematic. The cassava is often noncommercial, for example, the roots are small or left in the ground beyond the period of satisfactory quality, or is the surplus after a periodic harvest. Moreover, the swine, and even poultry, tend to scavenge for a large component of their feed needs. Animal productivity in these systems is low but costs are also low. Generally in such systems only a minor percentage of the total cassava crop is fed to the animal stock. The opportunity cost of the cassava is too high compared to the low weight gains by the animal--lack of protein tends to limit the effectiveness of the energy source. Such systems are quickly disappearing, being overtaken by more efficient production systems.

The key to more productive onfarm swine production systems has been the availability of protein concentrates. In areas such as southern Brazil, particularly Rio Grande do Sul and Santa Catarina, and parts of eastern Paraguay cassava has developed as a major onfarm feed source in intensive swine production systems. In Rio Grande do Sul, it contributes to dairying systems. Particularly in Brazil, the development has been dramatic over the past couple of decades. A coincidence of factors gave rise to this dominant role of cassava in onfarm feeding systems. Predominant among these was the demise of the farinha market in southern Brazil as a result of the wheat subsidy. Shrinking demand made cassava relatively cheap at a time when swine production systems were changing with the introduction of breeds with less fat (the market for lard declined with the rise of the soybean oil industry) and the improved availability of protein concentrates. However, the key was the low production costs for cassava compared to the principal competing energy source, maize (Table 23). At the farm level cassava is very competitive with grain sources as an energy source in the feeding of animals. The one restriction is that the varieties must be relatively low in HCN content, a factor that limits onfarm feeding to swine in the northeast.

Developing a cassava production system that can supply a continuous supply of roots during the whole year and yet releases land at critical planting periods requires either an extensive land area or a storage system. In southern Mexico, with the rise of large-scale swine production systems in the ejidos, large silos have been developed for ensiling cassava roots. The ensiled roots can be kept for an indefinite period of time and the roots can be assembled near the swine production units. The costs of such systems have been very price competitive with sorghum (Table 24), which must be imported into the region. The ensiled cassava is mixed with a protein concentrate and minerals and provides a balanced feed source. Ensiled cassava systems can be adapted to most any size of production system but investment in a permanent silo and a chipper requires a certain minimal size of swine operation.

Availability of protein concentrates, intensification and technical change in swine production systems, and organization of the cassava production system to provide continuity of supply are all necessary for the development of such integrated systems. They also require an obvious coincidence between cassava production areas and swine production, the latter which requires adequate access to urban markets. Besides southern

Table 23. Production costs for maize and cassava (dried) in the south, 1986, Brazil.

Cost item	Cassava (Cr$/t)	Maize (Cr$/t)
Variable costs	172.5	555.4
Factor costs		
Labor	131.2	330.0
Capital	17.6	32.2
Input cost	23.7	193.2
Fixed costs	139.3	331.6
Factor costs		
Land	58.3	220.0
Labor	27.9	27.5
Capital	13.3	27.5
Input cost	39.8	56.6
Total costs	311.8	888.7

SOURCE: Centro Internacional de Agricultura Tropical (CIAT) field data.

Table 24. Comparison of costs of production of ensiled cassava roots with sorghum price in tabasco, 1986, Mexico.

Cost component	Cost (Mex$/kg)
Variable costs	
Root price	17.00
Loading and unloading	.80
Transport	4.00
Chipping and tamping	.85
Plastic cap	.20
Working capital	2.29
Subtotal	25.14
Fixed costs	
Silo depreciation	.96
Capital costs	1.60
Subtotal	2.56
Weight loss and deterioration	4.92
Total costs	32.62
Cassava cost dry weight basis	77.67
Sorghum cost dry weight basis	93.49

SOURCE: Centro Internacional de Agricultura Tropical (CIAT) field data.

Mexico, southern Brazil, and Paraguay, there is also potential to develop such systems in the Dominican Republic and possibly in the Selva of Peru and the Santa Cruz area of Bolivia. However, to broaden the market for cassava as an animal feed source, especially for the poultry sector, requires the mixing of dried cassava in balanced feeds.

Cassava is just starting to participate in the market for feed components going into the rations industry. Spontaneous development of a feed market for dried cassava has developed in Asian countries, particularly Thailand and Malaysia, but in Latin America cassava has not easily made the transition away from onfarm uses and food markets. There are two questions to be asked in regard to cassava's emerging role in the feed market. First, can cassava compete price-wise with the principal feed grains and potentially carve out a significant share of this expanding market? Second, if cassava is already profitable, why have dried cassava markets that have not spontaneously developed in Latin America? If cassava can compete, then an understanding of constraints on development of a cassava feed market will hopefully pinpoint mechanisms by which market linkages can be formed.

To generalize about the ability of cassava to compete with grains in animal feed rations is fraught with the problem of policy interventions in the marketing and pricing of feed grains. A starting point is a comparison of costs of production and prices at the farm and factory level for dried cassava and the principal competing grain. As can be seen in Table 25 cassava competes favorably with feed grains in terms of farm-level profitability. In all countries considered, dried cassava either now provides or could provide a reasonable return on farmer-owned resources. Moreover, these farm-level prices are translated into prices at the rations factory that enter the least-cost feed formulation for swine and, in most cases, for poultry. At issue then, is why these obvious profit incentives have not been translated into a rising production of dried cassava. To understand this requires an evaluation of grain pricing policy, on the one hand, and an understanding of pricing of alternative cassava products, especially in food markets, on the other hand.

Governments have intervened heavily in feed grain markets in Latin America over the past two decades although there has been no direct intervention in cassava markets. Obviously, this policy support for grains has directly affected the private profitability of cassava. Policy intervention has taken many forms. In Mexico there were direct subsidies provided by the state trading company, CONASUPO, in which the sales price to factories were usually less than either the farmer purchase price or the import price (Table 26). Also, the sales price was fixed for any location in the country so that transport subsidies were also significant. In 1985 with the pressure to reduce the fiscal deficit, purchase and sales prices were brought into line and in 1986 sales prices started to reflect transport costs as different prices were now set for six different regions. Cassava produced in the south in 1986 could begin to compete with sorghum in regional markets.

In Peru and Venezuela cassava could compete with nationally produced grains on the basis of costs of production but it could not compete under existing policy arrangements. In Peru the state marketing agency buys and

Table 25. Comparison of production costs for dried cassava and prices for cassava and the principal feed grain, 1986, Latin America.

Country	Production cost[a] Cassava	Price[a] Cassava	Grain	Cassava/grain
Sorghum:				
Colombia	17,044	25,600	32,000	80
Mexico	50,429	64,000	78,000	82
Venezuela	1,279	1,870	2,200	85
Maize:				
Peru	994[b]	2,475	3,300	75
Panama	170	180	230	78
Paraguay	32,406	56,000	70,000	75
Brazil	1,306	1,330	1,705[c]	78

a. Prices and costs in local currency per ton.

b. Assumes cassava comes under ENCI purchasing system, in which case transport costs are not included.

c. Maize import price.

Table 26. Sorghum prices managed by CONASUPO, 1971-85, Mexico.

Year	Purchase price (Mex$/t)	Import price (Mex$/t)	Sales price (Mex$/t)
1971	600	870	817
1972	729	760	810
1973	776	-	873
1974	1113	1849	1225
1975	1600	1457	1595
1976	1638	-	1739
1977	2016	2293	2011
1978	2030	2473	2127
1979	2033	2704	2231
1980	2891	3352	2672
1981	3927	4072	3439
1982	5093	8264	4746
1983	12388	16239	9150
1984	20478	22631	18861
1985	28705	26598	33720

SOURCE: CONASUPO.

sells maize at one single price in the whole country. The whole marketing margin is absorbed by ENCI, the effect of which has been to shift comparative advantage from the high cost production on irrigated areas of the coast to the Selva (jungle areas) in eastern Peru. As can be seen in Table 27, maize production in the Selva is much more profitable than on the coast under such a subsidy system. However, cassava cannot compete in coastal markets with subsidized maize if it must pay the transport costs. In 1986 dried cassava was brough under ENCI price support and purchasing operations.

In Venezuela the policy has been to foster cheap feed but not at the expense of domestic grain producers. Domestic sorghum producers receive significant input subsidies, especially fertilizer and credit, and price supports ensure significant profit margins. Cassava is put under some disadvantage with the fertilizer subsidies but can still compete at sorghum support prices. The policy constraint, however, is that most sorghum is imported and it comes in under a preferential exchange rate (Table 28). In order to get the license to import, the feed manufacturer must purchase a certain amount of nationally produced sorghum at the ruling support price. There is no requirement that cassava be purchased in order to get an import license, meaning cassava must compete with this mix of domestic sorghum and imported sorghum at the preferential exchange rate. Under this policy cassava is made uncompetitive by an administrative rule which excludes cassava.

However, apart from Venezuela, the 1982 debt crisis has forced a rationalization of both exchange rates and domestic pricing policies in tropical Latin America. This has created a price environment in which cassava now can begin to compete on a basis which more accurately reflects real production and marketing costs. In this environment cassava is in general cost competitive with domestic grains. Nevertheless, for countries such as Panama and Colombia, there have never been grain policies that have adversely affected the ability of cassava to compete in the mixed feed market. In these countries the second constraint on the development of the dried cassava market becomes apparent, that is, the nature of price formation in existing cassava markets and the effect this has on incentives to invest in processing capacity for cassava chips.

In Panama and Colombia, and in the rest of Latin America except for Brazil, price formation in cassava markets is based on the human food market, which in turn is based on the marketing of fresh roots. The perishability and bulkiness of fresh roots creates several constraints on the development of a unified price structure for cassava. First, markets for fresh cassava are spatially fragmented. The perishability and high transport costs limit arbitrage between markets at any significant distance. Prices depend instead on local supply and demand conditions, resulting in significant differences in cassava prices in different markets.

Second, farm-level prices for cassava entering the fresh market are normally well above the costs of production of that cassava which would be processed. Prices set in the fresh market, therefore, give the illusion of higher costs of production than really predominate. The reasons for this divergence between prices and costs are due to risk and quality factors. A

Table 27. Cost and price comparison for maize and dried cassava, 1986, Peru.

Cost/price	Maize: Coast (Intis/t)	Maize: Selva (Intis/t)	Cassava: Selva (Intis/t)
Production costs	2377	1810	994
Transport costs	300	1500	1500
Total costs	2677	3310	2494
Price[a]	3300	3300	2475

a. ENCI purchase price.

SOURCES: Malarin, 1986; Centro Internacional de Agricultura Tropical (CIAT) field data.

Table 28. Comparison of prices for sorghum and dried cassava, 1985, Venezuela.

Item	Price (Bs/t)
Dried cassava	
Production costs	1279
Price	1870
Domestic sorghum	2200
Imported sorghum	
Free exchange rate	2640
Preferential exchange rate	990

SOURCE: Centro Internacional de Agricultura Tropical (CIAT) field date.

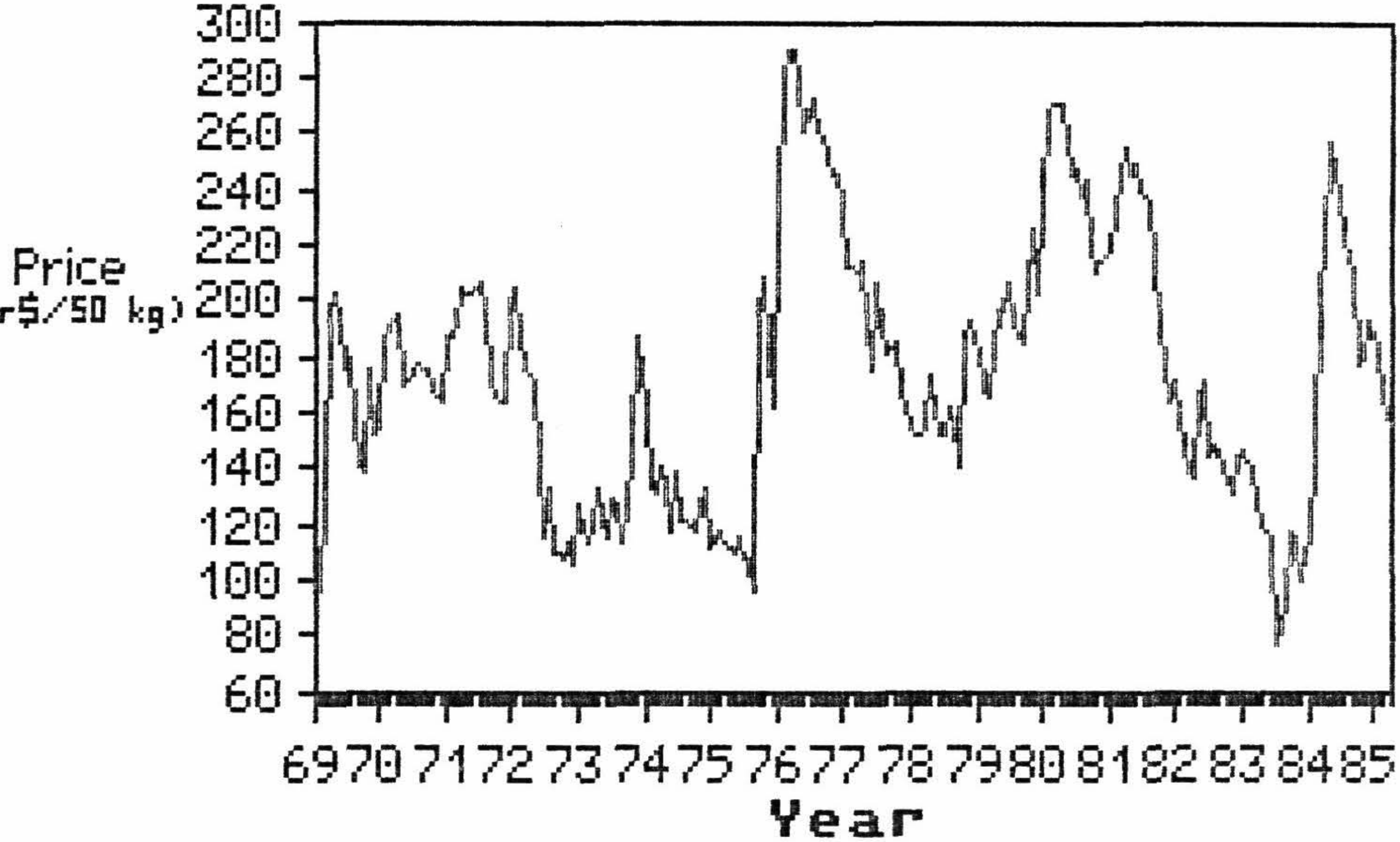
certain percentage of roots is discarded due to insufficient size. Normally, a relatively high starch content is required and factors such as insect attack or a rainfall after an extended dry period will reduce starch levels below commercial acceptance. Another risk is the rationing of market access that is found in fresh cassava markets. Farmers cannot normally sell when they want to but rather when they can. They will often sell early, sacrificing yield, in order to gain access to markets. Janssen (1986) estimated for the Atlantic Coast of Colombia that farm prices for the fresh market could be discounted by 25% to reach a price at which selling to a processing market would be equally profitable.

Finally, spatially fragmented markets where volumes entering the market are small compared to the production capacity introduce significant year-to-year price variability (significant seasonal price variability is limited because of the seasonal storage possible by leaving cassava in the ground). This interplay of supply and demand results in prices in years of relative scarcity being far above what is needed for cassava to enter the animal feed market. A unified price structure is needed for development of multiple markets. However, a shift in either supply or demand conditions in the fresh market makes returns on capital invested in processing capacity very risky, due to the inability to operate in years of high prices.

This riskiness of capital returns on processing investment also affects Brazil, where farinha dominates in price formation in cassava markets. In this case an inelastic price elasticity, declining demand induced by the wheat subsidy, and variability in production due to the marginal climatic conditions of the northeast, create a situation of significant price variability (Figure 5). This creates an uncertain environment for both farmers and prospective investors in cassava chipping and drying. For farmers any expansion in planted area, especially in a year of above average rainfall, risks driving prices down to variable costs of production. On the other hand, investment in chipping and drying capacity runs the risk of coinciding with a year of poor rainfall, high prices and inability to compete with maize in the animal feed market. Incentives on the side of the farmer and the processor run counter to each other, even though costs of production suggest acceptable profit levels for both farmers and processors.

In the case of both the fresh urban market and the farinha market, price formation has inhibited the development of alternative markets for cassava. By comparison, grains are tradeable internationally, year to year price variability is dampened by storage, and markets are spatially integrated by relatively low transport costs. Grain prices are more stable and market integration ensures a more effective transmission of incentives. However, the fact that cassava could compete in the feed rations market suggests a market failure where intervention would lead to increased production and economic efficiency.

The basis for correcting that market failure is suggested in Figure 6. Development of an alternative market such as the animal feed market provides both growth prospects and a price floor for the food market. Reduced market risk provides the incentive for farmers to expand production. Janssen (1986) gives an estimate of the response of farmers to



igure 5. Variation in the wholesale price of farinha (at constant 1977 prices), Bahia, Brazil.

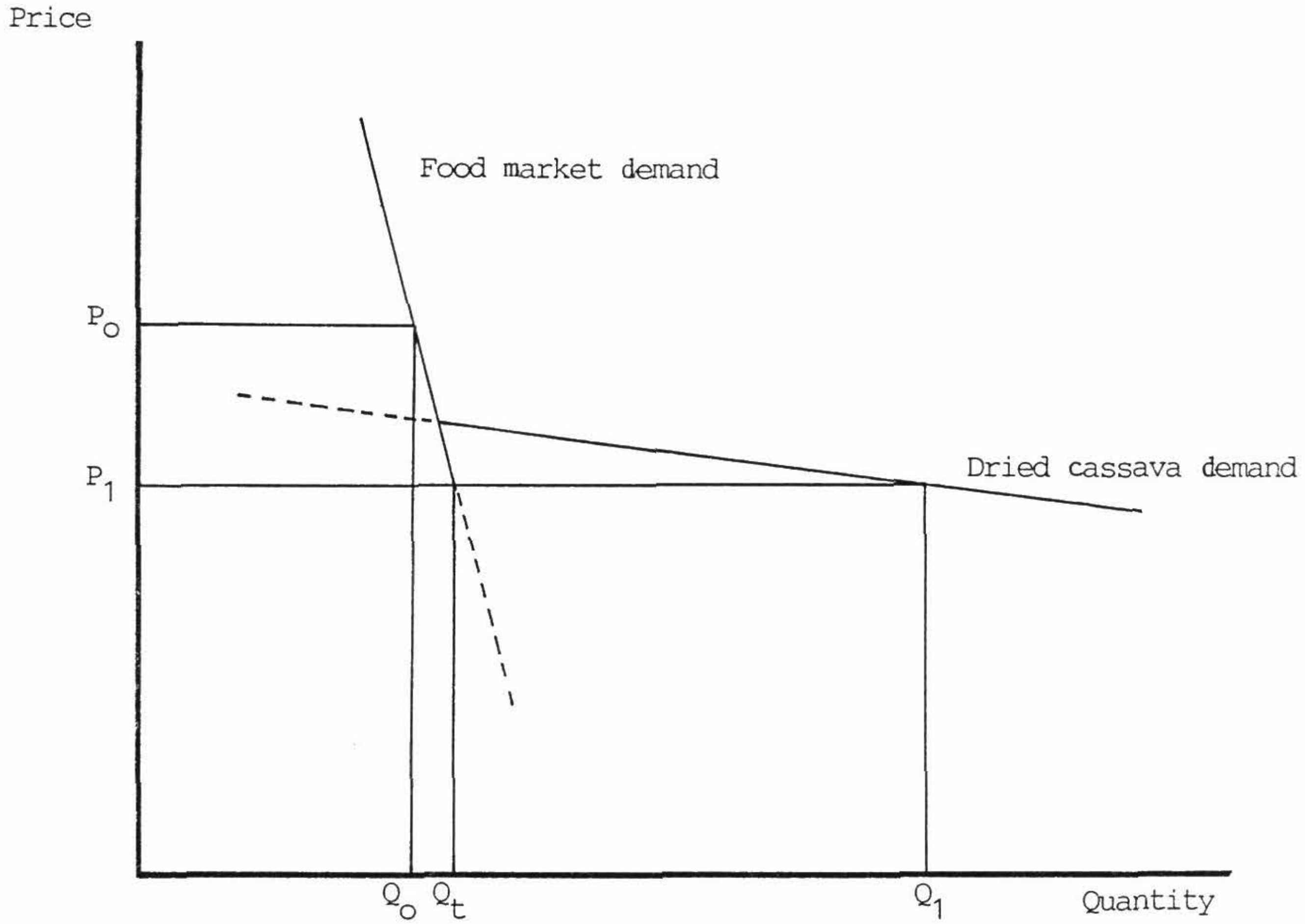


Figure 6. Representation of linking two markets and the effect of a price floor for the food market.

the development of such a floor price. On the other hand, expansion in the production base drives prices in the food market down to the floor price, thereby both stabilizing prices--with the attendant benefits for cassava consumers--and unifying prices in both markets. The key, of course, to the whole process are the investments in processing capacity that allow production to expand to that critical point where the cassava price has stabilized and is unified with the feed grain price. There are several options for accomplishing such stabilization and the options should be evaluated according to policy objectives.

The Development Potential of Cassava in Latin America

Cassava's multiple uses allow the crop to adjust to changing market conditions as economies develop and in so doing to maintain a significant elasticity in demand. Most staple food crops at critical income levels actually face declining per capita consumption but by developing alternative markets, such as that for animal feed rations, cassava is able to maintain a continued growth in market demand. Development of cassava as a component in the mixed feed industry thus opens an opportunity to use cassava as a means of income generation in typical cassava production zones. These tend to be the more marginal, agricultural regions of Latin America and, as a large World Bank study (Kutcher and Scandizzo, 1982) for northeastern Brazil concluded, such agricultural economies tend to be demand-constrained in terms of their growth prospects. This seems somewhat paradoxical until it is realized what type of and number of cropping and livestock alternatives are available to farmers in such areas. These are limited and most crops face inelastic demand. The potential of developing cassava as a major cash crop in such areas is both real and to date overlooked in areas such as northeastern Brazil or the Atlantic Coast of Colombia.

The other principal characteristic of cassava in Latin America is its production by small-scale farmers. Cassava fits well into small farm systems. Its manipulability in intercropping systems; its flexibility in planting and harvesting; and its adaptability to the lack of mechanization of principal cultural practices have contributed to its dominance in small-farm systems. However, just as important to the dominance of small farmers in cassava production is the organization of fresh root marketing or of the supply of roots to small-scale farinha plants. Harvesting small lots on a relatively continuous basis under significant marketing risk is not compatible with the management resources or (probably) risk preferences of large-scale farmers. Thus, cassava offers that rare combination of being a small-farmer crop, produced in marginal agricultural conditions, but with significant potential growth in overall demand. With these characteristics policy should be oriented to maximizing cassava's development potential in Latin America, especially as a source of increase in small farmer incomes.

Realizing cassava's development potential therefore depends on linking the small-scale producer to growth markets, particularly the feed component market. At issue then is how to motivate investment in processing capacity so as to maximize access of small-scale farmers to this market. Two design issues dominate: the scale of the processing plant, and ownership and management of the plant. Scale to a large extent will influence ownership options and both will influence the degree to which the cassava producer, himself, vertically integrates into processing and marketing of chips and pellets.

Small-scale agroindustry is rare in Latin America, especially when compared to Asia. Much of what small-scale processing is done in Latin America is done by the producer himself. Panela, cheese, farinha de mandioca, and chuno production are all cases where the farmer himself invests in processing capacity. The alternative in Latin America has been very large-scale processing plants, for example, rice-milling, sugar refining, milk and cheese processing, maize starch production and oilseed crushing. Rarely have intermediate-size, processing plants been a feature of the agricultural economy. Farinha production in parts of northeastern Brazil is one of the few examples of such intermediate processing plants. Two factors contributed to this development. First, Brazilian manufacturers designed intermediate processing machinery, such as hydraulic presses and mechanized roasting equipment. Second, cassava production itself reached a sufficient density to support specialization and economies of scale in processing. Improvements in transport infrastructure aided this process. By contrast, northern Brazil still is characterized by farinha production at the farm level.

The farinha economy of the Brazilian Northeast provides the model for the prospective cassava chip industry of Latin America. However, this chip industry must pass through various stages to arrive at such a model. The initiation must focus on stabilizing market conditions for the cassava farmer and in turn motivating his expansion in cassava production. The initial production base must be built on an integration of the farmer himself in processing. The technology of solar drying of cassava is well adapted to such an integration and moreover, makes use of underemployed labor during the off-season. Moreover, the processing plant provides the mechanisms for operation of the price floor. The farmer can expand production (whether through area expansion or yield increases) and should prices in the food market rise, he is still better off, having the funds to cover the investment in the processing plant through sales to the fresh market. Independent processors do not have such flexibility in covering the capital costs of the plant. A certain critical density of production needs to be developed before there is any movement to specialization in processing, motivated by scale economies (Lynam, 1987). The operative factor here is a sufficient density to minimize transport costs for roots, on the one hand, and the effective price linkage of the cassava root and feed grain markets, on the other. Otherwise, spatially separated, small-scale plants operated by producers will have the advantage.

Developing the market for cassava chips and pellets in Latin America requires key institutional interventions in order to overcome the particular kind of market failure inherent in lack of diversification in cassava markets. These interventions to date have been organized around pilot projects in key target regions. The initial interventions must demonstrate the economic and technical feasibility of the processing plants, create market channels to mixed feed factories, and develop plans for the backup of production increases. This process obviously requires an integrated, institutional approach in the initial stages, with institutional costs declining as the demonstration effect starts to take over. Key services are a line of credit for small-scale agroindustry, technical assistance in plant construction and management, extention services for production technology, and contract development between cassava drying plants and feed factories. Proper organization of these pilot projects can ensure that small-scale farmers are the primary beneficiaries of development of the dried cassava market (Lynam, et al., 1986).

Conclusions

Agricultural economies in tropical Latin America have undergone significant structural change in the postwar period. Changes on the production side such as massive mechanization, increased fertilizer and agrochemical use, and the advent of improved varieties in some major crops were matched by significant changes in food demand, due, principally, to rising incomes, very rapid urbanization, and major changes in the organization of food wholesaling and retailing. Changing consumption patterns and rapid demand growth in income-elastic food commodities created significant growth markets and income generation potential for domestic producers. However, in many commodities production was not able to respond quickly enough to meet rising demand, resulting in either imports or upward pressure on prices. This rapid structural change created a complex set of issues for policy makers, especially how to best utilize changing domestic demand to modernize agricultural production and yet how to ensure that food prices were kept in line to meet the needs of the burgeoning urban population and as a means of controlling inflation.

Nowhere were these issues more pronounced than in the feed-livestock sector in tropical Latin America. Expenditure on meat formed a large component of the consumer's total budget. Moreover, the relatively high income elasticity resulted in a significant growth in demand. However, growth in the supply of beef, the predominant meat in the diet of tropical Latin America, did not respond sufficiently to meet the growing demand. In part this was due to biological limits on the rate of growth in beef production and in part it was due to the reliance on extensive systems. The area in pastures expanded more or less in line with growth in cattle stock. Only in Brazil and Venezuela were there major increases in stocking rate, and even there these increases started from very low levels.

This gap between the supply and demand for beef was met, not by beef imports, but by increases in the production of alternative meats, especially poultry. Poultry production expanded at a very rapid rate in the last two decades in tropical Latin America, as production systems became more intensive and marketing systems for poultry were able to achieve significant scale economies. Real prices of poultry fell in most countries, while the price relative to beef fell even further. The poultry sector was the solution to the overall price inflation in the meat sector. First, supply was very responsive to profit incentives and meat supplies in the short-run were not constrained by biological or reproductive limits.

Second, substitution between beef and poultry was significant, with the falling price of poultry putting a lid on rising beef prices. The poultry sector made the whole meat sector more manageable and more responsive to short-run shifts in demand.

The rapid increase in poultry production resulted in numerous backward linkages to other sectors in the agricultural economy. The derived demand for feed components, especially carbohydrate sources, increased dramatically. Not all countries have exploited the opportunity created by this market to develop feed grain production (and income generation potential for feed grain producers); Moreover, all tropical Latin American countries except Paraguay have become net importers of feed grains, as production has not been able to keep up with demand. As with the diversification in meat production, one of the means to increase supplies of carbohydrate sources for the feed industry is by diversifying sources of supply. Some countries such as Colombia and Mexico have been particularly successful in developing sorghum production. Dried cassava offers another distinct, and yet unexploited, alternative for increasing supplies of feed components. Cassava will not completely replace maize or sorghum but there is a potential niche in most agricultural sectors in tropical Latin America where cassava can be competitively produced to compete with feed grains in mixed feed rations.

Latin America is at a stage in its development where diversification should be occurring in cassava markets. However, Latin America lags well behind Asia in this regard. There are many reasons for this lag but the principal factor has been that prices in cassava food markets have not been an efficient indicator of the relative profitability of investing in cassava processing capacity and price variability increased the risks of entrepreneur investment in these new markets. Linking price formation in cassava markets to feed grain markets will provide the basis for cassava to begin to take part in the development process in Latin America. However, in Latin America this requires an initial institutional intervention to form these market linkages. Moreover, cassava can be a policy tool by making the development process more equitable. Cassava is principally produced by small-scale farmers, usually in more marginal agroclimatic zones in which cassava has a comparative advantage. Linking these farms, which are characterized by both underemployed labor and land resources, to a growth market, such as exists for dried cassava, can achieve increased income in a stratum which has been increasingly marginalized in the recent growth process in Latin America.

The economic climate in tropical Latin America is now appropriate to bring cassava into the agricultural policy process. The 1982 debt crisis has resulted in major realignments in foreign exchange rates, reductions or elimination of subsidies, and a renewed emphasis on increasing domestic production and reducing imports. Except for Venezuela, cassava is now competitive with feed grains under existing grain pricing policies. Demonstrating that cassava can be a vehicle for raising labor and land productivity in marginal agricultural zones, in increasing small farmer incomes, and in reducing feed grain imports will ensure, in the future, that cassava will be a component in overall agricultural planning. Cassava adds flexibility to this planning process and it provides a cropping alternative especially adapted to tropical conditions. The niche is there; it remains only to be exploited.

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COUNTRY STUDIES

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BRAZIL: ECONOMIC STUDY OF CASSAVA

Demand Studies in Brazil

Introduction

Brazil is the world's largest cassava producer with a total production comprising 16% of world production and close to 80% of Latin American production. Historically cassava has played a fundamental role in Brazil as a source of carbohydrates for human consumption and as a source of employment and income in the poorer rural areas especially in the northeast. It has certain inherent characteristics that have made it an important crop grown in all areas of Brazil: it has very high productivity per unit land area; it is well adapted to adverse climatic and soil conditions; it has no fixed planting date or time of harvest; it can be harvested when needed over a long period of time; and it rarely fails as a crop.

In the last 15 years however the rate of increase in cassava production has not kept up with rapid urbanization and industrialization. Cassava production and utilization patterns have not changed to meet the new requirements of an urban, industrial society. This trend has been aggravated by government policies that have favored export crops such as soy and grain crops at the expense of traditional staples such as cassava and beans. These trends are disturbing as they have had potentially negative effects on the nutritional level of the poorer segments of the population and the income level of the small farmers who produce these staples.

In order to understand how cassava will fit into the agroeconomy of Brazil in the coming years it is necessary to analyze the production processing and marketing of cassava.

The diversity of climatic, edaphic, and social conditions in Brazil is great, ranging from the tropical rain forest of the underdeveloped northern region, through the very poor semi-arid areas of the northeast to the subtropical and relatively advanced southern states. These differences indicate that no single study can adequately cover this variability and hence the studies presented in this document are on a regional basis.

Objectives

The objective of these studies is to determine how cassava can fit into the Brazilian agricultural economy in the future in such a manner that it assists the country in reaching policy goals such as improved welfare of the rural community and increased availability of low-priced food to the population as a whole.

The specific objectives of the study are:

1. Analyze the current and potential role of cassava for human consumption with special attention to the country's nutritional policies.

2. Evaluate the income generation and employment opportunities created by cassava production and processing.

3. Describe the current and potential incorporation of cassava into animal feed.

4. Identify the regions where cassava production can be expanded and the markets which it will enter.

Information sources

This study is based on two principal sources of information. Firstly the demand side analysis is based on the Instituto Brasileiro de Geografía e Estatísticas (IBGE) Survey of household expenditure and consumption. In order to avoid bias caused by grouping of the data in the published reports, this analysis is based on the raw data obtained from the IBGE tapes. Secondly the supply-side analysis is founded on the EMBRAPA, EMBRATER, and CIAT farm survey carried out on 1200 farms. These farms where carefully selected using modern statistical-sampling techniques to ensure an adequate coverage of the wide range of conditions encountered in Brazil. In this manner it is felt that interpolation can be made to areas not covered in the survey. The survey data where collected in Rio Grande do Sul, Santa Catarina, Parana, Minas Gerais, Bahia, Pernambuco, Maranhao, and the Federal Territory of Parana.

Document layout

This first chapter serves as the introduction to the studies. The second chapter briefly summarizes the recent developments in the Brazilian agricultural sector with special emphasis on agricultural policies and on the balance between food production and exports.

The third chapter analyzes trends in cassava for human food and its future potential role. The fourth chapter turns to an analysis of the rapidly expanding animal feed industry and the fifth chapter looks at the supply side concentrating on production and processing aspects.

The sixth chapter concentrates on the cost structure of cassava production and processing and sets this in the framework of cassava's future role as a source of rural income and its contribution to food and feed supply.

Finally in chapter seven conclusions and recommendations are presented.

Special terminology

In this document the use of the word "farinha" is used for the special toasted cassava meal or flour used throughout Brazil. The word "aipim" is used for cassava that is eaten in the fresh form. This cassava is sweet, with a low HCN level as opposed to the roots used in the production of farinha or starch.

Agricultural Policy in Brazil

1950-1963

In the fifties and the early years of the sixties economic development policies were directed to stimulating the growth of the industrial sector and the substitution of manufactured imports. In order to achieve this policy goal, policies favored the industrial sector at the expense of the agricultural sector.

The cruzeiro was overvalued, food prices were controlled at low levels, and agricultural exports were restricted. These policies were coupled with the freezing of urban salaries, strict control of the price of basic agricultural products, and restrictions on the importation of agricultural inputs. These policies, which were designed to increase the rate of growth of the industrial sector, restricted the growth of the agricultural sector due to a negative effect on demand (e.g., through low salaries in the urban sector) and also to problems on the supply side (e.g., lack of availability of inputs).

These negative effects were to a certain extent mitigated by subsidies to fertilizers and other inputs for grain crops and traditional export crops such as coffee. Furthermore, the large areas of unexploited frontier lands and low-cost rural labor allowed the agricultural sector to subsist and even expand during this period.

1964-1972

In this period policies began to change in a manner that favored the agricultural sector. The cruzeiro was subject to a series of small devaluations; quality control on exports of agricultural goods were relaxed and other tariff barriers were reduced. In addition the price controls on food products were reduced and subsidized credit was made available to the agricultural sector. This credit beared negative real interest rates and compensated for the high price of agricultural inputs and the high price of rural labor that resulted from the rapid rural to urban migration in this period. Cheap credit and high labor costs resulted in rapid mechanization and increases in the use of inputs. This change occurred in those crops that responded to mechanization and heavy use of inputs--principally, crops that were grown by the farmers in the richer southern states. Thus crops such as soy were favored over the traditional crops such as tree cotton, cowpea, and cassava grown in the poorer states of the northeast.

On the demand side a series of factors began to stimulate the agricultural sector. World prices for agricultural prices were high thus making export an attractive option. It was at this time that the exportation of soy bean began to grow rapidly. Internally the growth of the industrial sector created increased purchasing power in the urban sector with its positive impact on the demand for agricultural products.

In addition the government indicated that the future development of Brazil lay in the vast unexploited central western region and established the city of Brasilia in this area. This region developed rapidly whist the northeast in spite of its high population and low level of development was largely neglected and did not share in the development taking place in the rest of Brazil.

1973-1979

The oil crisis in the early seventies renewed the fears of excessive dependence on the state of the world economy. To this was added rapid inflation. These two factors induced the government to adopt measures that tended to decrease imports and increase the exports from the industrial sector. Once again this provoked a new recession in the agricultural sector. In order to compensate, the policies for subsidized credit were maintained and there was a rapid increase in the research and extension efforts in the agricultural sector. Minimum prices were established for certain agricultural products and the wheat subsidy program was initiated. All these measures tended to favor the richer southern states and the larger farmers.

The overall economic development of Brazil was rapid in this period due to the rapid increase in manufactured exports, and easy access to international credit.

1980-1984

Repeated cuts in the supply of petroleum products by OPEC and the resulting increases in oil prices coupled with fears about protectionism in the developed countries reinforced Brazilian consciousness of their vulnerability to external factors that effect their development process. This was further increased by the enormous external debt and high interest rates. The government turned to the agricultural sector to assist in alleviating the critical economic situation in which the country found itself. The production of alcohol to replace imported oil was a component of this policy.

In addition, for the first time the government began to turn to the objective of stimulating the production of food crops (other than wheat which was subsidized heavily in the seventies) rather than seeing the agricultural sector mainly as a means of reducing the balance of payment deficits through export crops.

1985-1986

In 1985, the civilian government was installed in Brazil. This has brought with it an increased awareness of social goals in the formation of policies. Of particular concerns are the low nutritional level of millions of people, the low level of development in the North East, the skewed distribution of land holdings, and the ravages of the rampant inflation that has plagued Brazil in the last decade. The agricultural sector is seen as critical in reaching more equitable development in Brazil in the coming years.

As a result the government has set the target of improving the nutritional situation through increased production of food crops; rice, beans, cassava, and maize have been set as priority crops. Credit will be expanded in such a manner that the small- and intermediate-sized producer (traditionally the major food producer) have access to it. As a further stimulus to the producer the minimum price policy has been reactivated. Furthermore, the government is committed to a land-reform program that will be supported by integrated rural-development projects. Whilst in the past emphasis has been on the export crops in the south, present policies are geared to developing the agricultural frontier and the so often neglected northeast. This program will not only concentrate on the production side but will also assist in the development of infrastructure, education, marketing, and other aspects necessary for the development of the region. A special program has been established for this area with support from the Ministry of Irrigation to facilitate the rapid implementation of irrigation projects in the area. These are expected to be of the order of US$19 billion over the next 15 years.

At present these policies are to a certain extent negated by the rigid price controls that form part of the temporary plan Cruzado that has drastically reduced inflation. Nevertheless the present policies favor the food crops such as cassava that are produced by the smaller farmers in a manner that is unique in the recent history of Brazil.

Human Cassava Consumption

Demand estimations

Consumption and expenditure surveys are very scarce in Brazil, mainly because they are quite costly and take a lot of human resources for a reasonable job. Given the lack of time-series data on patterns of consumption and expenditure on food, the most common alternative to analyze the effects of policy changes and other structural changes over food consumption patterns over time is through estimation of demand functions which relate quantity consumed to relative food prices, income, and other socioeconomic indicators. Indeed, several demand estimations had been done in the past based on the ENDEF study (i.e., A.F. Filho, 1980; C.W. Gray, 1982; P. Musgrove, 1986). Unfortunately, there exist some problems with these studies that limits their use for our work. First, most of them are based on the aggregate data reported in the ENDEF publications (C.W. Gray, 1982). Second, the commodities studied are in highly aggregate groups (M. Wuelfinghoff, 1980), that does not relate to our specific purposes. And third, some studies just refer to one region (A.F. Filho, 1980; P. Musgrove, 1986).

The present research overcomes these three limitations. In order to avoid bias problems caused by the grouping of data in the ENDEF reports, this study uses as data the raw data on consumption and expenditures by individual families, obtained from the IBGE tapes. Because of the objectives of the present study, we will only concentrate on the individual demand of three food commodities: cassava flour, wheat, and rice. Finally, the analysis is done on a regional basis, and urban and rural locations.

The consumption model

Several behavioral demand functions have been reported in the literature. The most-widely used and best known are the log-linear, the double-log, and the double-log quadratic form of the Engel function. One limitation of the first two is that the income elasticity of a particular food is constant regardless of the income level of the consumer. Timmer and Alderman (1979), first used the double-log quadratic to test the consistency of income elasticity, and since then it has been widely used by other studies to overcome this particular problem.

There has also been the argument that demand-price elasticities vary among different income groups, and unless one applied these functional forms individually to each income group they are not useful to test this hypothesis. Use of this method however, is very limited depending on the possibility of having a large number of observations for every income stratum. Philip Musgrove (1986), solved this problem by using the double-log form and adding a new term to the right-hand side of the model, N*P/E, which he labeled the "inverse of maximum per capita consumption," where N represents the number of persons in the family; P, is the price of the particular food; and E, is the expenditures of the family, used to represent income. Therefore, this allows both the income and price elasticities to vary at different income levels.

Certainly it is commonly agreed upon among economists, that demand functions should be estimated accordingly to demand theory. That is, the demand for a particular commodity is a function of its own price, the vector of prices of other commodities, the income of the consumer, and other characteristics representing the taste and preference of the consumer. As mentioned above, however, there is no agreement on the functional form. Perhaps, the most reasonable approach, would be to use the translogaritmic (or translog) demand function developed by L.R. Christensen, D. W. Jorgenson, and L. J. Lau (1973), which is interpreted as a second-order approximation to any demand function. Our plan is to use this flexible function, which places no restrictions on the price and income elasticities, in such a way that we allow them to vary at different income levels, and at the same time, we don't make any arbitrary assumption about the true functional form. That is, a second order approximation to any fuction is:

$$Y = f(X),$$

where,

$X = (x_1, x_2, \ldots, x_n)$, is the Taylor Series Expansion,

such that,

$$Y(X) = f\ (x^*) + \sum_{i=1}^{n} (df/dx_i)\Big|_{x^*} (x_i - x_i^*)$$

$$+ 1/2 \sum_{i=1}^{n} \sum_{j=1}^{n} (d^2f/dx_i dx_j)\Big|_{x^*} (x_i - x_i^*)(x_j - x_j^*),$$

where,

$X^* = (x_1^*, x_2^*, \ldots, x_n^*)$ is the point around which Taylor's approximation is taken.

Therefore, our translogaritmic demand function will be:

$$\ln Qs = Bo + \sum_{i=i}^{4} Bi \ln Xi + \tfrac{1}{2} \sum_{i=i}^{4} \sum_{j=i}^{4} Bij (\ln Xi)(\ln Xj)$$

$$+ Bn (\ln N) + \text{the error term},$$

for all (s = 2,3,4) and (i,j = 1,2,3,4)

where,

$$Bo = f(x^*)$$

$$Bi = (df/dxi)\Big|_{x^*}$$

$$Bij = (d^2f/dx_i.dx_j)\Big|_{x^*} = (d^2f/dx_j.dx_i)\Big|_{x^*} = Bji$$

and Bij = Bji are imposed by the equality of cross-partial derivatives in a quadratic equation where:

Qs = is the quantity consumed of the good s-th by the family,

X_1 = is the annual money expenditures of the family, used as a proxy for family income,

X_2 = is the price of rice,

X_3 = is the price of wheat,

X_4 = is the price of cassava flour, and

N = denotes the size of the family, which is measured in adult-units.

(from now on let's denote the subscipts (1,2,3,4) as m=for money income; r=for rice, w=for wheat; f=for cassava flour).

Here, both family expenditures and food prices, were transformed into real values (Cr$ of 1977), enabling us to make inferences about income and prices changes over time. The family size was included in the model as another plausible variable affecting the family-consuming behavior. In statistical terminology, the parameter, B_n, will affect only the estimation of the intercept.

The income elasticity for the particular food, is defined as:

$$E_{Qi,\ I} = d(\ln Q_i)/d(\ln I) = B_m + B_{mm} (\ln I) + \tfrac{1}{2} \sum_i Bmi\ (\ln Pi),\ \forall: (i \neq m\ \&\ i=r,w,f)$$

The own-price elasticity, is defined as:

$$E_{Qi,Pi} = d(\ln Qi)/d(\ln Pi) = Bi + Bii\ (\ln Pi) + \tfrac{1}{2} \sum_j Bij\ (\ln Pj),\ \forall: (j \neq i\ \&\ i,\ j=r,w,f)$$

The cross-price elasticity, is defined as:

$$E_{Qi,Pj} = d(\ln Qi)/d(\ln Pj) = Bj + Bjj\ (\ln Pj) + \tfrac{1}{2} \sum_i Bij\ (\ln Pi),\ \forall: (i \neq j\ \&\ i,j=r,w,f)$$

This model was applied to each individual family observation obtained from a subsample of 2000 observations from the IBGE tapes. In order to keep the most possible homogeneous consumer groups, the observations were classified by region, and urban and rural location. This classification was shown to be useful, since there clearly exists a wide difference in taste and preferences among regions and urban-rural locations of Brazil. Finally, because the ENDEF survey was applied to each household over a period of only one week, some observations had missing data on the consumption of a particular food and/or its own price. To overcome this problem, it was decided to use only those observations that show consumption for the particular food that was being analyzed. With respect to the problem of the missing prices, it was resolved to use the zero-order regression estimators method (J. Kmenta, 1971), which reduces to use the average value for the missing independent variable, so that the parameters estimated remain unbiased and do not affect variance.

The estimation results

Tables 1, 2, and 3 contain the parameter coefficients estimated for the translog demand functions. The number of observations for different commodities varies because of the missing data problem mentioned above. In general the F-values and the standard errors are significant at the 5% confidence level for most of the regressions, with some exemptions in the parameters corresponding to the cross price products (Bij's). This was expected because of the little variation in relative food prices that is often found in cross-sectional data. As was also expected, the estimations for the parameter (Bn) were statistically significant in all of the regressions, clearly reflecting an increase in food consumption with increases in the family size.

Income and price elasticities, were calculated on the basis of minimum salary groups, where one minimum salary in the year 1975--when the ENDEF survey was applied (in real values of 1977)-- was equal to Cr$841.43 in the northeast, Cr$996.17 in the southeast, and Cr$1073.54 in the south. Elasticities estimated for rice, wheat, and cassava flour, are reported in tables 4, 5, 6, and 7. Lets make some general remarks with regard to these elasticities, and their implication to some nutritional policy issues, such as, income transfers and price subsidies.

First, the income elasticities for the three food products, among the lower income brackets tend to be rather small (less than 1), meaning that the demand for these commodities increases proportionally less than increases in income. Indeed the ENDEF data suggest that people tend to increase the variety of their meals as income increase. This means that even though there exist deficits in calorie intake particularly among the poorest, increases in their income will result in a tendency to increase their demand for more expensive foods, like meats for example (as it has been shown in past studies; i.e., C.W. Gray, 1982; P. Musgrove, 1986). The ENDEF data show that the need to increase nonfood items (i.e., clothing and housing) is as important as an increase in food quality. Therefore, any policy related to direct income transfers with the goal to increase calorie consumption among poor people, may be

Table 1. Regression estimates for cassava flour, Brazil.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Observations	89	44	140	62	143	413	29
R-sor	0.4044	0.4519	0.4608	0.247	0.4138	0.3084	0.82
F-value	3.30	1.54	7.06	1.01	5.97	11.80	3.94
Aver. prices:							
Rice	1.83	1.80	2.17	1.90	1.92	1.96	2.15
Wheat	2.06	1.67	2.94	2.36	2.48	2.50	2.38
Cassava flour	0.80	0.82	1.03	0.81	0.75	0.76	1.71
Bo	-4.1781	-32.7346	9.3619	-16.4418	-1.5132	1.5349	-23.8125
(std error)	(9.0873)	(21.8507)	(12.0260)	(28.2733)	(4.7059)	(3.2265)	(17.2601)
Bn	0.9879	1.1682	1.2707	1.1085	0.8233	0.8013	1.0515
(std error)	(0.2839)	(0.4596)	(0.1698)	(0.4730)	(0.1317)	(0.0845)	(0.2238)
Bd	1.5309	6.2600	-1.7337	4.1352	2.1214	1.5373	4.9142
(std error)	(1.5132)	(3.4775)	(2.0011)	(4.9519)	(0.8364)	(0.5270)	(2.7373)
Br	-1.5886	11.1366	2.7484	12.1303	5.9426	0.2616	3.9042
(std error)	(10.5569)	(23.1493)	(7.8935)	(15.2631)	(4.1520)	(2.9091)	(16.4005)
Bw	4.5854	7.3554	6.0256	-4.0901	-9.2365	-5.2792	10.9881
(std error)	(3.7788)	(10.5005)	(5.5814)	(11.4706)	(4.1717)	(2.3704)	(10.7977)
Bf	-1.5987	-9.7008	-6.4366	-3.4660	-0.2698	-0.4315	-0.1120
(std error)	(5.5193)	(14.6257)	(3.9304)	(12.3416)	(1.8049)	(1.0534)	(10.0258)
Bdd	-0.1065	-0.4616	0.2165	-0.3206	-0.2652	-0.2365	-0.3887
(std error)	(0.1441)	(0.2766)	(0.1877)	(0.4381)	(0.0929)	(0.0562)	(0.2651)
Brr	3.9485	9.9497	-3.0412	13.9185	-0.6677	-0.0368	-7.2212
(std error)	(4.6058)	(13.4288)	(3.5100)	(7.5162)	(0.4703)	(0.3984)	(9.2557)
Bww	2.8707	5.1237	-3.7459	4.8060	2.9465	-1.2836	-5.5389
(std error)	(1.6821)	(3.7164)	(1.5814)	(2.6063)	(2.3260)	(0.8517)	(4.8236)
Bff	-0.8728	3.0834	-0.8451	1.4840	-0.1595	-0.2704	-6.2628
(std error)	(1.7931)	(3.6110)	(1.0526)	(4.0013)	(0.5622)	(0.2792)	(4.8554)
Bdr	-0.5383	-3.7066	-0.9994	-4.3447	-1.3172	-0.2482	-0.7340
(std error)	(1.9285)	(4.1385)	(1.3306)	(3.2707)	(0.6949)	(0.4975)	(2.9595)
Bdw	-1.7169	-2.0038	-1.1601	-0.3752	1.2856	1.2084	-1.9024
(std error)	(0.7054)	(1.9269)	(1.1249)	(1.9214)	(0.7349)	(47.5200)	(1.9097)
Bdf	0.7539	2.8702	0.1746	0.9165	0.0815	0.1180	-0.4738
(std error)	(1.0266)	(2.5742)	(0.6802)	(2.5458)	(0.3109)	(0.2127)	(1.7191)
Brf	-4.5041	-4.7233	11.4219	1.3869	-0.5342	-1.6287	12.7615
(std error)	(8.1634)	(33.3785)	(3.3274)	(8.6885)	(1.6818)	(1.1822)	(11.8394)
Brw	6.0007	-1.1759	11.7837	4.4122	1.5069	2.0955	6.0958
(std error)	(5.5055)	(10.0635)	(6.4244)	(10.9203)	(3.9913)	(2.2930)	(12.1477)
Bwf	-5.3674	-11.7992	1.7981	-2.3920	-1.3712	-0.2802	1.3931
(std error)	(2.5140)	(7.1276)	(2.6599)	(8.7573)	(2.3632)	(0.9050)	(5.8766)

Table 2. Regression estimates for wheat, Brazil.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
Observations	123	157	423	174	427	191	31
R-sor	0.509	0.4721	0.5137	0.4728	0.5306	0.3039	0.8885
F-value	7.39	8.40	28.66	9.44	30.97	5.09	7.96
Aver. prices:							
Rice	1.81	1.80	2.17	1.90	1.96	1.95	2.15
Wheat	2.36	1.67	2.94	2.36	2.50	2.58	2.38
Cassava flour	0.72	0.82	1.03	0.81	0.76	0.71	1.71
Bo	-0.2480	-4.9736	-12.5351	-5.6493	-5.9903	-9.0911	1.2003
(std error)	(4.7312)	(5.8638)	(3.5376)	(6.7106)	(3.1483)	(9.4965)	(10.5508)
Bn	0.6959	0.3059	0.6652	0.6260	0.2727	0.3685	0.7295
(std error)	(0.1154)	(0.1371)	(0.0450)	(0.1411)	(0.0784)	(0.1501)	(0.1563)
Bd	1.7919	1.9466	3.0821	1.7367	1.3866	1.8485	0.3622
(std error)	(0.8412)	(1.0544)	(0.6195)	(1.1572)	(0.5319)	(1.6931)	(1.5220)
Br	-3.4238	1.1393	0.4415	-4.6266	0.9259	6.2973	5.0793
(std error)	(4.2830)	(4.7508)	(2.5193)	(5.9105)	(3.0215)	(8.9778)	(10.8597)
Bw	-3.1924	-1.9773	0.5379	0.5272	3.5274	2.4206	-4.4090
(std error)	(1.9175)	2.0640	(1.6560)	(2.3901)	(1.8943)	(3.1722)	(4.8455)
Bf	7.5952	-9.6428	1.0565	-9.1881	2.4007	-0.9093	-0.5917
(std error)	(4.3522)	(7.8165)	(1.9579)	(5.1193)	(1.3103)	(3.0769)	(6.7394)
Bdd	-0.1955	-0.1459	-0.2476	-0.1520	-0.0579	-0.0712	0.1016
(std error)	(0.0868)	(0.1033)	(0.0614)	(0.1088)	(0.0567)	(0.1828)	(0.1395)
Brr	0.0797	-1.8561	-0.0144	-1.0862	-1.1593	-2.1904	5.5720
(std error)	(2.1668)	(1.4035)	(0.4442)	(3.0897)	(0.4073)	(2.5281)	(6.4174)
Bww	-0.6386	-1.6949	-0.1981	-1.3816	-1.9473	-1.0525	0.2402
(std error)	(0.5078)	(0.7916)	(0.6419)	(0.5488)	(0.6999)	(0.8938)	(2.7959)
Bff	-1.7854	-2.7471	-0.0949	0.0288	0.1486	0.6433	4.6072
(std error)	(1.9737)	(1.9556)	(0.4779)	(1.6124)	(0.3206)	(0.5777)	(3.2272)
Bdr	0.5510	-0.2819	-0.1655	1.0702	0.1371	-1.2372	-2.2303
(std error)	(0.7632)	(0.9265)	(0.4731)	(1.2093)	(0.5516)	(1.8193)	(1.9075)
Bdw	0.3331	0.2871	-0.2170	0.1065	-0.4359	-0.4646	-0.0652
(std error)	(0.3459)	(0.4098)	(0.3289)	(0.4517)	(0.3612)	(0.6738)	(0.7699)
Bdf	-0.6251	2.4058	-0.1709	1.6411	-0.5743	0.1671	-0.2359
(std error)	(0.7249)	(1.5271)	(0.3370)	(1.1462)	(0.2574)	(0.7101)	(1.1852)
Brf	-3.6031	-7.2080	-0.2185	-2.2443	1.2668	0.0099	-2.5670
(std error)	(4.4708)	(12.5190)	(1.6520)	(4.3830)	(1.3801)	(3.8831)	(7.2729)
Brw	-0.7054	1.6833	0.9779	1.3765	-1.6384	0.5723	8.3997
(std error)	(1.9698)	(1.5329)	(1.5911)	(2.0953)	(1.7858)	(2.7468)	(7.3948)
Bwf	-8.4319	2.1433	0.1042	3.2392	0.8617	1.9777	1.1721
(std error)	(2.7848)	(3.5075)	(1.3349)	(3.2114)	(0.9056)	(1.4916)	(4.0396)

able 3. Regression estimates for rice.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
bservations	280	111	792	127	362	151	11
-sqr	0.3805	0.3147	0.5355	0.3974	0.3211	0.3301	
-value	10.81	2.91	59.64	4.88	10.91	4.43	
verage prices:							
Rice	1.83	1.80	2.10	1.90	1.96	1.95	2.14
Wheat	2.06	1.67	2.82	2.36	2.50	2.58	2.07
Cassava flour	0.80	0.82	0.96	0.81	0.76	0.71	1.64
Bo	1.7738	-4.0124	-4.1560	-27.3292	-4.4727	-11.8834	
std error)	(3.1736)	(7.3930)	(1.7573)	(8.9034)	(4.6664)	(11.9005)	
Bn	0.8903	0.6227	0.9546	0.6698	0.6007	0.5606	
std error)	(0.0830)	(0.1825)	(0.0361)	(0.1763)	(0.0998)	(0.2110)	
Bd	1.1797	2.8619	1.9532	7.1052	1.0910	2.6845	
std error)	(0.5859)	(1.3659)	(0.3564)	(1.7538)	(0.8378)	(2.2182)	
Br	-3.0619	-6.4680	-2.6288	-9.4034	-0.2631	7.0696	
std error)	(2.2674)	(4.9827)	(1.2766)	(4.7290)	(2.5078)	(6.0501)	
Bw	-0.8006	-4.9790	2.3551	4.1205	7.2546	3.7806	
std error)	(1.2147)	(2.9968)	(0.8472)	(3.1101)	(3.0071)	(6.8428)	
Bf	6.6094	15.7217	1.1342	-2.7340	-0.7340	2.0432	
std error)	(2.9129)	(9.9990)	(1.1331)	(5.7819)	(2.1104)	(4.2967)	
Bdd	-0.1529	-0.3652	-0.1832	-0.7217	-0.0488	-0.2256	
std error)	(0.0586)	(0.1351)	(0.0394)	(0.1837)	(0.0870)	(0.2341)	
Brr	-1.0701	-0.4189	-0.4108	1.7206	-1.0586	-3.4917	
std error)	(0.9923)	(1.5447)	(0.3975)	(2.7248)	(0.3970)	(2.2939)	
Bww	-0.2024	-0.6997	0.3385	0.7529	-0.6831	-0.9695	
std error)	(0.4510)	(1.0584)	(0.3459)	(0.9217)	(1.0139)	(1.4145)	
Bff	-0.8308	2.1133	-0.1340	-2.7850	0.1887	0.8726	
std error)	(0.9106)	(2.1884)	(0.3734)	(1.6690)	(0.5179)	(1.1451)	
Bdr	0.4515	1.0705	0.4382	1.3009	0.2390	-1.0613	
std error)	(0.4231)	(0.9721)	(0.2462)	(1.0109)	(0.4531)	(1.2498)	
Bdw	0.3116	1.1802	-0.5831	-1.1055	-0.8997	-0.0656	
std error)	(0.2400)	(0.5791)	(0.1835)	(0.6294)	(0.5569)	(1.4680)	
Bdf	-1.1271)	-2.8852)	-0.5493	0.0901	0.0554	-0.4969	
std error)	(0.5408)	(2.0053)	0.2263	(1.2638)	(0.3752)	(0.8576)	
Brf	-7.0974	-4.7346	1.3179	-0.8023	-1.6480	-0.2134	
std error)	(4.1771)	(13.9998)	(1.1597)	(3.9505)	(1.1972)	(2.7059)	
Brw	-0.0328	1.2686	1.0558	3.4542	-4.6509	-4.9947	
std error)	(0.9703)	(1.6747)	(0.8171)	(2.2254)	(1.8799)	(3.1242)	
Bwf	3.4228	2.8383	0.0273	6.0404	2.6816	1.4046	
std error)	(1.3899)	(4.5447)	(0.8171)	(4.2238)	(1.6245)	(2.8267)	

Table 4. Price and income elasticities for fresh cassava[a].

	Fresh cassava			
	Northeast		South and southeast	
	Urban	Rural	Urban	Rural
Income elasticities (by salary class)				
SC= 1/2 minimum salary	2.7109	2.6529	2.6824	2.6228
1/2< SC=<1 minimum salary	2.5939	2.5297	2.5654	2.4991
1< SC=<2 minimum salary	2.4769	2.4056	2.4484	2.3755
2 < SC=<5 minimum salary	2.3222	2.2421	2.2937	2.2120
Price elasticities				
Own price	-1.8776	-1.8776	-1.8776	-1.8776
Price of rice	-1.8968	-1.8968	1.8968	1.8968
Price of wheat	1.4937	1.4937	1.4937	1.4937
Price of potatoes	0.2442	0.2442	0.2442	0.2442

a. Model: Log Q = Bo+Log Inc+Log Sqr-Inc(1+dummy rural)
+sum (log prices)

R-sqr = .6077 and No.OBS=153

Where parameters estimated were:

	Intercept	Cassava	Rice	Wheat	Potatoes
Estimate	-18.8697	-1.8776	-1.8968	1.4937	0.2442
Std error	14.0865	0.3857	0.4117	0.2871	0.2594

	Income	Incom-sqr	Rural (INC-sqr)
Estimate	3.7308	-0.0844	-0.0048
Std error	1.4465	0.0376	0.0005

Characteristics:

a. Mean cells (for consumption and expenditure) as observations

b. Dummy variables were used for rural/urban areas

c. Double-Log function

ble 5. Income and price elasticities for rice.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
come:							
/2 min salary	0.213	0.562	0.225	0.763	0.335	0.460	0.335
1 min salary	0.107	0.309	0.099	0.263	0.302	0.304	0.302
2 min salary	0.001	0.056	-0.028	-0.238	0.268	0.148	0.268
5 min salary	-0.139	-0.278	-0.196	-0.899	0.223	-0.059	0.223
8 min salary	-0.210	-0.450	-0.282	-1.238	0.200	-0.165	0.200
n price:							
/2 min salary	-0.949	-1.225	-0.508	-1.075	-1.861	-2.117	-1.861
1 min salary	-0.792	-0.854	-0.356	-0.624	-1.778	-2.485	-1.778
2 min salary	-0.636	-0.483	-0.204	-0.174	-1.695	-2.853	-1.695
5 min salary	-0.429	-0.008	-0.003	0.000	-1.586	-3.339	-1.586
8 min salary	-0.323	0.000	0.000	0.000	-1.530	-3.589	-1.530
ice of wheat:							
/2 min salary	0.028	-0.071	0.562	0.433	0.860	0.674	0.860
1 min salary	0.136	0.338	0.360	0.094	0.548	0.651	0.548
2 min salary	0.244	0.747	0.158	-0.334	0.236	0.628	0.236
5 min salary	0.386	1.288	-0.109	-0.840	-0.176	0.598	-0.176
8 min salary	0.460	1.565	-0.246	-1.100	-0.387	0.583	-0.387
ice of farinha:							
/2 min salary	0.554	0.986	0.472	0.456	0.144	0.048	0.144
1 min salary	0.163	-0.013	0.386	0.487	0.163	-0.124	0.163
2 min salary	0.163	-0.013	0.386	0.487	0.163	-0.124	0.163
5 min salary	-0.353	-1.335	0.272	0.529	0.188	-0.352	0.188
8 min salary	-0.618	-2.013	0.213	0.550	0.201	-0.469	0.201

ble 6. Income and price elasticities for wheat.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
come:							
'2 min salary	0.486	0.419	0.745	0.631	0.818	0.579	0.283
1 min salary	0.351	0.318	0.574	0.526	0.778	0.530	0.354
2 min salary	0.215	0.217	0.402	0.420	0.738	0.481	0.424
5 min salary	0.036	0.083	0.175	0.281	0.685	0.415	0.517
8 min salary	-0.056	0.014	0.059	0.210	0.658	0.382	0.565
n price:							
'2 min salary	-1.104	-1.305	-0.239	-0.096	-0.785	-0.705	-0.949
1 min salary	-0.989	-1.206	-0.314	-0.059	-0.935	-0.866	-0.972
2 min salary	-0.873	-1.106	-0.389	-0.022	-1.087	-1.027	-0.995
5 min salary	-0.721	-0.975	-0.489	.000	-1.287	-1.240	-1.024
8 min salary	-0.643	-0.907	-0.540	.000	-1.389	-1.349	-1.040
ice of rice:							
'2 min salary	-0.671	-0.041	0.235	0.157	-0.194	-0.171	2.789
1 min salary	-0.480	-0.139	0.177	0.528	-0.147	-0.599	2.016
2 min salary	-0.289	-0.236	0.120	0.898	-0.099	-1.028	1.243
5 min salary	-0.037	-0.366	0.044	1.389	-0.036	-1.595	0.221
8 min salary	0.093	-0.432	0.005	1.640	-0.004	-1.886	-0.303
ice of farinha:							
'2 min salary	0,751	-0.116	0.282	-1.388	0.732	0.523	0.400
1 min salary	0.535	0.717	0.223	-0.820	-0.533	0.581	0.318
2 min salary	0.318	1.551	0.164	-0.251	0.334	0.639	0.236
5 min salary	0.032	2.653	0.085	0.501	0.071	0.715	0.128
8 min salary	-0.115	3.219	0.045	0.886	-0.064	0.755	0.073

ble 7. Income and price elasticities for cassava flour.

	South		Southeast		Northeast		North
	Urban	Rural	Urban	Rural	Urban	Rural	Urban
come:							
'2 min salary	-0.2703	0.3236	-0.8612	0.3236	0.0026	-0.0254	0.3670
1 min salary	-0.3441	0.0037	-0.7111	0.0037	-0.1813	-0.1893	0.0976
2 min salary	-0.4180	-0.3163	-0.5610	-0.3163	-0.3651	-0.3532	-0.1719
5 min salary	-0.5156	-0.7393	-0.3627	-0.7393	-0.6081	-0.5699	-0.5280
8 min salary	-0.5656	-0.9562	-0.2609	-0.9562	-0.7327	-0.6811	-0.7107
n price:							
'2 min salary	-1.3984	-2.1398	-0.3085	-2.1398	-0.6734	-0.5306	-0.0037
1 min salary	-1.1371	-1.1451	-0.2480	-1.1451	-0.6451	-0.4897	-0.1679
2 min salary	-0.8758	-0.1503	-0.1875	-0.1503	-0.6169	-0.4488	-0.3321
5 min salary	-0.5304	0.0000	-0.1075	0.0000	-0.5796	-0.3947	-0.5492
8 min salary	-0.3533	0.0000	-0.0664	0.0000	-0.5604	-0.3670	-0.6606
ice of rice:							
'2 min salary	1.1079	0.8977	2.5697	0.8977	0.6524	0.3622	1.3133
1 min salary	0.9213	-0.3869	2.2233	-0.3869	0.1959	0.2762	1.0589
2 min salary	0.7347	-1.6715	1.8770	-1.6715	-0.2606	0.1901	0.8045
5 min salary	0.4881	-3.3696	1.4191	-3.3696	-0.8641	0.0764	0.4683
8 min salary	0.3616	-4.2407	1.1742	-4.2407	-1.1736	0.0181	0.2958
ice of wheat:							
'2 min salary	1.5431	2.0210	1.5332	2.0210	.0000	-0.5599	0.7813
1 min salary	0.9480	1.3215	1.1311	1.3265	0.0550	-0.1411	0.1220
2 min salary	0.3530	0.6321	0.7291	0.6321	0.5006	0.2777	-0.5373
5 min salary	-0.4336	-0.2860	0.1976	-0.2860	1.0896	0.8313	-1.4089
8 min salary	-0.8371	-0.7569	-0.0750	-0.7569	1.3917	1.1153	-1.8560

inefficient in the sense that it will require huge ammounts of money transfers in order to make some impact on calorie intakes among these groups. Furthermore, the difficulties to clearly distinguish the target income groups when applying this type of policy, makes the problem even more difficult because as income increases, the elasticities estimated for these three foods were found to decrease and even became negative for the higher income brackets which may offset the original goal of raising the average calorie consumption of the whole population.

Second, own-price elasticities were found to be around 1 or higher than 1, for the lower income brackets in all regions, except for cassava flour in the northeast, where the product is traditionally consumed in high levels and hence a smaller reaction to changes in cassava prices is expected. This means that, apparently, there is a better chance to influence consumers' behavior through price subsidy policies than income transfers for increasing the consumption of these food staples particularly in the case of wheat, where the demand response was found to be very elastic to changes in its own price.

Finally, despite the small changes in relative prices that are often found in cross-sectional data, we were able to measure some degree of substitution among these three products. Particularly in the case of rice and cassava flour, we found that the demand cross-price elasticities for these products, with respect to changes in wheat prices are positive and close to 1, within the lower income groups in various regions of the country. This means that any price-subsidy policy directed to any of these products, should be analyzed not only with regard to its direct own-price effect, but also to its consequences over the demand for its close substitutes since there is clearly a risk, of affecting the overall level of calories consumed by the population via effects on their relative-price competitiveness.

The parameters estimated here will be used in the next sections to examine in greater detail these issues. Particularly in the case of our central concern, they are going to be useful for explaining some recent changes in the demand for cassava, which has been occurring over the last decade in Brazil.

Cassava for human consumption

A series of studies on nutrition in Brazil indicate that a large proportion of the population suffers from malnutrition. The World Bank (1979) study indicated that 58% of the population less than 17 years old suffers from malnutrition. In terms of people this translates into 19 million young people with first grade malnutrition; 10.5 million with second grade; and 0.5 million with third grade (Table 8). This malnutrition affecting a large part of the population, results in physical defects and mental retardation, and in severe cases in high levels of infant mortality.

Malnutrition is related to poor hygiene in the poorer areas, and a series of health-related problems. The major cause however, is simply the lack of sufficient calories in the diet of large sectors of the population. The IFPRI (1982) study indicated that the caloric intake

Table 8. Number (in thousands) and percentage of children under 17 years of age with first, second, and third degree of malnutrition by region, 1975.

	Degree of malnutrition					
	First		Second		Third	
Region	(No.)	(%)	(No.)	(%)	(No.)	(%)
North	2234	39.0	1131	23.3	42	0.7
Northeast	6332	38.2	4630	28.0	361	2.2
Southeast	10783	36.2	4581	15.4	44	0.2
Brazil	19349	37.2	10543	20.2	447	0.9

SOURCE: Gray, C. W. Food Consumption parameters for Brazil and their application to food policy. International Food Policy Research Institute. Research Report No. 32. September 1982.

was below minimum requirements in almost all regions of the country, with the greatest deficit in the north and northeast (Table 9). Furthermore, the situation is worse in the urban areas.

Cassava is a major calorie source in Brazil. The data of the IBGE survey (ENDEF) shows that rice and sugar were the two most important calorie sources in 1975, followed by cassava, beans, and wheat which are all about equally important. There are, however, regional differences. In the north cassava at 27% of the total calorie intake and in the northeast at 23% is the most important calorie source. The consumption is highest in the rural areas but still reaches levels of 290 calories per capita per day in the urban centers of the northeast and 465 calories per day in the north (Table 10). The tendency for higher consumption in the rural areas is found throughout Brazil.

Cassava is consumed in two principal forms in Brazil. First as farinha (a toasted flour) and second as aipim or fresh cassava. Per capita farinha consumption at 17.6 kg/year, as the national average, is much more important than aipim at 6.1 kg/year. The importance of farinha is also greater in the north and northeast regions at about 45 kg/year than in the south and southeast at 3.5-6 kg/year.

Consumption trends

The per capita consumption of cassava flour declined in the period 1960 to 1975 from 93 kg/year to 59 kg/year (Table 11). The decline was most pronounced in the south where the urbanization process has been most rapid in the last 20 years. The decrease in per capita consumption is related to two fundamental causes: the massive rural to urban shift resulting in altered consumption patterns, and the wheat subsidy reduced the price advantage of farinha over wheat flour.

The wheat subsidy. The production of wheat in the southern states is an attractive option for farmers who grow soy in the summer and wheat in the winter months. Both crops use similar machinery and do not compete for land or labor as they are planted in different seasons. Perhaps the factor that makes wheat so attractive is the high price. The government, concerned with the balance of payments, and wishing to reduce inflation and mantain low-cost food in the urban centers adopted the measure of subsidizing local wheat production. Wheat production is not easy in southern Brazil; yields are low and fluctuate widely from year to year. This results in enormous sums of money being required to sustain the policy goal of low consumer prices whilst at the same time inducing farmers to produce the crop. The World Bank estimates that the wheat subsidy is greater than US$1 billion in 1986 (recently "The Economist" quoted US$1.5 billion as the estimate for 1986). The form of the subsidy is such that the World Bank estimated that the consumers did not receive any effective subsidy in 1970, but by 1981 they recieved 90% of the subsidy (Table 12).

The role of the wheat subsidy was to break the link between producer and consumer prices, so as to maintain price incentives for domestic production and at the same time support lower prices to

Table 9. Average per capita daily calorie deficits by region and urban/rural location, (1975).

Region	Average consumption (calorie)	Estimated requirements[a] (calorie)	Calorie deficit (calorie)
Northeast			
Urban	1814	2150	336
Rural	2016	2145	129
North			
Urban	1750	2232	482
Rural[a]	1926	2226	300
South/ Southeast			
Urban	2127	2299	172
Rural	2445	2273	-

a. Taken from Cheryl Williamson Gray, "Food Consumption Parameters For Brazil and Their Application to Food Policy". International Food Policy Research Institute. Research Report No. 32. September 1982.

Table 10. Average per capita daily calorie consumption for each food by region and urban or rural location, 1975.

Foood Type	South and southeast			Northeast			North	Central West	Brazil		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Urban	Urban	Rural	Total
Cereals	814.82	991.42	878.98	574.33	476.14	518.82	479.82	852.63	659.83	753.91	698.55
Rice	465.32	525.22	487.08	217.67	258.79	240.92	178.75	609.88	355.51	402.41	374.82
Maize	36.47	181.90	89.31	51.24	149.95	107.05	5.96	25.76	34.03	167.17	88.83
Wheat bread	195.53	50.31	142.77	252.03	54.36	140.27	249.31	150.96	185.13	52.18	130.41
Macarroni	68.12	56.42	63.87	36.37	7.45	20.02	33.52	40.87	50.91	33.85	43.89
Wheat flour	31.26	166.96	80.56	5.20	1.61	3.17	4.90	12.98	20.22	90.75	49.24
Roots and tubers	66.90	160.85	101.04	332.95	616.17	493.07	478.73	84.31	131.81	370.72	230.13
Potatoes	27.00	26.45	26.80	4.63	0.43	2.26	5.06	12.05	17.57	14.46	16.29
Fresh cassava	7.40	38.49	18.69	8.91	15.85	12.83	3.73	20.51	7.40	28.06	15.90
Cassava flour	25.24	77.98	44.40	293.45	572.16	451.02	465.93	40.90	96.23	305.76	182.46
Sugar	306.18	349.98	322.09	229.64	196.7	211.02	168.77	238.72	246.62	279.33	260.08
Legumes	178.74	281.90	216.22	214.29	404.9	322.05	101.11	181.17	163.70	338.59	235.68
Beans	171.27	266.89	206.01	190.78	346.2	278.65	94.49	175.04	153.66	303.45	215.30
Vegetables	27.52	21.89	25.47	12.55	8.48	10.25	8.69	20.75	20.15	15.71	18.32
Fruits	47.17	28.12	40.25	46.83	26.4	35.28	41.00	45.33	41.41	27.32	35.61
Meat and fish	193.87	159.89	181.52	200.30	162.69	179.04	262.30	173.18	174.30	161.18	168.90
Beef	87.44	36.17	68.81	103.68	52.8	74.91	129.75	101.03	83.03	43.84	66.90
Pork	33.94	61.24	43.86	34.16	53.8	45.26	17.10	31.87	29.46	57.81	41.13
Poultry	27.11	23.97	25.97	17.85	9.32	13.03	14.73	16.64	21.06	17.22	19.48
Dairy products	145.31	132.21	140.55	82.94	72.18	76.86	68.70	110.67	110.83	104.54	108.24
Oil and fats	322.84	302.42	315.42	105.72	45.9	71.90	121.44	328.14	232.00	184.18	212.32
Beverages	24.59	17.12	21.88	14.44	7.27	10.39	19.90	14.96	18.93	12.58	16.32
TOTAL	2127.93	2445.79	2243.42	1814.01	2016.83	1928.68	1750.46	2049.86	1799.58	2248.07	1984.15

SOURCE: ENDEF 1975, IBGE.

Table 11. Per capita cassava consumption (kg) in 1960 and 1975, Brazil.

	1960			1975		
Region	Fresh	Flour	Total	Fresh	Flour	Total
Northeast	7.1	55.2	172.6	4.3	43.7	135.4
Urban	.9	26.8	81.3	3.2	20.4	64.4
Rural	10.3	69.7	219.4	5.2	55.0	170.2
Southeast	11.8	17.0	62.8	4.5	5.9	22.2
Urban	4.4	6.4	23.6	2.0	2.7	10.1
Rural	20.2	29.0	107.2	5.0	14.1	47.3
South	44.6	12.1	86.9	15.8	3.5	26.3
Urban	3.7	5.2	19.3	7.6	2.5	15.1
Rural	68.7	16.2	117.3	23.2	4.4	36.4
Brazil	14.9	26.3	93.5	6.1	17.6	58.9
Urban	3.0	11.4	37.8	2.7	9.7	31.8
Rural	24.7	38.3	139.5	11.2	29.4	99.4

SOURCES: Fundação Getulio Vargas, 1979; Instituto Brasileiro de Geografía e Estatísticas (IBGE), 1978.

Table 12. Wheat subsidies (US$ millions) received by producers and consumers.

	Total subsidy (A)	Consumer subsidy (B)	B/A (%)	Producer subsidy (C)	C/A (%)
1968	36.6	16.43	44.9	20.12	55.1
1969	60.1	28.87	48.1	31.30	51.9
1970	33.3	-30.74[a]	0.0	64.05	100.0
1971	32.1	-60.11	0.0	92.23	100.0
1972	113.0	108.42	95.9	4.49	4.1
1973	222.8	248.71	100.0	-25.93[b]	0.0
1974	299.2	391.19	100.0	-92.05	0.0
1975	517.3	495.74	95.8	21.49	4.2
1976	424.6	377.20	88.8	47.36	11.2
1977	292.9	158.85	54.2	134.04	45.8
1978	707.1	705.53	99.7	1.56	.3
1979	828.4	760.52	91.8	67.74	8.2

a. Both government and consumers subsidized producers.

b. Both government and producers subsidized consumers.

SOURCE: World Bank, "A Review of Agricultural Policies in Brazil." September 1981.

consumers. Besides the great budgetary burden that this policy caused the government, there are also serious concerns with regard to wheat's nutritional effects, and for what location and to whom this policy helped. Because the wheat subsidy clearly affected the consumption levels of its close substitutes, such as rice and cassava, the balance of the combined calories consumed of these products have also been affected. The demand parameters discussed in this report, together with the average per capita daily calorie intake data obtained from the ENDEF survey, can be useful in analyzing the nutritional effects of this policy.

Based on the data collected by EMBRAPA on production costs and processing for wheat grains, wheat flour, bread, and macarroni the corresponding subsidy was obtained for these products. As reported in Table 13, the wheat subsidy reduced the price of bread (50 grams) to 27.48% and the price of macarroni to 29.6-32%. These figures, were weighed by the average expenditure shares on each wheat product by income groups and regions (Table 14), so as to calculate the wheat subsidy recieved by different income groups in different regions (Table 15). The effect of this subsidy in the per capita consumption for a given food commodity is given by:

$$DC_i = Co_i * [E_{iw} *. \text{ (wheat subsidy)}], \forall : (i = r, w, f)$$

where,

DC_i = change in calories consumed in food i-th due to the wheat subsidy,

Co_i = the amount of calories consumed of food i-th before the subsidy,

E_{iw} = the cross-price elasticity as defined before,

Hence the combined effect of the subsidy over the total calorie consumption of these three products, is given by:

$$DC_t = \sum_i DC_i, \quad \forall : (i = r, w, f)$$

The calculation results are reported in Table 16. It can be observed that the apparent effects of wheat subsidy over calorie intake widely differs and sometimes in a negative way for different sections of the population within and among regions. First, per capita consumption of rice and farinha decreased in all regions because of the wheat subsidy. Particularly, this substitution was strongly affected farinha

Table 13. Price subsidy (Cr$) for wheat bread and macaroni, Brazil.

Commodity	Production costs		Price	Subsidy
	Flour	Other		(%)
Wheat bread (50 g)				
with subsidy	0.074	0.306	0.38	27.48
without subsidy	0.218	0.306	0.52	
Macaroni (1 kg-comun)				
with subsidy	1.39	4.41	5.80	32.00
without subsidy	4.12	4.41	8.53	
Macaroni (1 kg-semola)				
with subsidy	1.78	6.52	8.30	29.66
without subsidy	5.28	6.52	11.80	

Table 14. Expenditures shares (%) on wheat bread and macaroni by regions and income group, Brazil.

Income group	South	Southeast	Northeast	North
Wheat bread				
Up to 2 min salaries	4.8	5.5	7.1	6.6
Between 2 and 5 min salaries	5.6	6.4	10.2	7.8
More than 5 min salaries	5.7	5.9	9.8	7.4
Macaroni				
Up to 2 min salaries	3.1	3.3	0.7	4.2
Between 2 and 5 min salaries	2.5	2.3	1.3	1.5
More than 5 min salaries	2.2	1.7	1.4	1.6

SOURCE: ENDEF, IBGE 1978.

Table 15. Wheat subsidy (%) received by region and income group, Brazil.

Income group	South	Southeast	Northeast	North
Up to 2 min salaries	29.3	29.2	27.9	29.2
Between 2 and 5 min salaries	28.9	28.7	28.0	28.2
More than 5 min salaries	28.1	28.0	27.8	27.9

SOURCE: Taken from Tables 13 and 14.

Table 16. Effects of wheat subsidy on daily calories consumed.

	South		Southeast		Northeast	
	Urban	Rural	Urban	Rural	Urban	Rural
Rice						
1 min salary	-18	-52	-49	-8	-33	-47
2 min salary	-33	-115	-21	51	-14	-45
5 min salary	-52	-195	15	127	11	-43
8 min salary	-60	-231	32	162	23	-42
Wheat						
1 min salary	85	97	27	5	77	15
2 min salary	75	89	34	2	89	18
5 min salary	61	77	41	0	106	22
8 min salary	53	70	45	0	113	24
Cassava flour						
1 min salary	-7	-30	-8	-30	-5	23
2 min salary	-3	-14	-5	-14	-41	-44
5 min salary	3	6	-1	6	-90	-133
8 min salary	6	17	1	17	-113	-177
Total						
1 min salary	60	14	-30	-33	39	-9
2 min salary	40	-41	7	39	34	-71
5 min salary	13	-112	55	133	27	-154
8 min salary	-1	-145	77	178	23	-195

in the northeast and rice in the south where these products are traditionaly consumed. Second, the direct effects of the subsidy over wheat consumption, apparently was favored more by rich people than the poor in the urban centers of the southeast and northeast. And third, the overall calorie intake increased in the south which has a relatively minor nutritional problem, while the subsidy effect was negative within the malnourished groups of the southeast, and a relatively small increase in the northeast.

In other words, because the own-price elasticity for wheat is apparently very elastic (greater or close to -1) in most regions, any subsidy in its price will likely cause a large substitution of traditonal calorie products, like rice, cassava, bread, and macarroni, so that the overall calorie intake by the malnourished may actually decrease. For nutritional purposes, the wheat subsidy policy certainly was not the most appropiate taken. Past studies, like the IFPRI 1982, show that a price subsidy on rice could be a more effective mechanism to raise the level of calories consumed by the poorest in the calorie-deficit areas of Brazil.

The wheat subsidy has obviously distorted the price structure for starchy staples and has affected the competitive ability of cassava. The demand cross-price elasticities for cassava with respect to the price of wheat were found to be positive, in particular for the lower income groups which indicates that wheat substitutes for cassava. In the period 1972 to 1980 the relative price of cassava flour to wheat flour increased (Table 17). As a result there has been substitution and the consumption of cassava flour (farinha) has declined. In the case of aipim (fresh cassava) the high-yield levels in the south have enabled fresh cassava to mantain its price relative to wheat even when this was falling due to subsidies. As a result, consumption of aipim has increased in the south. In the north and northeast, however, the relative price of both aipim and farinha has increased and this has obviously led to substitution of wheat for cassava.

In 1980 the government, concerned with the high cost of the wheat subsidy, began to slowly reduce the level. As a result there has been a slight tendency for the price of cassava relative to wheat to decrease (Table 17). At present, the government is in the position of being committed to reducing the wheat subsidy, however, at the same time it wishes to reduce inflation. Wheat plays an important part in the determination of the consumer price index and although reducing the subsidy is an economic necessity, it may well be politically difficult.

<u>The rural-urban migration</u>. Urbanization has been extremely rapid in Brazil. The population census of 1960 and 1984 show the urban population rising from 48.6% to 72.4%. Consequently, there has been a shift to the consumption of more convenient food sources. At the same time new marketing channels have been developed and a more varied diet is available.

The consumption of farinha on a per capita basis has declined over the last 15 years. This is partially due to urbanization, since urban consumption per capita is three times as low as rural consumption.

Table 17. Relative price (5-year moving average) of cassava.

Period	Porto Alegre		Sao Paulo		Rio		Salvador		Fortaleza	
	Flour	Root	Flour	Root	Flour	Root	Flour	Root	Flour	Root
				(5-year moving average)						
69/73	0.56		0.68		0.57	0.44	0.86	0.58	0.52	0.31
70/74	0.61		0.72		0.61	0.44	0.86	0.58	0.58	0.31
71/75	0.74		0.88	1.14	0.69	0.47	1.04	0.55	0.61	0.32
72/76	1.04	0.96	1.24	1.42	0.99	0.64	1.36	0.55	0.72	0.34
73/77	1.22	0.85	1.44	1.37	1.25	0.77	1.49	0.68	0.87	0.39
74/78	1.38	0.86	1.60	1.36	1.17	0.75	1.62	0.79	0.97	0.44
75/79	1.60	0.97	1.78	1.43	1.12	0.80	1.95	1.11	1.15	0.64
76/80	2.10	1.12	2.09	1.64	1.03	0.65	2.25	1.42	1.54	0.93
77/81	2.02	1.10	1.93	1.58	0.66	0.44	1.80	1.37	1.68	1.04
78/82	1.86	1.07	1.78	1.50	0.45	0.24	1.70	1.15	1.64	1.03
79/83	1.76	1.05	1.66	1.46	0.57	0.34	1.53	1.07	1.61	1.00
80/84	1.72	0.91	1.61	1.29	0.82	0.35	1.39	0.85	1.61	0.92

SOURCE: Anuario Estadistico, IBGE.

Nevertheless, analysis of urban farinha demand shows some interesting features. The demand for farinha calculated at constant prices has apparently increased in the urban areas. This is of great importance as the urban centers are those that face the greatest nutritional problems. How has this increase in demand occurred?

In the lower income groups the demand for cassava increases as incomes rise (i.e., it is a normal good). This is very plausible as the lower income groups do not have sufficient resources to meet their basic nutritional requirements. As their income increases they will purchase basic food such as farinha. The overall income elasticity is indeed negative; richer people want a more varied diet. The natural tendency is to interpret this fact as indicating that there will be a decrease in demand as income rise. This neither takes into account the differences in income elasticity in different income groups nor the overall increase in the population and the segments of the population in which this occurs.

In the last 15 years in Brazil the lowest income groups are those that are increasing most rapidly. The percentage of the population with income less than the minimum salary increased from 17% to 33% (Table 18). At the same time the urban population increased dramatically (Table 19). The average income levels also tended to increase (Table 20). The population increase, the income increase and distribution, and the farinha demand parameters estimated were combined in a model to predict the demand for farinha at constant prices. In Table 21 it can be seen that there was a substantial overall increase in the demand for farinha in the urban centers. The increase in demand takes place in the poorest segments of the urban population with the greatest nutritional problems. This increase in demand more than compensated for the decrease in demand in the richer segment of the population. Thus in the urban centers of the northeast demand increased from 139 thousand tons for the population with less than one minimum salary income level, in 1975, to 344 thousand tons in 1985. Similarly, in the lowest income groups of the urban centers of the south, demand increased from 13.4 thousand tons to 31.1 thousand tons. This indicates that if farinha prices can be maintained or reduced a substantial increase in total urban demand can be expected in the coming years.

With respect to fresh cassava, the low levels of consumption in the urban areas are apparently related to the inconvenient nature of this highly perishable product. This problem is illustrated by the fact that whereas over 90% of the farinha consumed in the urban areas enters through commercial markets only 55% of fresh cassava for human consumption follows this path (Table 22). Furthermore the marketing margins account for 80% to 90% of the final consumer price in the two major urban centers of Brazil (Table 23) due to the high risks involved in marketing fresh cassava. The price elasticity and the income elasticity for fresh cassava were found to be high. All the above stated facts indicate a buoyant demand for fresh cassava if the problem of perishability could be obviated. New fresh cassava conservation technology developed by CIAT has the potential to greatly reduce the perishability of cassava and also lower the price to the urban consumer thereby opening up the market for fresh cassava.

Table 18. Distribution (%) of people by salary class (SC) in 1976, 1981, and 1985.

	Salary Class (minimum monthly salary=1)					
Year	SC=<1	1<SC<2	2<SC<5	SC<5	Without response	Total
1976	16.93	25.07	31.84	25.13	1.03	100.00
1981	29.80	25.60	23.20	11.00	10.40	100.00
1985	33.00	22.60	22.30	12.10	10.00	100.00

SOURCE: FIBGE, "Anuario Estatistico do Brazil."

Table 19. Actual and estimated population, 1970-1990.

Popu- lation	Northeast Urban	 Rural	Southeast Urban	 Rural	South Urban	 Rural
1970	11723	16359	28965	10889	7303	9193
1976	14837	17985	36947	9540	9575	10462
1980	17586	17275	42848	8904	11881	7156
1983	20244	16988	47419	8609	12671	7275
1986[a]	22430	16745	53602	7011	14534	6398
1990[a]	26405	16591	62367	3732	17253	4852

a. Estimated.

SOURCE: FIBGE, "Anuario Estadistico do Brazil."

Table 20. Minimum salary by region[a], 1975-1985.

Year	General price index (%)	Northeast	Southeast	South
1975	49.63	841.43	996.17	1073.54
1976	70.10	859.34	1016.83	1095.58
1977	100.00	868.80	1027.20	1106.40
1978	138.74	1295.66	1518.81	1634.71
1979	213.53	1609.52	1964.41	1943.33
1980	427.47	1667.49	1980.21	1980.21
1981	897.30	1604.81	1850.89	1850.89
1982	1753.74	1744.84	1982.96	1982.96
1983	4463.80	2176.98	2176.98	2176.98
1984	14311.70	2327.61	2327.61	2327.61
1985	41160.74	1457.70	1457.70	1457.70

a. Real, base year = 1977.

SOURCE: FIBGE, "Anuario Estadistico do Brazil."

Table 21. Urban cassava-flour demand for urban areas (thousand t/yr) by income group.

Salary group	Northeast	Southeast	South
1975/1976			
1 min salary	114.28	48.18	10.83
2 min salary	119.92	27.70	6.09
5 min salary	139.00	23.31	6.02
8 min salary	58.54	14.00	2.70
1980/1981			
1 min salary	296.85	93.16	24.27
2 min salary	159.65	30.96	7.89
5 min salary	109.03	18.50	5.55
8 min salary	24.60	6.66	1.49
1985/1986			
1 min salary	426.07	149.72	37.51
2 min salary	187.63	39.74	9.74
5 min salary	146.20	25.93	7.47
8 min salary	38.95	10.69	2.30

Table 22. Fresh cassava prices (Cr$) at farm and retail levels in Sao Paulo and Rio de Janeiro, Brazil.

	Sao Paulo			Rio de Janeiro		
	Retail	Farm	F/R	Retail	Farm	F/R
1970				160.3	17.7	11%
1971	193	15.5	8%	195.4	27.7	14%
1972	204	22.2	11%	184.0	25.7	14%
1973	267	21.4	8%	197.8	24.3	12%
1974	317	20.2	6%	223.2	35.8	16%
1975	283	31.2	11%	244.8	55.2	23%
1976	301	59.3	20%	219.9	79.2	36%
1977	240	37.9	16%	206.5	75.5	37%
1978	217	16.6	8%	200.4	26.5	13%
1979	221	14.2	6%	200.8	33.6	17%
Average			10%			19%

SOURCES: Fundação Getulio Vargas; IBGE.

Table 23. Percent of cassava consumption that is purchased by urban and rural locations, 1975, Brazil.

	Cassava purchased (%)	
	Fresh cassava	Cassava flour
Central west		
Urban	39.22	74.18
North		
Urban	44.09	82.17
Northeast		
Urban	44.14	86.67
Rural	6.50	49.59
Southeast		
Urban	55.81	91.74
Rural	36.53	55.41
South		
Urban	42.26	95.52
Rural	2.19	73.14

SOURCE: IBGE. 1978.

The Market for Animal Feed Rations

Meat production

Brazil is one of the main beef producers in the world, and has a cattle stock of over 127 million animals. Although the south and the southeast together are the main beef producers, the central west is the single most outstanding beef production area. The northeast and the north have the lowest beef production figures (Table 24).

Beef, as well as swine production, has remained relatively stable over the last 15 years, with the exception of the central west region. The stagnant situation in beef and swine production is strongly related with the dynamic growth of the poultry sector within the same time frame.

Brazil is the world's third largest producer of poultry meat and produces some 7% of total world market supply. From the beginning of the seventies the poultry industry has been growing at an extremely fast rate, even by Brazilian standards. From 1970 to 1975, production increased by 139%. The Brazilian government became enthusiastic with these growth figures and did make a decisive effort to open export markets.

Brazil has been exporting poultry since 1975. In 1975 only 3.4 thousand tons per year were exported but afterwards volumes reached 280 thousand tons per year, equal to some 270 million dollars (Table 25). In this period beef and pork production stayed constant at 2 million tons and 0.5 million tons respectively, but poultry production rose from 413 thousand tons to 1.14 million tons (Table 26).

Simultaneous with the exports, domestic consumption of poultry increased rapidly. This was mainly due to the significant price decrease of poultry meat, as caused by rapid technological change in poultry production. The shift to poultry consumption accounted for the complete increase in meat consumption. Consequently, beef and swine consumption per capita stayed relatively constant (Table 27).

Demand for animal feed rations and maize

Up to the sixties Brazil's industry of animal feed rations was relatively small and mainly directed to dairy cattle (IPEA, 1978). Swine production took place in small holdings, directed to the production of swine fat ("manteca") for baking purposes in the absence of a vegetable oil industry. It was only at the beginning of the sixties, that swine production, on the basis of balanced animal feed rations, started to take place. This was induced by the arrival of new hybrid swine races for meat production. From that moment on the animal feed industry started to grow. Around the same time, the poultry industry got established, showing spectacular growth figures at the beginning of the seventies. The swine and poultry industry created an enormous increase in demand for balanced animal feed (from 2.4 million tons in 1971 to 10 million tons in 1985, Table 28). This caused, in turn, a rapid

Table 24. Animal stock (millions) by region.

Stock	Region				
	South	Southeast	Central West	Northeast	North
Beef					
1973	20.6	32.5	19.5	15.9	2.0
1980	24.6	35.1	33.7	21.9	3.7
1984	24.3	35.0	40.8	21.7	5.9
Swine					
1973	16.4	7.7	3.5	8.9	1.1
1980	15.4	6.1	2.9	8.0	1.9
1984	12.4	5.9	3.5	7.6	3.0
Poultry					
1973	86.7	114.1	16.4	45.7	8.7
1980	152.1	181.7	20.1	72.5	15.0
1984	128.5	105.7	12.7	47.5	12.4

SOURCE: IBGE, Anuario Estatistico do Brasil.

Table 25. Exports of poultry meat 1975-1984, Brazil.

Year	Poultry (millions of t)	Value (US$ in millions)
1975	3.47	3.28
1976	19.64	19.56
1977	32.83	31.57
1978	50.81	46.87
1979	81.10	81.14
1980	168.71	206.69
1981	293.93	354.29
1982	301.79	285.47
1983	289.30	242.21
1984	280.00	270.00

SOURCE: Agroanalysis, FGV, vol 8(10), Oct. 1984.

Table 26. Production (thousands of tons) of meats, 1976-1984, Brazil.

Year	Beef	Swine	Poultry
1976	2176	542	413
1977	2255	462	447
1978	2143	566	587
1979	2114	611	713
1980	2084	699	914
1981	2115	709	1049
1982	2397	626	1192
1983	2365	647	1204
1984	2161	567	1146

SOURCE: Instituto Brasileiro de Geografía e Estatísticas (IBGE). Anuario Estatistico do Brasil.

Table 27. Annual per capita consumption (kg) of meats, 1962-1984.

Year	Beef	Swine	Poultry
1962	17.5	7.8	0.1
1967	17.1	7.7	0.4
1972	19.0	7.9	1.5
1977	20.7	7.4	4.2
1981	23.7	7.9	10.2
1984	22.6	7.4	10.9

SOURCES: IBGE. Anuario Estadistico do Brasil.
Luis Sanint (OP. CIT.).

Table 28. Demand estimations (thousands of tons) for animal feed rations and maize, 1971-1985.

Year	Feed rations			Maize		
	Poultry	Swine	Total	Poultry	Swine	Total
1971	2149	316	2465	1397	7021	8418
1975	4136	821	4957	2688	7375	10063
1982	8828	2512	11340	5738	8558	14296
1985	10816	2671	13487	7030	8670	15700

SOURCES: IPEA. 1978. "Tecnología Moderna para la agricultura", Vol 3.
Luis Sanint. 1985. "Producción de Carnes en el Brazil", unpublished report, CIAT.

modernization of the balanced animal feed and meat production industry, which by now has conversion rates similar to those in the United States.

The strong growth of balanced animal feed consumption created a rapidly increasing demand for maize. Maize is the main animal-feed, raw material in Brazil and normally makes up 65% of the ration. In the last 15 years the consumption of maize by the animal feed industry increased from 8.4 to 15.7 million tons (Table 28).

Until the mid-seventies, Brazil was a maize-exporting country. Afterwards, internal demand increased so rapidly that Brazil had to start importing maize. Between 1977 and 1980 Brazil imported more than 4 million tons. Because of excellent maize harvests in the years between 1982 and 1984 Brazil could again export some maize, but the situation was short-lived. Due to prolonged drought in the central west in 1985 and 1986, the country had to import more than 3.5 million tons in 1986 (Table 28).

The potential application of cassava in animal feed rations; a regional perspective

The large maize imports and the considerable subsidies on the transport of maize from the central west oblige the government to look for alternative animal feed raw material sources. The utilization of dried cassava instead of maize could contribute to the desired maize substitution. This alternative looks particularly viable in the northeast where soil and climate permit low cost cassava production, but almost completely prohibit maize production and reduce the potential of animal feed, poultry, or swine production.

Table 29 shows the geographical distribution of cassava production, maize production and consumption, animal feed production and consumption, and poultry, egg, and swine (estimated) production and consumption. Cassava production is concentrated in the north and northeast, especially on a per capita basis. Maize production is (Table 30) concentrated in the south and central west; two regions that produce a considerable surplus on top of their own consumption needs. In the production of balanced animal feed, again the south and central west produce more than they actually consume. The northeast on the other hand has large deficits of maize as well as animal feed availability.

The ample availability of feed grains in the south and central west has also led to a concentration of poultry, swine, and egg production in these regions (Table 31). Especially in the south, poultry and swine production is very high. In this region per capita poultry and swine production is two and a half times as high as consumption. Surplus poultry production is, to a great extent, exported, while surplus swine production is sold in other regions of the country, mainly the southeast. The relatively high animal production levels in the southeast are based on the cheap transportation of maize and animal feed from the south and central west to this region.

In the northeast, production levels of poultry, eggs, and swine are less than half the levels of the southeast or the central west and less

Table 29. The geographical distribution of cassava production, maize production and consumption, animal feed production and consumption, poultry, egg and swine production and consumption, by region in Brazil, 1983.

Region	Cassava	Maize		Animal feed		Poultry		Eggs		Swine	
	Production	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption	Production	Consumption
Total (000 t)											
North	3523.70	279.30	260.00	44.70	73.39	48.89	49.07	22.50	31.52	54.60	45.58
Northeast	10382.72	900.00	1608.00	701.25	900.50	120.00	228.02	123.34	141.03	214.87	321.33
Southeast	2837.46	6080.90	7293.00	4526.73	4666.67	670.00	687.26	491.42	498.32	249.81	540.71
South	4055.01	10343.10	9743.00	5450.07	5106.49	764.00	297.24	228.67	189.73	589.72	243.01
Central west	947.19	2395.10	836.00	355.94	325.17	65.18	67.97	41.76	47.08	97.94	56.32
Per capita (kg)											
North	536.33	42.51	39.57	6.80	11.17	7.44	7.47	3.42	4.80	8.31	6.94
Northeast	276.06	23.93	42.75	18.65	23.94	3.19	6.06	3.28	3.75	5.71	8.54
Southeast	50.13	107.44	128.85	79.98	82.45	11.84	12.14	8.68	8.80	4.41	9.55
South	201.94	515.09	485.21	271.42	254.31	38.05	14.80	11.39	9.45	29.37	12.10
Central west	110.78	280.13	97.78	41.63	38.03	7.62	7.95	4.88	5.51	11.45	6.59

Table 30. Supply, demand, and net imports of maize (thousand of tons), 1977-1986, Brazil.

	Year								
Variable	77/78	78/79	79/80	80/81	81/82	82/83	83/84	84/85	85/86
Supply:									
Initial stock	901.0	1.0	334.2	1180.0	1362.7	1823.4	823.5	2121.0	2441.9
Production	14016.7	16513.2	19484.8	21282.7	21603.7	19014.1	21177.5	21173.9	19870.1
Imports	1500.0	1520.0	2011.0			465.0		200.0	3573.0
Total	16417.7	18034.2	21830.0	22462.7	22966.4	21302.5	22001.0	23494.9	25885.0
Demand	16416.7	17700.0	20600.0	21100.0	20600.0	19740.0	19700.0	21053.0	22154.0
Surplus	1.0	334.2	1230.0	1362.7	2366.4	1562.5	2301.0	2441.9	3731.0
Exports					543.0	739.0	180.0		
Final stock	1.0	334.2	1230.0	1362.7	1823.4	823.5	2121.0	2441.9	3731.0
Net imports	1500.0	1520.0	2011.0	0.0	-543.0	-274.0	-180.0	200.0	3573.0

SOURCE: Companhia de Financiamento da Produção (CFP).

Table 31. Regional surpluses (+) or deficits (-) in maize, animal feed and poultry, egg and swine availability in Brazil.

Region	Maize (000 t)	Animal feed (000 t)	Poultry+egg +swine (000 t)
North	19.30	-28.69	-0.18
Northeast	-708.00	-199.25	-232.17
Southeast	-1212.10	-139.94	-315.06
South	600.10	343.58	852.41
Central west	1559.10	30.77	33.51
Percentage of total consumption			
North	7.42	-39.09	-0.14
Northeast	-44.03	-22.13	-33.63
Southeast	-16.62	-3.00	-18.25
South	6.16	6.73	116.77
Central west	186.50	9.46	19.55

than 20% of the level in the south. To satisfy the demand for these products in the regions, considerable amounts of poultry and swine are brought in. Still, consumption of swine, eggs, and poultry is much lower than it is in the south or southeast. Besides the effect of the lower per capita incomes, reduced consumption levels in the northeast are also caused by the higher prices for swine, poultry, and eggs. During 1981 and 1982 consumer prices of swine, poultry and eggs were, on average, 10% higher in the northeast than in the south.

As shown in Table 29, the northeast runs deficits of 22% to 44% on its maize consumption, its animal feed consumption and its poultry, egg, and swine consumption. Additionally, the low availability of locally produced poultry, swine, and eggs have had their prices increased and their consumption has diminished. In the southeast there is also a deficit on maize, animal feed and eggs, and poultry and swine availability but it is much smaller as a percentage of total consumption.

The previous analysis suggests that dried cassava production in the northeast might be an appropriate way to improve the region's self-sufficiency rates in feed grains, animal feed, and animal products. Additionally, production of dried cassava would widen the market perspectives for the small farmer. Since the traditional market for "farinha da mandioca," has strongly suffered throughout the seventies and early eighties from the wheat subsidies, an alternative cassava market would be very welcome.

Linear programming feed cost models

To find the most efficient composition of balanced animal feed, linear programming models are commonly used. These models try to determine which combination of feedstuffs fulfills the nutritional requirements of animals' diet at the lowest cost. These models have been used in the present study to define at which price level (as a percentage of the maize price) dried cassava would start to substitute for maize (Table 32).

At 74% of the maize price, dried cassava would form 8% of the balanced poultry ration. If the cassava price were to be reduced to 70% of the maize price, dried cassava would enter in the poultry diet with a participation of 10%.

In swine diets, cassava's potential is still much larger. Already at a price of 87% of the maize price, cassava would form 17% of the balanced swine ration. If the dried cassava price were to be reduced to 79% of the maize price, it would form around 30% of the diet.

At the moment the sale price of maize is around 1.69 cruzados per kilogram. This means that at a price of 1.46 cruzados per kg, dried cassava would enter in swine rations and at a price of 1.25 cruzados per kg it would enter in poultry rations.

Table 32. Utilization of dried cassava in animal feed rations based on minimum cost feed models, Brazil.

	Maize[a] (%)	Cassava price/ maize price[b] (%)	Maize (%)	Dried cassava (%)
Hens (layers)	52.35	73.62	44.39	7.99
	52.35	70.41	44.72	9.96
Pigs (60/100 kg)	52.29	86.45	38.80	16.77
	52.29%	78.72%	26.96%	30.48%

a. Cassava utilization artificially restricted to 0 (RHS = 0).

b. Maize price = 1.69 NCr$/kg.

Advantages for the farmer

At present, for the small farmer in the northeast, farinha production forms one of the most important income sources. However, income obtained in this way is highly variable because farinha prices are very unstable. Table 33 shows the instability of farinha prices in a number of urban markets: prices appear to have moved from below 1 to over 5 cruzados per kg.

Most farinha price instability has been caused by supply variations. Since the farinha price-elasticity of demand is between 0 and -1, price fluctuations are always bigger than volume fluctuations. The volume fluctuations, in turn, are caused by the climatic fluctuations, that have a heavy influence on the agricultural sector of the northeast.

Dried cassava as an animal feed would broaden the cassava market to the small farmer, which would have two positive effects on his income. Firstly, the use of cassava as an animal feed would diminish the price fluctuations, to which the farmer is subject in the farinha market. This is illustrated with Figure 1. If only the farinha market exists, random price fluctuations equal to P2-P1 exist. If the cassava market is broadened with the animal feed market, the effective demand for cassava becomes more elastic and price fluctuations will be reduced to P3-P2. This in turn stabilizes the farmer's income.

Secondly, with a new market the income from cassava sales would be increased. Figure 1 shows that before the opening-up of the new market the expected income of the farmer is given by Y1= E(P)*Q(f). When the animal feed market would be opened-up the expected income would be equal to Y2= E(P)*Q(r).

Besides the effect on the income of the farmer, the capacity to generate rural employment in cassava processing would be enhanced. This would be very welcome in the northeast where rural unemployment and urban migration are high. There is no doubt that expansion of cassava production in order to supply the animal feed industry would have a very favorable effect on small-farm income and rural employment.

The Supply of Cassava

Introduction

Cassava is grown in all states of Brazil. The 1985 statistics of the IBGE indicate that 1.87 million ha were planted with a total production of 23 million tons, valued at Cr$1.87 billion. The agricultural census of 1981 estimates that cassava is the eighth most important crop in terms of area planted and the seventh in terms of value (Table 34).

Credit

Despite the fact that cassava has frequently been named as a priority crop by the government, the principal policy instrument to

Table 33. Cassava flour real prices (Cr$/kg) (base year = 1977).

Year	Porto Alegre	Sao Paulo	Rio	Salva-dor	Forta-leza
1969	2.56	3.25	2.13	3.65	1.96
1970	2.72	3.09	2.53	4.46	4.77
1971	3.16	4.39	3.45	6.02	3.83
1972	3.82	4.54	3.47	5.48	3.08
1973	3.43	3.92	3.29	4.30	2.93
1974	3.49	4.49	2.81	3.48	3.60
1975	4.90	5.89	3.31	7.13	4.42
1976	6.75	8.41	6.92	9.11	4.74
1977	5.24	6.33	6.79	2.05	4.11
1978	3.88	4.56	0.72	1.61	3.15
1979	3.73	4.11	0.69	1.86	3.66
1980	5.34	5.12	0.84	1.38	5.15
1981	4.51	4.97	1.14	1.35	5.68
1982	3.13	3.75	3.40	4.31	3.76
1983	2.83	3.13	2.87	2.54	3.17
1984	5.15	5.09	5.14	5.48	5.15

SOURCE: IBGE. Anuario Estatistico do Brazil.

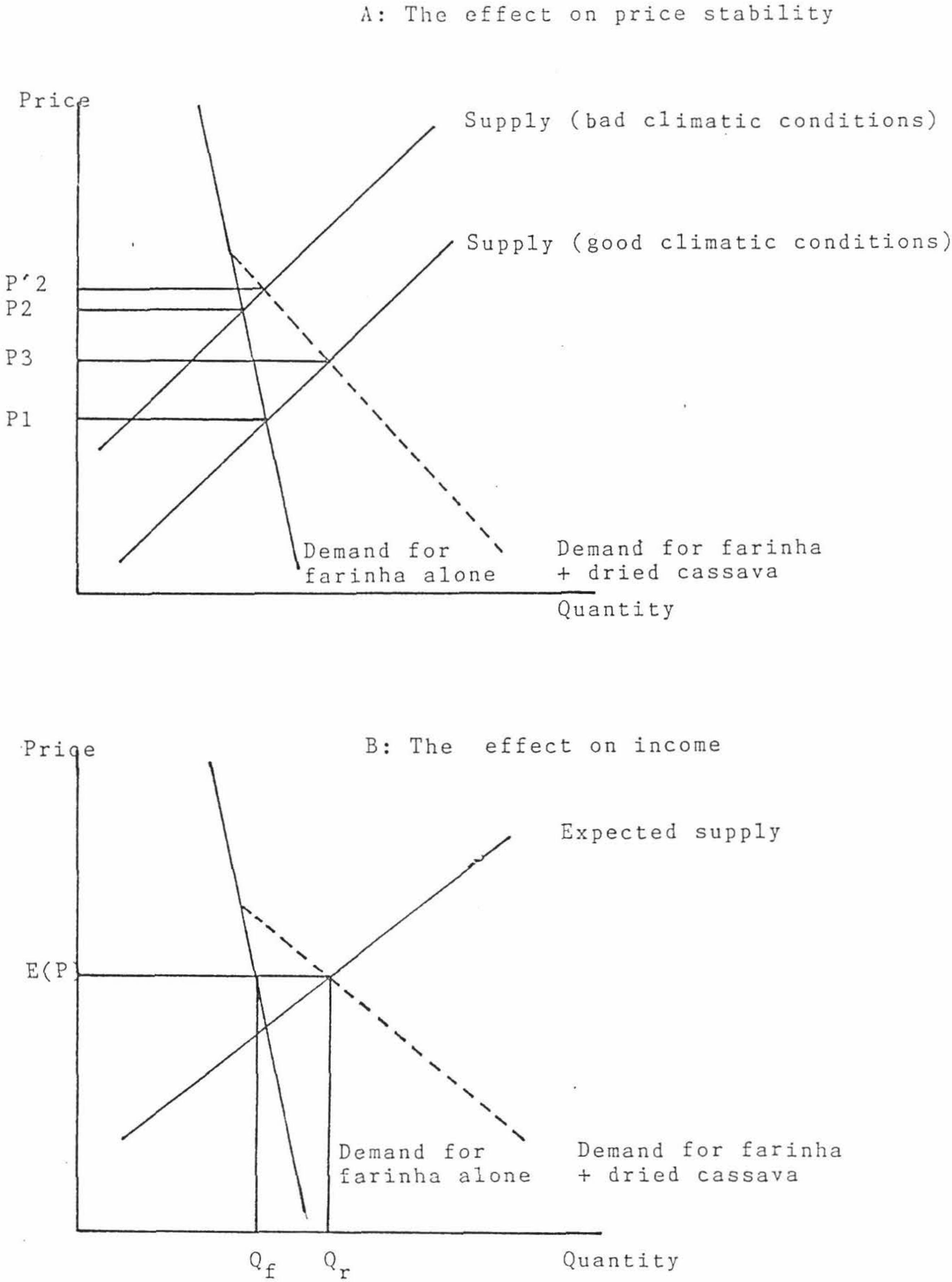

Figure 1. Impact of opening the dried cassava market on prices and incomes

Table 34. Main agricultural products, in order of monetary value including area, production, and yield, in Brazil, 1980.

Product	Area (ha)	Production (ton)	Yield (kg/ha)	Value (thousand Cr$)
Temporary crops				
Soybean	8,774,023	15,155,804	1,727	132,636,930
Sugarcane	2,607,628	148,650,563	57,006	110,737,618
Corn	11,451,297	20,372,072	1,779	119,586,810
Rice	6,243,138	9,775,720	1,565	98,059,130
Beans	4,648,409	1,968,165	423	57,600,228
Cassava	2,015,857	23,465,649	11,640	67,280,181
Cotton	1,353,443	1,439,330	1,063	29,306,153
Wheat	3,122,107	2,701,613	865	29,205,648
Potato	181,084	1,939,537	10,710	22,805,924
Tobacco	316,427	404,660	1,279	12,994,864
Permanent crops				
Coffee	2,433,604	2,122,391	872	88,248,110
Orange[a]	575,249	54,459,072	94,670	32,162,469
Cocoa	482,521	319,141	661	22,897,127

a. Production in thousand fruits, and yield in fruits/ha.

SOURCE: FIBGE.

increase agricultural production, credit, has barely reached the cassava farmer. The production credit for cassava in the last 15 years was only 1.2% of the total (Table 35). As mentioned earlier the government stimulated the export crops; soy received 22% of the total credit. In addition the crops that played a role in import substitution like sugarcane (to produce alcohol in order to replace oil) and wheat received more than 20% of the total. This emphasis obviously reduced the government's ability to respond to the needs of basic food crops such as rice, beans, and cassava which received less than 16% of the total production credit.

On a regional basis the farmer survey showed that in the northeast only 28% of the farmers received credit for cassava production. The figures for the southeast, north, and south are 17%, 10%, and a mere 5% respectively (Table 36).

The principal constraint on obtaining credit, as seen by the farmers, is the excessive bureaucratic requirements of the banks. These include guarantees, land titles, and a multitude of other papers.

Less than 3% of the farmers received marketing credit. Forty percent of the farmers were not aware of the existence of the minimum-price program and 20% of the farmers said that the appropriate agencies would not buy their produce as they had no storage space.

Trends in cassava production

In the last 15 years the total area planted to cassava has remained relatively constant at close to 2 million ha (Table 37). Production has, however, decreased by 6.4 million tons (22%) over the same period. This is due to a shift of production from the central and southern regions to the north and northeast (Table 38).

In order to increase agricultural exports in the decade of the seventies, a strong program was set up to support the production of soy. The result was an expansion in area planted to soy from 1.2 million ha to 9 million ha, mainly in the south of the country. Cassava was displaced towards the northeast. The center and south produced over 50% of the cassava in 1964/66 whilst the northeast produced only 38.5%. By 1983/85 the northeast accounted for 57% of production and the center and south for less than 30% (Table 38).

The climatic and soil conditions of the northeast are much harsher than those of the center and south and, as a result, yields are lower. In the South, 7 out of every 10 years are considered as favorable for cassava production whereas in the northeast only 4 of ten are favorable. Furthermore even in good years the yields in the northeast are lower (Table 39).

Cassava production systems in the different regions

The myth has arisen that cassava is essentially a subsistence crop with almost all the production being used to feed the farmers that produce it. It is indeed an important source of calories for the farmer

Table 35. Participation of cassava (real values, base year=1977) in the production credit (millions of Cr$), in Brasil, 1972-1984.

Year	GPI (%)	Credit Cassava	Credit Total	Percentage (%)
1972	26.25	237	17740	1.34
1973	30.15	195	23841	0.82
1974	38.81	159	33585	0.47
1975	49.63	224	43669	0.51
1976	70.10	342	52306	0.65
1977	100.00	536	90879	0.59
1978	138.74	421	87888	0.48
1979	213.53	1432	91675	1.56
1980	427.47	2057	96490	2.13
1981	897.30	2404	93044	2.58
1982	1753.74	1446	98740	1.46
1983	4463.80	758	71754	1.06
1984	14311.70	803	51509	1.56
Average				1.17

Credit distribution by crop (average 1975/1985)

Crop	%
Soybean	22
Rice	14
Wheat	12
Coffee	11
Sugarcane	9
Maize	8
Cotton	6
Cassava	1
Others	18
Total	100

SOURCE: Anuario Estatístico do Brasil.

Table 36. Use of credit programs (%) for cassava.

	South	Southeast	Northeast	North
Production credit				
Government bank	5%	17%	28%	10%
Private bank	1%	7%	1%	
Without credit	94%	76%	71%	90%
Reasons not to use credit				
High interest rates	25%	14%	11%	26%
Too many procedures	5%	14%	22%	42%
Timing problems	1%	6%	7%	20%
Credit was disapproved			3%	8%
Minimum price program				
Storage option	3%		1%	
Sales option		1%		
No participation	97%	99%	99%	100%
Reasons not to participate				
Minimum price below costs of production	3%	13%	15%	33%
Intervention office did not purchase	17%	15%	27%	26%
Do not know program	40%	46%	42%	37%

SOURCE: Cassava survey. 1986.

Table 37. Trends in cassava production and area harvested.

Year	Area (ha)	Production (t)
1970	2,024,557	29,464,275
1973	2,103,991	26,558,535
1976	2,093,638	25,443,053
1979	2,111,052	24,962,191
1982	2,122,029	24,072,320
1985	1,865,756	23,072,553

SOURCE: IBGE. Anuario Estatístico.

Table 38. Pattern of cassava production (tri-annual averages) in the northeast and center-south.

Period	Northeast (%)	Center-south (%)
1964/66	38.5	56.5
1967/69	42.4	52.7
1970/72	42.6	52.5
1973/75	45.7	48.5
1976/78	51.9	40.0
1979/80	53.9	35.4
1983/85	57.3	28.1

SOURCE: IBGE. Anuario Estatístico.

Table 39. Subjective farmer's appreciation of cassava production and production circumstances.

Question	South	Southeast	Northeast	North
Of every 10 years, how many are				
Good	7	3	4	4
Normal	2	4	3	3
Bad	1	3	3	3
What is your yield in tons per hectare in a				
Good year	30	16	14	18
Normal year	23	11	9	11
Bad year	15	7	6	5
Average yield (t/ha)	27	11	10	12

SOURCE: Cassava Survey. 1986.

and his family, however, the view of cassava as a subsistence crop distorts the reality; cassava plays an important role as a generator of small farm income.

The production systems that are used differ widely depending on the region. There is obviously some variation in production systems within the various regions, however this is less than the variation between regions. In this chapter the most important characteristics of each of the production systems in the different regions are outlined. Nevertheless, one outstanding and uniform feature of cassava throughout the country is that it is essentially a small- or medium-sized farm crop (Table 40).

The north. The north of Brazil is commonly known as the "Rural Frontier." It is characterized by large reserves of virgin forest that form the largest potential area for agricultural expansion in the country. According to the 1980 agricultural census, 70% of the farms are of less than 50 ha with a further 12% between 50 and 100 ha (Table 40). These figures are however suspect. In the survey of cassava farms it was practically impossible to find farms of less than 50 ha.

Due to the great availability of land in the area farmers have increased the size of their holdings and the small farms in the region should be considered as those with 50 to 300 ha. These farms have a very narrow financial base, low availability of labor, and are supported by minimal infrastructure. These smaller farms, dedicated to the production of food and fruits, coexist with very large holdings of 1000 ha or more that produce perennial crops such as rubber, forest crops, and fruits. The lack of a dry period in this area makes it apparently favorable for agricultural production, however the fragile nature of these inherently infertile soils, which rapidly degrade when the forest is cleared, makes sustained agricultural production difficult. In addition the region is prone to periodic flooding. Cassava is the pioneer crop in the region that allows colonizers to get started and then to diversify their relatively large holdings with the inclusion of other crops in their production system; of the farms between 50 and 100 ha cassava planting averages 5.6 ha and occupies 80% of the crop area. It is generally planted as a monocrop or with maize or rice (Table 41). Over 90% of the production is destined to be converted to farinha (Table 42).

Farinha is the basic staple of the region. Grains are difficult to produce and dry in the humid environment and can only be imported to the region at great expense due to the distance from the production sites and also the poor infrastructure in general. The farinha of this area is different from that of the northeast: it is fermented before toasting, has a yellow color, and is known as "farinha d'aqua." This farinha d'aqua is a principle source not only of food but also of cash for the smaller farmers of the region who sell to the small markets developing in the villages which are rapidly appearing in the region.

The northeast. The northeast is characterized by large areas of under-utilized land and disparity in the farm size distribution. Six percent of the farms are greater than 100 ha while 67% of the holdings

Table 40. Distribution of farms by region and size.

Region	Total	Less than 10 ha	Between 10 and 50 ha	Between 50 and 100 ha	Greater than 100 ha
North					
Percentage of farms	100.00%	35.77%	34.58%	12.07%	17.20%
Average size (ha)	102	4	23	71	488
Northeast					
Percentage of farms	100.00%	67.61%	20.72%	5.32%	6.18%
Average size	36	3	23	68	420
Southeast					
Percentage of farms	100.00%	32.57%	39.53%	11.97%	15.71%
Average size	83	5	25	71	399
South					
Percentage of farms	100.00%	39.44%	48.37%	6.12%	5.98%
Average size	42	5	21	68	423

SOURCE: IBGE. 1980. Censo Agropecuario.

Table 41. Cassava farm characteristics.

	South	Southeast	Northeast	North
Area				
Less than 10 ha	35%	25%	78%	
From 10 to 50 ha	57%	41%	16%	
From 51 to 100 ha	6%	14%	3%	49%
Above 100 ha	2%	20%	3%	51%
Area appropriate for cropping (ha)	20.6	12.5	4.5	50.3
Area in:				
Crops	15.2	7.0	3.5	7.0
Pastures	6.5	17.1	2.0	19.2
Area with cassava	2.6	3.8	2.4	5.6
Cassava area as a percentage of:				
Area in crops	17%	54%	69%	80%
Area appropriate for crops	13%	30%	53%	11%
Percentage of cassava in:				
Monoculture	83%	87%	76%	55%
Mixed cropping	17%	13%	24%	45%

Table 42. Destination (%) of harvested cassava by region.

Use	South	Southeast	Northeast	North
Farinha production	3	53	68	91
Starch production	1	36	0	1
Animal feed	80	2	3	6
Fresh cassava sales	16	9	29	2

are less than 3 ha (Table 40). The most fertile soils with the most favorable rainfall distribution are on the coastal strip and further inland there are large cattle ranches interspersed with small farms dedicated mainly to the production of cassava. The region has traditionally been considered as the major farinha-producing area in Brazil.

Cassava is produced mainly by small farmers who plant an average of 2.4 ha. It is their most important crop occupying 69% of the cropped area. From the time when it is less than one-year-old, cassava is harvested continuously with most harvested by the time it is two years old (Table 43). Most of the harvest (69%) is used for farinha production, with smaller amounts (29%) sold either as aipim (fresh cassava) or for farinha production and minimal quantities (3%) are used for animal feed (Table 42).

The continuous harvesting of cassava for the production of farinha provides the farmer and his family with a steady food supply. Furthermore the ability to harvest over time is used by the farmers to obtain a regular cash flow (Table 43). This factor is of particular importance for the smaller farmers of this region who have historically had little access to credit.

The southeast. In an agricultural context, the southeast is a transition area between the northeast and the south. Land distribution is such that the majority (70%) of the land holdings are less than 50 ha with the typical farm being 25 ha (Table 40). Cassava production is concentrated on the areas that border the northeastern states. Climatic conditions are similar to those of the northeast but rainfall patterns are less variable and total rainfall tends to be greater.

The region is highly industrialized and the infrastructure is well developed. Cassava is mainly used for farinha production and to a lesser extent as a source of starch for the industry.

The south. The southern region is characterized by a relatively uniform pattern of land distribution; 88% of the farms are of less than 50 ha with an average size of about 25 ha (Table 40). The soil and climate are favorable for agricultural production and the infrastructure is well developed, especially for the handling of grains and animal products. The agriculture of the region is notable for the preponderance of small- and medium-sized farms, intensive use of the available land for the production of grains and grain legumes, and the production of pigs and dairy products (Tables 41, 42, 44). Cassava fits into the system mainly as livestock feed (Table 45) because of its high productivity per unit area, its low production costs, and its low capital requirements. In general about 80% of the cassava is used as animal feed, however whereas in Rio Grande do Sul this is for dairy, in Santa Catarina it is mainly fed to pigs. The remainder of the cassava is used as food on the farm or sold as aipim (fresh cassava). Farmers consider cassava to be their most important crop in terms of home consumption and for animal feed (Table 43). The average farm which uses cassava as an animal feed consumes 7-12 tons for cattle feed and about 14 tons as pig feed.

Table 43. Age of cassava at harvesting by region.

Age	South	Southeast	Northeast	North
Less than 12 months	36	4	20	38
From 12 to 18 months	39	51	51	49
From 19 to 24 months	20	31	24	11
More than 24 months	5	14	5	2
Reasons to harvest at different age:				
Cash flow	5	27	61	58
Price expectation	38	10	23	10

Table 44. Most important farm products by region in Brazil.

Use	South	Southeast	Northeast	North
Most important product for sale	Soy	Fresh cassava	Fresh cassava	Farinha
	Maize	Starch	Farinha	Rice
	Milk/pigs	Maize	Beans	Maize
Most important product for animal feed	Cassava	Maize	None	None
	Maize	Cassava	Cassava	Cassava
	Pastures	Pastures	Maize	Maize
Most important product for family nutrition	Fresh cassava	Fresh cassava	Farinha	Farinha
	Beans	Farinha	Beans	Rice
	Rice	Rice	Fresh cassava	Maize/bean

Table 45. Cassava as an animal feed in the south of Brazil.

Variable	Cattle			
	Fattening	Dairy	Double Purpose	Pigs
Farms involved in the activity	16%	56%	45%	50%
Number of animals	10	10	17	53
Number of months per year that cassava is used	7	7	8	9
Daily intake/animal (kg/day) of root	3.71	3.51	2.95	1.32
Green matter	.83	3.38	3.57	
Animal feed cassava consumption/farm/year (tons) of root	7.79	7.37	12.04	14.31
Green matter	1.74	7.10	14.57	

In this region the vast majority of the farmers (83%) grow cassava as a monocrop on an average area of 2.6 ha which corresponds to about 17% of their total land area (Table 41). Most of the cassava is harvested between 12 and 18 months and is available to feed livestock throughout most of the year (Table 44).

Private and Social Profitability of Cassava Production in Brazil

Private profitability of cassava production in Brazil

Production costs and production systems differ greatly in Brazil. While in the north of the country all production activities are done manually, in the south cassava production depends heavily on tractor or animal power. In the same way, intercropping with maize and rice is common in the north, while in the rest of the country monoculture is the most common production system. Input use is also very variable. In the north inputs are zero, except for the use of maize and rice seed in the intercrop. In the northeast inputs amount to Cr$438 per hectare--8% of production costs. The major input cost is organic fertilizer, which is applied on average at a rate of 3 t/ha. In the southeast input use is restricted to some insecticides, while in the south organic fertilizer is again a major input. Where used, tractors plus additional machinery make up from 12% to 21% of production costs. In production systems with animal traction, the oxen represent 6% to 13% of production costs. The marked differences in cost structure between cassava production systems can be appreciated in Table 46.

Except for the frontier areas of the north where land is still available almost gratis, land costs represent 20% to 25% of production costs. Land costs are higher in the northeast than in the south, which probably expresses the effect of the very uneven land distribution in the northeast.

Differences in cost structures are not so big as to conceal the dominating importance of labor in every production system. Labor is by far the biggest production cost component, varying from 47% in the south to 87% in the north. In Brazil cassava remains a crop with excellent opportunities to create employment. This is especially true in the north and northeast, where the labor costs correspond with a larger number of labor days than in the south because of lower wages.

The profitability of different production systems is not only determined by production costs, but also by yields obtained and prices received. Yield levels tend to move up from north to south, with the extensively managed systems of the north yielding only 7.4 t/ha and the well managed systems in the south yielding over 20 t/ha. Yield levels tend to depend on the use of machinery, oxen, or labor for land preparation. Manually prepared land yields less than oxen-prepared land, which in turn yields less than mechanically prepared land. On the basis of current data it is difficult to distinguish whether this is because of the method of preparation or because of differences in land quality which require different methods of preparation.

Table 46. Cassava budgets for different management practices and different regions, Brazil, 1986.

Variable	North: Monoculture manual	North: Cassava/maize/ rice manual	Northeast: Monoculture manual	Northeast: Monoculture tractor	Northeast: Monoculture oxen	Southeast: Monoculture manual	South: Monoculture tractor	South: Monoculture oxen
Production costs								
Labor	2275	2131.25	3483.75	3153.75	3075	2343.75	2000	2006.25
Inputs		125	438.75	438.75	438.76	29	324.5	324.5
Machinery			700				910	
Animals					330		375	
Land	200	200	1000	1000	1082	800	800	
Interest	148.5	147.375	295.35	317.55	290.6256	207.285	242.07	210.345
Total production costs	2623.5	2603.625	5217.85	5610.05	5134.385	3662.035	4276.57	3716.095
Yield (t/ha)								
Cassava	7.4	3	9.364	13.183	10.733	11.3	34.3	23.3
Rice		0.48						
Maize		0.3						
Price (Cr$/t)								
Cassava	350	350	375	375	375	350	350	
Gross income per hectare	2590	2499	3511.5	4943.625	4024.875	4237.5	12005	8155
Net income per hectare	-33.5	-104.625	-1706.35	-666.425	-1109.51	575.465	7728.43	4438.905
Income attributable to labor and land	2441.5	2226.625	2777.4	3847.325	2965.489	4001.215	10528.43	7245.155
Income per day of labor	26.82967	26.11876	23.91733	33.17302	28.93160	51.21555	363.2107	180.5646
Income per day of labor as % of market wage rate	107.3186	104.4750	79.73443	110.5770	96.43867	170.7185	526.4215	361.1292
Production costs per ton	354.5270	n.a.[a]	557.2244	425.5518	478.3737	324.0738	124.6813	159.4890
Costs per calorie	0.940990	n.a.	1.010155	0.771455	0.867212	0.639709	0.317699	0.406392

a. n.a. = not available.

Price levels are comparable through the country, slightly above the minimum price of Cr$348 per ton, imposed by CFP. However, care has to be taken in the interpretation of these price levels. In southern Brazil only 16% of the harvest is actually sold. When this cassava is sold for fresh consumption ("aipim"), its price is considerably higher, around Cr$2000 per ton. In the north only 2% is actually sold and the rest is used for onfarm production of "farinha da mandioca." Although in the northeast and the southeast larger proportions of the production are sold, more than half of all the cassava produced is transformed or consumed at farm level. In the north, northeast, and southeast cassava profitability is not only a function of yields, prices, and production costs, but also of processing parameters and farinha prices.

The profitability of cassava, given the aforementioned prices, can also be appreciated in Table 46. Four indicators have been developed: net income per hectare, income attributable to land and labor, income per day of labor, and cost of production per ton. The net income per hectare is negative in the north and the northeast and indicates that the value added in cassava cultivation does not allow complete remuneration of the factors of production. In the north the main reason for the negative net income is the low yield levels. In the northeast high production costs cause the negative net income. In the southeast, and more so in the south, the net income per hectare is positive and allows for area expansion or for future wage or land price increases. In fact, in the south the cassava area has been reduced over the last 10 years, but rural wages have already reached a level which is double that of the north and northeast.

The steady existence of cassava in the northeast and the north can be explained by considering the income attributable to labor and land. Even in the north more than Cr$2000 per hectare are available for this purpose. This shows that although land and labor are not remunerated according to going market rates, the farmer does not stay without an income. Underpayment of family resources is a well-known phenomenon in agriculture, partly explained by the problems that farmers and their families face in obtaining employment outside agriculture.

In fact, many farmers who own their land, will consider the cost of land as an integral part of their income. In that case the implicit income per day of labor would be higher than the going day wage in all cases except for the manual and oxen land preparation systems in the northeast. Since it is doubtful whether a farmer would have an equal amount of employment as a day laborer, it becomes clear why cassava production stays a preferable option for many farmers.

The regional differences in the implicit income per day of labor are striking. In the north and northeast the implicit income per day stays around Cr$30, whereas it is Cr$51 in the southeast and Cr$200 in the south. The enormous regional development problem, with large unequalities between south and northeast of Brazil, finds an easy expression in the different implicit incomes.

Costs of production for cassava are considerably lower in the south than in other regions. As a matter of fact, the production costs per calorie of cassava in the south are only about 40% of the production costs per calorie of maize. In the south, onfarm swine feeding, using cassava, has low feed costs and will leave comfortable profits to the cassava/swine producer. However, in a country the size of Brazil, utilization flexibility is not only determined by costs of production, but also by the potential of cassava within the region to substitute for other products. This would open up possibilities for cassava in the northeast, because, although production costs for maize are low in this region, regional maize production only satisfies 55% of local consumption (see p. 44-48).

Reduction of production costs in the north is greatly dependent on improving the ratio of yield levels to labor input. Yield levels may be increased by the introduction of fertilizers, or labor input may be decreased by the introduction of chemical weed control. Production cost reduction in the north has to be achieved simultaneously with improved yield levels and production systems in order to slow down frontier development.

In the northeast there seems to be considerable scope for reducing production costs by introduction of better technology and improved management practices. Management improvements should be directed mainly to the reduction of labor costs. The negative effects on employment that this would have, could be easily offset by the increased effective demand that cheaper cassava would face. Decreased production costs could be of great significance, allowing cassava to act as a maize substitute in order to reduce the maize deficit of the northeast while simultaneously improving profitability to the producer.

In the southeast, production costs are at present lowest in the production system involving manual land preparation. The future feasibility of this system in the region is limited, given the strong incentives for rural laborers to migrate toward industrial centers where wages are considerably higher. Cassava production will therefore have to take place in more mechanized systems, based on oxen or tractor power. The main reason for the relative high costs of production in this region are the low yield levels. Contrary to the northeast as well as the south, farmers in the southeast do not use organic fertilizer. Introduction of better soil fertility practices could be instrumental in increasing yields and reducing production costs.

In the south production costs are already very low. Production is intensively managed, input levels are high, yield levels are outstanding. Further cost reduction would probably be realized by improving mechanization practices and by introducing new varieties.

The profitability of "farinha da mandioca" and "polvilho" processing

"Farinha da mandioca" production is important in the north, northeast, and southeast of Brazil. Farinha is mainly processed in small-scale processing facilities, often at the farm. "Polvilho" or starch is an important product in the southeast where it is processed in plants with very varying sizes.

A rough calculation of variable "farinha da mandioca" processing costs is made in Table 47. On the assumption that 10 tons of cassava are needed to produce 3 tons of farinha, the raw material costs are equal to Cr$1250 per ton. Raw material accounts for 68% of variable farinha production costs and forms by far the biggest cost component. The second biggest cost component is labor, needed for peeling, chipping, and other processing activities. This sums up to Cr$420 or 23% of variable farinha production costs. Inputs (petrol, firewood, packings) total Cr$160 per ton, 9% of variable costs.

The calculation of starch-processing costs can be found in Table 46 as well. Raw material costs are considerably higher than in the case of farinha, because the conversion of cassava to starch is less efficient than the conversion to farinha. Labor costs in starch production are also considerably higher. This involves peeling, as well rasping, straining, and drying. Also fuel costs, to dry the starch, are high. However, since the price of starch is considerably higher than the price of farinha, starch production remains a profitable activity.

Variable costs for farinha production are already higher than farinha prices, which implies that the remuneration to production factors has to be below going market rates. If fixed costs, which mainly consist of depreciation and interest on investments, are assumed to be zero, than labor can still be paid only at 76% of the market rate of the northeast and southeast. Labor in farinha production is to a great extent supplied by the women and children of the farm family. Their ability to find productive and better paid employment outside the farm is often minimal, and forces them to supply their labor below the market rate.

In the southeast, cassava is in fact produced at Cr$60 below the assumed costs of Cr$375 per ton. In this case, the profitability of producing cassava compensates for the losses in farinha processing. Although cassava production looks a profitable activity and cassava processing an unprofitable activity, the integrated activity of production and processing breaks more or less even in this region. Additionally, a profit can be made in starch processing.

In the northeast the situation is less rosy. The net profitability of cassava production was shown to be negative, to the extent that farmer-owners, who do not reckon land costs, are still perceiving a daily income which is below the market wage rate. In this case, the integrated activity of cassava production and processing maintains itself only because the income alternatives for the farmer and his family outside agriculture are reduced. Given the dominance of raw material costs in the total costs for farinha processing, the profitability of cassava production and processing will be most rapidly improved by decreasing production costs.

The Domestic Resource Costs of Cassava Production in Brazil

In Brazil, as in most other countries, internal prices are not freely formed in the confrontation of demand and supply, but are partly

Table 47. Variable processing costs (in Cr$) of farinha and starch, Brazil.

Costs	Farinha production	Starch production
Raw material	1250	2250
Peeling	150	270
Chipping	100	180
Other salaries	170	420
Petrol	10	180
Firewood	70	0
Packing	80	140
Total costs	1830	3440
Farinha price/ton	1730	3660
Losses per ton of farinha cassava/ton	-100	220
Labour payment/ day wage	0.76	1.25

determined by existing subsidy and tax structures, as well as by existing market rigidities. Regarding costs, price deviations represent transfers of income by the rest of the economy to (in case of subsidies) or from (in case of taxes) producers. Considering output prices, subsidies imply a transfer to and taxes imply a transfer from producers. These price deviations imply that the private profitability of an activity is not necessarily equal to the profitability of the activity for the country as a whole. This complicates the understanding of which activities are most economically performed in the country, as regards to questions of domestic production versus imports, or the production of certain commodities versus their substitutes.

Therefore, apart from the private costs of cassava, it is useful to understand the social costs of cassava production, that is, after correction for subsidies, taxes, and market rigidities. This parameter, as calculated in domestic resource costs (DRC) analysis, indicates to what extent internal production of cassava is preferable to the importation of cassava or its substitutes, or to what extent cassava production uses more or fewer resources than the production of its substitutes.

International cassava trade to and from Brazil is almost zero, with the slight exception of some dried cassava that was incidentally exported to Western Europe in the seventies. This means that the comparison of domestic cassava production with cassava imports is not relevant. However, within the country, cassava flour is a partial substitute for wheat flour, while dried cassava is a substitute for feed grains such as maize and sorghum.

Production prospectives of cassava flour versus wheat flour

As regards to the possible substitution of cassava flour for wheat flour, it is difficult to make a correct DRC-analysis due to the absence of reliable wheat production costs data. It is also hard to estimate, to what degree the two products can actually substitute each other. Nevertheless, some brief remarks on the substitution between wheat and cassava flour can be made. Since the beginning of the seventies, the wheat price was heavily subsidized in order to stimulate wheat production and to decrease the cost of the diet of the urban poor. Seventy-one percent of the acquisition costs of wheat by the wheat mill are covered by a government subsidy, which results in a 65% subsidy of the price of wheat flour or a 38% subsidy of the price of bread. As a result of the wheat subsidy, cassava flour, which was 35% cheaper in 1970, became three times as expensive in 1980 (Table 48). Without the subsidy cassava flour and wheat flour would have been in the same price range. Although the 1980 wheat-flour/cassava-flour price ratio still implies certain progress of wheat-flour productivity versus cassava-flour productivity, cassava-flour consumption would probably not have dropped so quickly as it appears to have done. The firmly established wheat subsidy policy has increased wheat production and has decreased the cost of the diet of the urban poor, but has done this at the cost of the income of the cassava farmer and processor.

Table 48. Relationship between farinha da mandioca and wheat consumption, and their respective prices, Brazil.

	1960	1970	1980
Farinha consumption (kg per capita)	26.3	23.5	12.0
Wheat consumption (kg per capita)	26.2	25.2	45.5
Farinha: wheat consumption	1.00	0.93	0.26
Farinha: wheat prices	0.61	0.64	2.95

Production prospectives of dried cassava as an animal feed

Although production costs for cassava and maize in Brazil are affected by a number of subsidies and taxes, the potential for dried cassava to substitute maize and sorghum as animal feed raw material is not constrained by government interventions similar to those in the case of wheat. As mentioned before (p. 71), the potential of cassava to substitute for maize looks best in the northeast.

In 1986 maize was supplied in the northeast from four areas. The first area of supply was the northeast itself. Data of CFP (Companhia de Financiamento da Producao) for 1985, that were corrected for inflation, suggest production costs for local maize of around Cr$1517 per ton (Tables 49 to 59). The second area that supplied maize to the northeast is the south. Maize is shipped by sea from Paraná to Pernambuco or Ceará and is mainly consumed in coastal areas. The costs of supplying this maize to the northeast are around Cr$1616 per ton, 45% of which are transport costs. The third area which supplies the northeast is central west, mainly the department of Goias. Maize from this area is transported by truck to those areas of the northeast that cannot easily be reached from the ports. In 1986 this maize could be supplied at a cost of Cr$2494 per ton. Transport absorbs 50% of the costs of supplying this maize, due to the long distances, the bad roads, and the absence of return freight. Also maize was imported at a cost of approximately Cr$1705 per ton. Maize from the region as well as from the south would compete with CIF maize import prices, but maize from Goias would only find its way into the market through the minimum price schemes operated by CFP (this means buying at a price of Cr$1480 per ton in Goias, transporting to a deficit region and selling at the going market rate, while absorbing the transport costs).

In the costs for supplying maize from the northeast the cost of capital is very high (Tables 50 to 55). This is due to the fact that these cost data were gathered when inflation and, therefore, interest rates were still galloping. If these production cost data had been gathered after the establishment of the Plan Cruzado-I, other cost factors would have been higher while capital costs would have been lower. Because of the low yield levels (estimated at 1350 kg/ha) land costs were also high.

Inputs form a considerable part of the cost of supplying maize for all the three systems studied. For maize from the northeast, inputs constitute almost 30% of total supply cost; for maize from the south and central west, it takes, respectively, 40% and 60% of total supply cost. Fuel for transport or traction is a very important input and, since Brazil is a net importer of energy, it involves a relative high cost to the country in terms of foreign exchange.

As part of the Plan Cruzado-I, which tried to control the galloping inflation, maize prices were frozen in 1986 at a price level of Cr$1483 per ton. The difference between the frozen price and the actual costs of supplying maize was absorbed from the government's budget. This does not appear to be a long-term policy and therefore has not been taken into account in the present analysis.

Table 49. Private and social costs of supplying maize or dried cassava in the northeast of Brazil, 1986.

	Private costs	Social costs
Locally produced maize	1516.6	1404.8
Maize from the south	1615.9	1467.5
Maize from central west	2493.9	2130.1
Imported maize	1705.0	1675.0
Locally produced dried cassava	1455.1	1379.4
Locally produced dried cassava, factors paid at opportunity costs	1306.4	1230.7

Table 50. Northeast local maize production and supply costs, per ton, nominal prices,[a] 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	18.5	444.4	101.4	18.0	3.2	585.4
Variable costs	275.9		133.5	313.6	9.3	732.2
Total costs	294.3	444.4	234.8	331.6	12.5	1317.7
Price	Cr$3.25/ha	Cr$600/ha	n.a.[b]			
Transportation						
Fixed costs	44.1		25.9	33.4		103.4
Variable costs	12.1			83.4		95.5
Total costs	56.3		25.9	116.7		198.9
Total						
Fixed costs	62.6	444.4	127.3	51.4	3.2	688.9
Variable costs	288.0		133.5	396.9	9.3	827.7
Total costs	350.6	444.4	260.7	448.3	12.5	1516.6

a. Cr$14.2 = US$1.00.

b. n.a. = not available.

Table 51. Northeast local maize production and supply costs,[a] per ton, shadow prices, 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	18.5	444.4	98.9	14.4	3.2	579.4
Variable costs	275.9		120.1	256.9	9.3	662.2
Total costs	294.3	444.4	219.0	271.3	12.5	1241.6
Price	Cr$3.25/ha	Cr$600/ha	n.a.[b]			
Transportation						
Fixed costs	44.1		20.7	26.7		91.6
Variable costs	12.1			59.5		71.6
Total costs	56.3		20.7	86.2		163.2
Total						
Fixed costs	62.6	444.4	119.6	41.1	3.2	671.0
Variable costs	288.0		120.1	316.4	9.3	733.8
Total costs	350.6	444.4	239.7	357.5	12.5	1404.8

a. Cr$14.2 = US$1.00.

b. n.a. = not available.

Table 52. Northeast maize supply costs[a] from the south per ton, nominal prices, 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	27.5	220.0	27.5	56.6		331.6
Variable costs	330.0		32.2	193.2		555.4
Total costs	357.5	220.0	59.7	249.7		887.0
Price	Cr$6.25/ha	Cr$800/ha	n.a.[b]			
Transportation						
Fixed costs	107.5		133.7	163.4		404.6
Variable costs	95.8			228.5		324.3
Total costs	203.2		133.7	392.0		728.9
Total						
Fixed costs	135.0	220.0	161.2	220.0		736.2
Variable costs	425.8		32.2	421.7		879.7
Total costs	560.8	220.0	193.5	641.7		1615.9

a. Cr$14.2 = US$1.00.

b. n.a. = not available.

Table 53. Northeast maize supply costs[a] from the south per ton, shadow prices, 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	27.5	220.0	26.7	45.2		319.4
Variable costs	330.0		31.3	175.0		536.3
Total costs	357.5	220.0	57.9	220.3		855.8
Price	Cr$6.25/ha	Cr$800/ha	n.a.[b]			
Transportation						
Fixed costs	107.5		106.7	130.8		344.9
Variable costs	95.8			171.0		266.8
Total costs	203.2		106.7	301.8		611.7
Total						
Fixed costs	135.0	220.0	133.3	176.0		664.3
Variable costs	425.8		31.3	346.1		803.1
Total costs	560.8	220.0	164.6	522.1		1467.5

a. Cr$14.2 = US$1.00.

b. n.a. = not available.

ble 54. Northeast maize supply costs[a] per ton, nominal prices, 1986, Goias, Brazil.

sts	Factor costs			Input cost		
	Labor	Land	Capital	Tradeables	Nontradeables	Total
rm level						
ixed costs	37.0	200.6	48.6	100.2		386.4
ariable costs	150.2		40.2	663.1		853.5
otal costs	187.3	200.6	88.8	763.3		1239.9
rice	n.a.[b]	Cr$461/ha	n.a.			
ansportation						
ixed costs	173.5		156.9	192.8		523.2
ariable costs	148.0			582.8		730.8
otal costs	321.5		156.9	775.6		1254.0
tal						
ixed costs	210.5	200.6	205.5	293.0		909.5
ariable costs	298.3		40.2	1245.9		1584.3
otal costs	508.8	200.6	245.7	1538.8		2493.9

Cr$14.20 = US$1.00.

n.a. = not available.

able 55. Northeast maize supply costs[a] per ton, shadow prices, 1986, Goias, Brazil.

	Factor costs			Input costs		
osts	Labor	Land	Capital	Tradeables	Nontradeables	Total
arm level						
?ixed costs	37.0	200.6	38.9	80.1		356.6
/ariable costs	150.2		35.2	564.1		749.5
Total costs	187.3	200.6	74.0	644.2		1106.1
?rice	Cr$6.25/ha	Cr$800/ha	n.a.			
ransportation						
?ixed costs	173.5		130.3	154.2		458.0
/ariable costs	148.0			417.0		566.0
Total costs	321.5		130.3	572.2		1024.0
otal						
?ixed costs	210.5	200.6	169.2	234.4		814.6
/ariable costs	298.3		35.2	982.0		1315.5
Total costs	508.8	200.6	204.4	1216.4		2130.1

. Cr$14.20 = US$1.00.

. n.a. = not available.

Table 56. Northeast dried cassava production, processing and marketing costs,[a] per ton, nominal prices, 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	86.4	189.6	26.5	79.6		382.2
Variable costs	538.3		63.1	7.0	76.2	684.5
Total costs	624.6	189.6	89.6	86.6	76.2	1066.7
Price	Cr$3.25/ha	Cr$1000/ha	6%			
Processing						
Fixed costs	35.3	0.9	11.4	48.8		96.4
Variable costs	70.3		6.2	15.5		92.0
Total costs	105.6		17.6	64.3		188.4
Transportation						
Fixed costs	44.0		26.0	34.0		104.0
Variable costs	12.0			84.0		96.0
Total costs	56.0		26.0	118.0		200.0
Total						
Fixed costs	165.6	190.5	63.9	162.5		582.6
Variable costs	620.6		69.3	106.5	76.2	872.5
Total costs	786.2	190.5	133.2	269.0	76.2	1455.1

a. Cr$14.20= US$1.00.

Table 57. Northeast dried cassava production, processing and marketing costs,[a] per ton, shadow prices, 1986, Brazil.

	Factor costs			Input costs		Total
	Labor	Land	Capital	Tradeables	Nontradeables	
Farm level						
Fixed costs	86.4	189.6	21.2	59.7		357.0
Variable costs	538.3		63.1	5.6	72.4	679.3
Total costs	624.6	189.6	83.0	65.3	72.4	1036.3
Price	Cr$3.25/ha	Cr$1000/ha	6%			
Processing						
Fixed costs	35.3	0.9	10.7	46.2		93.0
Variable costs	70.3		6.2	10.9		87.4
Total costs	105.6		16.9	57.0		180.3
Transportation						
Fixed costs	44.0		20.8	27.2		92.0
Variable costs	12.0			58.8		70.8
Total costs	56.0		20.8	86.0		162.8
Total						
Fixed costs	165.6	190.5	52.7	133.1		542.0
Variable costs	620.6		69.3	75.2	72.4	837.5
Total costs	786.2	190.5	122.0	208.3	72.4	1379.4

a. Cr$14.20 = US$1.00.

ıble 58. Northeast dried cassava production, processing and marketing costs[a], per ton, nominal prices, opportunity costs for labor and land, 1986, Brazil.

	Factor costs			Input costs		
	Labor	Land	Capital	Tradeables	Nontradeables	Total
ırm level						
'ixed costs	95.5		26.5	79.6		201.7
'ariable costs	595.2		63.1	7.0	76.2	741.5
:otal costs	690.7	0.0	89.6	89.6	76.2	943.1
'rice	Cr$3.60/ha	Cr$0.0/ha	6%			
:ocessing						
'ixed costs	26.9	0.9	11.4	48.8		88.0
'ariable costs	53.6		6.2	15.5		75.3
:otal costs	80.5		17.6	64.3		163.2
:ansportation						
'ixed costs	44.0		26.0	34.0		104.0
'ariable costs	12.0			84.0		96.0
'otal costs	56.0		26.0	118.0		200.0
otal						
'ixed costs	166.4	0.9	63.9	162.5		393.7
'ariable costs	660.8		69.3	106.5	76.2	912.7
'otal costs	827.1	0.9	133.2	269.0	76.2	1306.4

. Cr$14.20 = US$1.00.

ble 59. Northeast dried cassava production, processing and marketing costs, per ton, shadow prices, opportunity costs for labor and land, 1986, Brazil.

	Factor costs			Input costs		
	Labor	Land	Capital	Tradeables	Nontradeables	Total
rm level						
ixed costs	95.5		21.2	59.7		176.5
ariable costs	595.2		63.1	5.6	72.4	736.3
otal costs	690.7	0.0	89.0	65.3	72.4	912.7
rice	Cr$3.60/ha	Cr$0.0/ha	6%			
ocessing						
ixed costs	26.9	0.9	10.7	46.2		84.6
ariable costs	53.6		6.2	10.9		70.6
otal costs	80.5		16.9	57.0		155.2
ansportation						
ixed costs	44.0		20.8	27.2		92.0
ariable costs	12.0			58.8		70.8
otal costs	56.0		20.8	86.0		162.8
tal						
ixed costs	166.4	0.9	52.7	133.1		353.1
ariable costs	660.8		69.3	75.2	72.4	877.7
otal costs	827.1	0.9	122.0	208.3	72.4	1230.7

Cr$14.20 = US$1.00.

Although maize production is not subsidized in a similar way to wheat, the private costs of supplying maize do not form a true reflection of the social costs, because a number of taxes on inputs increase maize production and marketing costs. For example, although Brazil produces most of its tractors itself, this production takes place behind a tariff wall of 30% on the CIF-value of every imported tractor. Similarly, there is a duty of 50% added value on most agrochemicals. Internal taxes on nontradeable inputs could have disrupted further the picture of social versus private costs, but happened to be zero for all inputs considered. This means that costs have to be corrected mainly for the import duties on tradeable cost items in order to obtain an unbiased judgment on the social costs of maize production.

Correcting these costs is complicated in the case of Brazil for a number of reasons. Brazil maintains some 28 different import regimes and it is difficult to discover which import regime has been effective for a certain product. In the case of production behind a tariff wall, as in the case of tractors, the nominal duty might be higher than the real duty needed to protect the industry. Additionally, although it may appear that the internal production of a certain commodity is inefficient in comparison with external production, the abolition of internal production may raise the request for foreign exchange to so high a level that internal production would appear efficient (a paradox similar to the one that can be found in defining a Pareto-optimum). Given these complications, the probable social costs of supplying maize to the northeast are outlined in Table 49.

Maize can be supplied to the northeast at a social cost of Cr$1405 when coming from the region, at a cost of Cr$1467 when coming from the south, at a cost of Cr$2130 when coming from Goias, or at a cost of Cr$1675 when imported (Table 49). Within the social costs of maize supply, inputs play a less dominating role, but can still absorb more than 50% of total costs.

Dried cassava can be supplied to the northeast at an approximate private cost of Cr$1455 per ton (Table 49). Comparable shares of some 14% are needed to process fresh into dried cassava and to transport dried cassava to the consumer. The rest, over 70%, are production costs (Tables 56 to 59). The cost structure of cassava supply demonstrates that more than 50% of the total costs are labor costs, while only 20% are input costs. Cassava is basically supplied by production factors and needs at considerably lower input levels than maize.

After correcting the private costs for subsidies and taxes a social cost of cassava supply of Cr$1379 per ton results (Table 49). The costs of supplying dried cassava in that case vary between 98% of the cost of local maize to 65% of the cost of maize from Goias. Since Brazil might well be importing maize in the coming years, the cost of supplying dried cassava versus the cost of supplying imported maize is especially relevant. This value is around 83%.

It should be taken into account that, at the moment, the farmer in the northeast does not receive complete remuneration for his production factors. In the most profitable system the net income per hectare still stays at Cr$666 negative. At the same time, processing labor receives only 76% of the market wage. If cassava supply costs are calculated, not on the basis of market prices, but on the basis of the present remuneration of production factors, the supply costs as presented in the bottom of Table 49 result. In this case, dried cassava could be supplied at Cr$1306 per ton, if calculating at private costs, or at Cr$1231 per ton, if calculating at social costs. At private costs the cost of supplying dried cassava vary between 86% and 52% of the cost of supplying maize, at social costs they vary between 88% and 58%.

The competitiveness of dried cassava versus maize as a balanced animal feed raw material is summarized in Table 60. Linear programming models have already shown that dried cassava would be an efficient substitute for maize in layer hen rations at 74% of the maize price. That would make dried cassava competitive in comparison with maize from Goias or with imported maize, but in the last case only if calculated with shadow prices and opportunity costs of labor and land. Although dried cassava forms an attractive option from the national point of view, some government support (for example, credit subsidies on processing equipment or transport cost reduction) would be necessary to make it a viable option for the private enterprise. Dried cassava enters as a maize substitute in pig rations at 86% of the maize price. It would therefore be competitive with imported maize or brought in from Goias and, if calculated with opportunity costs for land and labor, with maize supplied from the south.

Regarding the competitiveness of dried cassava versus imported maize, it is important to consider the effect of the exchange rate. For every 10% that the exchange rate goes down, the price ratio of dried cassava versus imported maize would decrease with some 6%. The exchange rate of Cr$14.2 to the U.S. dollar, used in this study, was the official exchange rate in October 1986. However in the black market, the exchange was almost double. therefore, it is not unrealistic to state that Brazil's exchange rate at the moment of analysis, was overvalued by at least 20%. In that case, dried cassava would be fully competitive with imported maize as an energy source for layer-hen rations, or any other balanced animal feed, especially if production factors are paid at full market rate instead of their presently low opportunity costs.

It should be noted that cassava already plays an important role as fresh animal feed in southern Brazil. It has potential to play an important role in the dried form in northeast Brazil. There is also obvious potential for cassava to form part of swine rations, and there also appears to be potential to form part of layer-hen rations. Improved production technology that would decrease the cost of dried cassava would enhance this potential. Additionally, increased feed availability can be expected to stimulate further growth of the animal feed and animal production sector, partly creating its own demand.

In former days, when Brazil was a residual exporter of maize, dried cassava production in the northeast replaced maize from Goias, which was exported at a considerable loss. Production of dried cassava in the northeast therefore invoked a regional development conflict between the northeast and the central west. At the moment, Brazil is not

Table 60. Costs of supplying dried cassava[a] as a percentage of the cost of supplying maize, northeast region of Brazil, 1986.

Maize supply region	Remuneration of factors in cassava production			
	At market wage		At opportunity costs	
	Costs		Costs	
	Private	Social	Private	Social
Local	96	98	86	88
South	90	94	81	84
Central west	58	65	52	58
Imported	85	83	77	73

a. Maximum price ratios at which dried cassava forms part of balance feed: Laying hens: 0.737 (7% participation); Pigs: 0.865 (16% participation).

self-sufficient in maize production, and any increase in local production of maize or its substitutes would be welcome. Dried cassava would not only contribute to the rural development of the northeast, but would also allow Brazil to divert its scarce foreign exchange from maize to other products.

Conclusions: The Need for Cassava Development in Brazil

Cassava is an important crop in Brazil. It holds eighth place as regards to area planted, and seventh place regarding monetary value. After rice and sugar, it shares third place with wheat, beans, oils, and fats in providing calories for the Brazilian diet. Cassava is an especially important crop in Brazil because it is grown mostly by small farmers and consumed mostly by poor urban or rural consumers. Therefore the crop can play a dominating role in equity oriented programs that aim to mitigate the effects of the skewed income distribution of the country.

The importance of cassava stems not only from its monetary value, but also, possibly to an even larger extent, from the specific functions it has performed and will perform within the Brazilian economy. One of these functions is the provision of a gradual, well-spread cash flow to severely financially constrained farmers. This steady cash flow allows these farmers to purchase daily life essentials through most of the year without having to borrow at often excessive rates.

Another function of cassava has been its availability in times of drought and famine. During the drought period from 1978 to 1983 in the northeast of the country, cassava was, for many people, the first and often only relief from starvation. For the government it was one of the buffers against social unrest.

A third important function stems from its ability to grow in marginal agroecological conditions. In many parts of the northeast it forms the only viable crop for the peasant population, and in northern Brazil it allows the colonizers a readily accessible calorie source to survive the first tough years of opening up the land.

Finally, because of its high-yield potential per hectare, it forms an extremely cheap calorie source for onfarm animal feeding, particularly in southern Brazil. Here the availability of high-yielding cassava has allowed small and intermediate farmers to intensify their agricultural operations, venturing into export crops such as soybean, and pig production.

Brazil is the most important cassava producer of the world, but this position is apparently at risk because of the reduction in production that has taken place in the last 15 years. Between 1970 and 1985 production went down from 29 to 23 million tons, which means that per capita production was almost halved.

The urbanization process, which always tends to negatively affect rurally produced traditional staples, has been a first cause for the decreasing importance of cassava. In the rural areas of Brazil consumption levels of fresh cassava as well as farinha are about three times as high as in the urban areas.

Another reason for the decreasing importance of cassava can be found in the agricultural policies of Brazil. Most agricultural policies of Brazil have been directed toward export promotion (soybean, cotton) and, in a later phase, import substitution (sugarcane and, to a certain extent, wheat). The most important policy instruments have been the provision of subsidized credit as well as the development of a minimum price support program. The direct budgetary costs of these programs have not been excessive, certainly not compared to spending in USA or EEC agriculture, except for the case of wheat, where a price subsidy of over a billion U.S. dollars takes place. However, the emphasis on export crops came at the expense of domestic food crops. As a result, growth in food supply in Brazil has been inadequate and the nutritional condition of the Brazilian population is poor.

Low-input crops such as cassava are naturally disadvantaged by credit subsidies, but additionally the amounts of credit available for cassava were very much smaller than those for example, soybean, cotton, or maize. On top of that, most cassava farmers have problems fulfilling the official requests for credit. At the same time, it appears that the minimum price programs for cassava (flour) have not been functioning well. These factors have led to large-scale substitution of cassava by soybean, especially on the fertile land of the south.

Moreover, the regional development policies pursued by the Brazilian government did not favor cassava. Since the sixties and the foundation of Brasilia most efforts have been directed towards opening up the agricultural frontier in central west Brazil. The south and southeast, which had relatively high development levels anyway, could autonomously finance infrastructure expansion. They also benefited from the spinoff from the development of the central west and by the export-oriented agricultural policy, directed to crops grown in the south. The northeast, where cassava production was concentrated, not only was neglected but was adversely affected by regional policies in the rest of Brazil.

The knockout blow for cassava in Brazil has been the wheat subsidy. Between 1970 and 1980 wheat prices decreased from about equal to only one-third of the farinha prices. Consequently, wheat consumption doubled, at a high cost to farinha consumption.

Just as the present status of cassava has been defined by agricultural policy, its future role will also be determined by policies. The question, therefore, is to what extent the existing policies can be expected to stay the same or to change in favor of or against cassava production and utilization.

In 1985 Brazil returned to a democratic government, after two decades of military rule. The new democratic government is more inclined to direct policies to those fields where the benefits for the electorate are largest. Among other objectives, adequate nutrition of the population and control of the previously galloping inflation will be stressed. For both reasons it is not expected that the wheat subsidy will be eliminated, but it may well be that other food products will receive more attention.

At the same time the democratic government is looking for development opportunities in the northeast where more than 35 million people are living. In collaboration with the World Bank, a special program for the northeast (SUDENE) has been established. Within this program cassava development could help to improve income prospects of the rural poor.

A third consideration for the Brazilian government is the continued scarcity of foreign exchange, mainly due to the large interest and debt service payments. Consequently, the government is interested in autonomous development of its industrial sector and in maximum levels of agricultural self-sufficiency. The growth of the Brazilian animal-feed industry up to the present has been mainly supported by domestic maize production, incidentally supplemented with imported maize. In this respect, it has responded satisfactorily to the government desire to save foreign exchange. However, it appears infeasible that maize supply will grow quickly enough to maintain the historic growth rate of the animal feed industry. Instead of importing maize, the government could decide to promote the use of dried cassava in animal feed rations. Apart from the positive effect on foreign exchange availability, this could shift the regional balance of animal feed production (and probably swine and poultry production and consumption) towards the northeast.

The recent changes in the Brazilian political environment will have lasting effects on the government's policies. Issues that were neglected until recently will receive more attention. The government will emphasize the development of the northeast, will try to control inflation, will try to improve the nutritional status of the poor urban dweller, and will attempt to redress its balance of payment. It can be concluded that the future for cassava in such an environment is more promising than in the past. In the same way, it can also be concluded that cassava's potential to contribute to government policies is larger than in the past. However, to realize cassava's contribution towards development it is necessary to focus on the most appropriate ways of utilization.

At present, cassava is mainly utilized in four different forms in Brazil. The most important form is farinha. Farinha consumption has been declining over the last 15 years, basically because its relative price has become less competitive. It remains and will remain, however, a very important product for the Brazilian consumer, especially for the very poor. Given the increasing numbers of poor people in the Brazilian cities (the urban income distribution has become notably worse) it can even be shown that farinha demand at constant prices has increased over the last ten years.

To improve the role of farinha as a staple food an integrated strategy is necessary. Increased per capita consumption will basically depend on better availability, better quality, and lower prices. Therefore, efforts should be undertaken to decrease the costs of cassava production and to streamline farinha processing and distribution. The distributive impact of cheaper farinha is considerable. Pachico (1981) calculated that 46% of potential benefits would accrue to the poorest 25% of the population. Williamson-Gray (1982) calculated that of each dollar of subsidy spent on farinha 60 cents would be transferred to the poorest 30% of the population. For bread and rice those figures would only be 18 and 23 cents. Nutritional policies aimed at adequate dietary intake could be conveniently focused around farinha. Such a policy would have a relatively small leakage to more wealthy consumers and would be both cheap and effective.

The second traditional utilization is "aipim" (fresh cassava). "Aipim" consumption levels are under extreme pressure because of the exorbitant marketing margins that are charged (over 80%). For fresh cassava to play a larger role as a secondary staple or vegetable, it is necessary to diminish these marketing margins. The introduction of storage techniques, which might have an additional effect on "aipim" quality, will be critical for increased fresh consumption.

The third utilization of cassava in Brazil is as starch. Cassava starch is easily interchangeable with maize or sorghum starch and its competitiveness depends mainly on the price/quality relation at which it can be supplied to the market. Since 65% of starch production costs are for raw material, the reduction of production costs becomes the critical factor. At the same time, ways in which costs of processing can be diminished or ways in which quality of the final product can be improved should be evaluated.

The fourth utilization is for onfarm animal feeding. It can be safely stated that the utilization potential for onfarm cattle and swine feeding in Brazil is immense. Realization of this potential is dependent on further reduction of costs of production, together with improved storage and feeding systems. Silage systems, such as at present developed in Mexico, might have special value for this purpose.

Apart from the existing end uses, the development of dried cassava production for animal feed purposes has great potential. Present production costs already allow the introduction of dried cassava in animal feed rations, but with improved production technology the benefits of dried cassava to both producers and consumers are going to be enormous. A dried cassava industry would diminish the need to import maize, would stabilize cassava onfarm prices and would greatly extend the market size for the crop. A rough estimate suggests that in the northeast alone around 3.5 million tons of cassava per year could be used in animal feed.

The variety of end uses and the strong differences between the regions of the country allow and necessitate the development of specific regional cassava programs. As far as the north is concerned, it is expected that cassava will maintain its role as a settler's crop. Appropriate development of cassava hinges on striking the right balance between ecological considerations such as yield sustainment and minimal erosion, and the colonist's anxiety for land. In the north settlers occupy large areas of land, often more than 100 hectares per farm. The intensive cultivation of cassava could decrease minimum farm sizes and reduce the rate of frontier movement.

In the northeast, cassava development should be directed towards the creation of a dual market system. For the coming decade, farinha will stay the most important utilization of the crop and a strong effort should be made to maintain its critical role in the northeast diet. Nevertheless, in an environment of continuing urbanization and wheat subsidies, its market prospects are not expansive. Since the small farmer in this region is dependent on cassava, the opening up of the animal feed market will be highly beneficial for his earning capacity. Apart from the development and extension of cassava drying and industrial marketing systems, the success of this alternative market outlet will be greatly determined by the degree to which production costs are decreased. Since reduced production costs are also essential for the maintenance of farinha consumption, this implies that there is a basis for developing a strategy for both farinha and animal feed production development.

The southeast of Brazil has the most complicated utilization pattern, with farinha, starch, fresh cassava, and onfarm feeding existing simultaneously. The starch market appears to have good prospectives for income, market development, and competitiveness reasons. Further development of it will depend on reducing production costs, basically by increasing the relatively low-yield levels of the region.

In southern Brazil, the dominate cassava market is for cassava as an onfarm animal feed. Enhancing cassava's role in this burgeoning market segment depends on a further decrease in production costs. These are already low, but might be reduced by the introduction of improved genetic material. Increasing cassava's importance for onfarm feeding would be an indirect means of increasing protein availability in urban and rural diets as well as farmers' incomes.

In the south fresh cassava consumption is higher than in any other region. The introduction of storage methods would allow fresh cassava consumption to stabilize itself or increase above present levels. This, in turn, will improve its role as an income source for urban-oriented fresh vegetable producers.

It is clear from the analysis described previously that cassava will have a prominent role in the agricultural sector of Brazil. The ability of cassava to substitute for feed grain imports, to supply calories to the poorest strata of society, to provide incomes and steady cash flows to small farmers with marginal land resources, and to provide semi-industrial employment in processing activities will convert the crop into an efficient agricultural policy instrument. The present political situation, in which a newly established democratic government tries to direct its policies more to the welfare of the overall electorate, provides the best opportunity of the last thirty years for cassava to contribute to balanced economic development of this South American giant. Appropriate inclusion of cassava in its development plans will surely guarantee the consolidation of Brazil's first place in the world's cassava league.

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COLOMBIA: POTENTIAL DEMAND FOR CASSAVA

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Macroeconomic Policy and Agriculture

This section focuses on the various economic aspects that have influenced resource allocation in Colombia, particularly between the agricultural sector and the rest of the economy (in a macro context) and within the agricultural sector during the past two decades. The analysis of the set of policies applied should contribute to the understanding of the role that the food and fiber sector have played in the development of the country, how that role has evolved, and more importantly how it is likely to evolve in a near future. Once we reach an understanding of this participation, we will focus on the role of cassava and its products and their potential demand in the near future. Potential demand will be determined by focusing on the consumption of carbohydrates by humans, for which cassava plays a basic role, and on the market for meats where cassava can be incorporated as a source of energy in feed rations.

Economic policy context

The Colombian economy has experienced stable and rapid growth since the mid-1950s. This growth has had as its platform, the performance of the agricultural sector which contributes nearly a quarter of the gross domestic product (GDP) (Table 1), close to two-thirds of export earnings (mainly from coffee) and one-third of total employment in the economy. Agriculture's share in GDP is twice as high in Colombia as it is for Latin America and the Caribbean (LAC) region. Overall, Colombia's per capita GDP for 1985 was US$1,243 (15 among 25 LAC countries, Table 2).

Real GDP grew at an annual rate of 4.2% from 1964 to 1967, 6.4% from 1967 to 1974, and at 5.3% from 1975 to 1980, only to slow down in to 1.9% from 1981 to 1985. This growth was accompanied by rates of growth of 2.8%, 4.7%, 4.1% and 1.4% for the agricultural sector, respectively. Population growth was around 2.1% per year in the period 1965-85, and has since decreased to about 1.5% per year. Urban population accounts for 70% of the total. International reserves were US$3 billion at the end of 1986. For this same year, exports are calculated to reach US$4.5 billion and imports around US$4 billion.

The policy environment

In broad terms, Colombia has striven for food self-sufficiency. Out of 12 items that supply about two-thirds of the protein and calorie requirements of the population, almost all were produced internally (Garcia, 1983). The country went from an import substituting policy to an export promotion policy in 1967 (Decreto 444). A continuous devaluation policy (crawling peg) was adopted, improving the terms of trade by reducing the overvaluation of the Colombian peso. Total exports grew at an annual rate of 4.6% in the period 1970-75, 12.0% in 1976-80, and decreased by -5.4% in 1981-83 while agricultural exports grew at 2.0%, 13.8% and 2.8% in those years.

Table 1. Gross domestic product (GDP) of Colombia and contribution of agriculture to the GDP[a].

Year	Total GDP (millions Col $)	Contribution of agriculture to GDP (millions Col $)	Contribution of agriculture to GDP (%)
1960	71,902	24,305	33.8
1965	90,351	27,834	30.8
1970	119,797	34,245	28.6
1975	163,399	44,066	27.0
1976	170,227	44,905	26.4
1977	178,326	46,097	25.8
1978	194,818	50,575	26.0
1979	203,664	52,618	25.8
1980	211,930	53,954	25.5
1981	217,228	55,580	25.6
1982	219.183	54,622	24.9
1983	221,375	55,606	25.1
1984	228,459	56,940	24.9
1985	234,956	58,591	24.9

Period	Average annual growth of GDP (%)	Average annual growth of agriculture (%)
1960-67	4.6	2.9
1967-78	6.0	4.5
1978-85	2.4	1.8
1981-85	2.0	1.5

a. Figures given in constant 1970 prices.

SOURCE: IDB. 1986.

Table 2. Total and per capita gross domestic product (GDP) by country (1960, 1970, 1980, 1983-85).

Country	Total GDP (Millions 1984 dollars)						Per capita GDP (1984 dollars)			
	1960	1970	1980	1983	1984	1985[a]	1960	1970	1980	1985[b]
Argentina	35,236.5	52,874.0	67,144.3	61,543.9	63,023.8	60,250.8	1,710	2,227	2,387	1,971
Bahamas	n.a.[b]	n.a.	1,667.5	1,726.3	1,778.3	1,840.5	n.a.	n.a.	7,444	7,275
Barbados	379.5	692.9	816.1	758.4	775.0	793.7	1,650	2,911	3,103	2,865
Bolivia	2,611.9	4,245.9	6,594.9	5,692.0	5,518.2	5,402.6	793	989	1,178	840
Brazil	59,345.8	100,712.5	228,798.6	220,137.4	230,043.5	249,137.2	821	1,086	1,923	1,852
Chile	11,572.9	17,510.7	22,480.6	20,237.4	21,520.6	21,947.3	1,524	1,870	2,025	1,817
Colombia	10,466.2	17,431.9	29,805.6	31,069.2	32,063.5	32,961.3	673	834	1.195	1,243
Costa Rica	1,373.3	2,445.6	4,233.3	3,946.0	4,240.8	4,309.5	1,040	1,417	1,910	1,708
Dominican Republic	2,213.6	3,631.9	7,099.7	7,808.0	7,837.1	7,665.0	643	847	1,280	1,225
Ecuador	2,774.0	4,461.8	10,469.5	10,675.7	11,108.4	12,462.1	626	749	1,300	1,222
El Salvador	1,750.2	3,029.9	4,163.7	3,633.4	3,687.2	3,746.2	658	856	923	771
Guatemala	3,474.2	5,936.1	10,287.4	9,733.8	9,795.3	9,685.7	886	1,140	1,488	1,216
Guyana	416.5	583.1	689.3	566.7	588.0	593.9	690	814	876	720
Haiti	1,047.5	1,134.9	1,801.6	1,697.8	1,727.8	1,757.5	293	268	359	320
Honduras	1,158.4	1,885.2	3,001.4	2,968.0	3,050.9	3,142.4	583	696	810	719
Jamaica	2,506.7	4,222.6	3,868.9	4,097.8	4,081.4	3,918.1	1,490	2,259	1,814	1,701
Mexico	44,116.4	86,895.0	164,658.3	167,459.1	173,614.9	178,288.9	1,190	1,698	2,402	2,248
Nicaragua	1,307.0	2,548.3	2,638.7	2,880.1	2,839.4	2,764.2	870	1,294	954	845
Panama	1,162.8	2,496.7	4,268.3	4,708.1	4,687.6	4,841.4	953	1,617	2,183	2,218
Paraguay	n.a.	2,528.2	5,861.6	6,120.5	6,308.7	6,559.1	n.a.	1,104	1,850	1,777
Peru	9,117.3	15,203.6	21,351.1	19,540.5	20,465.4	20,772.4	878	1,134	1,232	1,055
Suriname	n.a.	n.a.	1,125.3	1,104.2	1,102.7	1,046.2	n.a.	n.a.	2,900	2,642
Trinidad and Tobago	1,436.3	2,165.9	3,462.1	3,578.5	3,342.4	3,359.1	1,706	2,268	3,165	2,837
Uruguay	4,827.6	5,629.1	7,577.7	6,649.4	6,429.1	6,472.7	1,902	2,080	2,651	2,208
Venezuela	16,936.2	30,492.8	45,682.6	43,279.7	42,693.8	42,527.6	2,127	2,735	3,041	2,451
Latin America	215,230.8	368,758.6	659,548.1	641,611.9	662,323.8	685,245.4	1,040	1,380	1,933	1,782

a. Preliminary estimate.
b. n.a. = Not available.

SOURCE: IDB. 1986.

Table 3. Statistical profile of Colombia.

	1981	1982	1983	1984	1985[a]
Area (km^2)	1,138,338				
Population: Total 1984 (69.9 % urban)	26,526,000				
Annual growth rate 1970-85	1.6				
Birth rate (1981)	28.9				
Mortality per 100 inhabitants (1982)	5.8				
Infant mortality per 100 live births (1981)	60.9				
Life expectancy at birth (1981)	62.1				
Percentage of literacy (1981)	81.0				
Labor force by sector (1980)	(Percentages)				
Agriculture	34.3				
Manufacturing	17.7				
Commerce and finance	15.9				
Services	19.4				
Others	12.7				
Real Production			(Growth rates)		
Total GDP (market prices)	2.3	0.9	1.0	3.2	2.8
Agricultural sector	3.2	-1.9	1.8	2.4	2.9
Mining sector	5.4	1.8	13.2	14.3	24.6
Manufacturing sector	-2.6	-1.4	0.5	6.7	2.5
Construction sector	7.1	4.0	5.1	4.7	3.7
Public Sector			(Percentages of GDP)		
Current revenues	19.6	19.6	19.5	20.5	20.3
Current expenditures	17.6	17.9	17.4	17.9	17.5
Current savings	2.0	1.7	2.1	2.6	5.8
Capital expenditures	7.9	8.2	9.7	10.1	10.0
Deficit or surplus	-5.9	-6.5	-7.6	-7.5	-3.7
Domestic financing	3.1	4.1	5.0	5.0	0.2
Money, prices and salaries			(Growth rates)		
Domestic credit	51.0	123.3	66.2	82.9	18.0
Public sector	-5.3	299.4	212.4	236.3	9.1
Private sector	30.6	22.7	42.1	27.3	26.6
Money supply (M1)	21.2	25.4	25.6	23.2	27.5
Consumer prices (annual average)	27.5	24.5	19.8	16.1	24.0
Real wages	2.0	5.0	6.1	6.0	-3.0
Exchange rate			(Annual Average)		
Official rate (national currency units/dollar)	54.49	64.09	78.85	100.82	144.68
Real effective exchange rate (Index 1980 = 100)	92.8	87.7	88.3	96.7	115.1
Terms of trade (Index 1980 = 100)	77.5	88.3	90.4	93.6	92.1
Balance of payments			(Millions of dollars)		
Current account balance	-1,894.0	-2,729.0	-2,747.0	-2,248.0	-1,670.0
Merchandize balance	-1,572.0	-2,114.0	-1,494.0	-566.0	-356.0
Merchandize exports (FOB)	3,158.0	2,933.0	2,970.0	3,414.0	3,671.0
Merchandize imports (FOB)	4,730.0	5,047.0	4,464.0	3,980.0	4,027.0
Net Services	-631.0	2,245.0	-1,673.0	-1,887.0	-1,778.0
Transfers	242.0	169.0	164.0	205.0	464.0
Capital account (net)	2,040.0	2,231.0	1,436.0	837.0	1,990.0
Change in net reserves (- = increase)	-242.0	701.0	1,723.0	1,261.0	-284.0
Total external debt			(Millions of dollars)		
Disbursed debt	8,069.0	9,555.0	10,574.0	11,667.0	12,867.0
Debt service actually paid	1,116.0	1,418.0	1,573.0	1,644.0	1,882.0
Interest payments/export of goods and NFS			(Percentages)		
	21.3	27.2	26.3	27.7	25.4

a. Preliminary estimate.

SOURCE: IDB, 1986.

Colombia also has one of the lowest per capita public external debts of Latin America (US$485, Table 3) as of 1986, although debt service is close to one fourth of foreign exchange earnings. The exchange rate policy of the past two decades was fundamental to the low foreign debt contracted by the country. The fixed rates constituted as an incentive to obtain external financing.

Industrial protection has also been a policy objective. This has been at the expense of agriculture. Garcia showed that 90% of an import tariff is transferred as a tax to primary exports. The price of importable inputs (fertilizer, machinery, etc.) increases and producers of other import-competing and exportable goods are penalized (Valdes, 1986). In the presence of import restrictions, the price of imports is driven up with the consequent drop in demand (i.e., the feed industry would have grown faster in the absence of these policies). Nontradeables, such as cassava, are at a disadvantage with imports, such as wheat and sorghum, in the competition for resources.

Starting in 1978 the country witnessed a decrease in its rate of growth; a phenomenon observed in most Latin American countries. The sharp increase in 1980 of the international interest rates and the world recession that brought reductions in the prices of primary exports merged in Colombia with another adverse element: the coffee boom of the late seventies.

"In the late 1970's, a coffee boom set in motion a rapid growth in the money supply and inflation, despite the stabilization efforts of the Colombian authorities. The deceleration in the depreciation in the crawling peg exchange rate led to an appreciation of the real exchange rate, which reduced incentives to produce noncoffee agricultural tradeables. This deceleration... contributed to inflation. Although some attempt was made to increase agricultural incentives... these policies were directed only at import-competing cereals and ignored a vast agricultural sector" (Valdes, 1986).

Real GDP grew at an annual rate of 2.4% in 1978-85, agricultural GDP grew at 1.8%, while population increased by 1.9% (total) and 3.3% (urban). The level of international reserves dropped from over US$5 billion in 1980 to US$2 billion in 1985. The current account deficits that started in 1981 were no longer compensated by credits. The fiscal deficit as a percent of GDP went from 2.0% in 1980 to 4.2% in 1984. Inflation continued at around 20.0% as the fiscal deficit was financed with monetary expansion. The real rate of exchange (based on 1975=100) went to 70 in 1980 and to 80 in 1984 (SAC, 1985). The policy of mild liberalization pursued from 1972-82 came to an end in 1982 when the tariff levels were increased and the number of agriculture and food categories with most items being restricted went from four to seventeen (out of a total of twenty-one). Nominal rates of protection for cereals increased significantly, presumably due to tighter import restrictions (Thobany, 1984).

Compensatory policies to domestic agricultural production, as subsidized credit, became quite expensive as those resources came from open market operations at substantially higher costs (Montes, 1983).

Other price inputs (wages, fertilizer, etc.) increased faster than output prices (Table 4). Apparently, agricultural nonwage value added has been declining and rural wages have increased even in real terms, to become the highest in South America by January 1985 (at US$4.00 per day plus a mark-up of about 40% for social benefits). At the same time migration was high and unemployment grew to over 14.5%.

After a devaluation of 50% in 1985, the country achieved balance in the current account and the perspectives for higher revenues from primary exports (coffee, coal, and oil) appeared quite good; economic recovery has begun already. Population growth is expected to remain at 1.5% per year, while real GDP should annually increase at 3.0%. Beginning in 1986 about 70% of the import positions were transferred to the free import list, including farm inputs.

In summary, the macroeconomic and trade policies of Colombia led to an appreciation of the real exchange rate that switched consumption to tradeables (grains and cereals) and away from nontradeables such as cassava. Agricultural production is locked in a high cost scheme that does not make it competitive at world prices. Compensatory policies adopted to stimulate agricultural production were mostly directed at importables (grains, barley, and wheat) while ignoring a vast agricultural sector; besides, these policies have lost effectiveness in recent years. Investment in the sector has been reduced. Lower unit costs are needed to increase production at profitable levels. The easing of import restraints (particularly for inputs) as well as the improvement in terms of trade are seen as a favorable developments, but yield improvements are needed in the mid-term.

Agricultural Policies

Presently, about 55% of the gross agricultural output comes from crop activities and 45% from livestock (Table 5). Tha latter increased its share from 37% in 1970 due mainly to the strong dynamism of poultry and pork production. The agroindustrial sectors are growing more rapidly than primary agriculture (Machado, 1986). The ratio of value added in agroprocessing to value added in crops and livestock increased from 54% in 1970 to 70% in 1983.

In the period 1953-67, when significant distortions existed between domestic and international prices, per capita GDP grew at 1.2% and per capita food production decreased by -0.4%. The rate of migration was 5.3%. In addition to this, the threat of agrarian reform and land pressures meant that the number of units operated by renters and sharecroppers fell from 282,347 in 1960 to 166,539 in 1970 (BID, ESP in LA, 1986, p. 124). When prices approached those in the international market (in 1967-78), per capita GDP grew at 2.3% and per capita food production increased at 0.7%. Rural migration increased at a rate of 3.5% between 1967 and 1978. The ratio of urban to rural wages had been falling steadily since the 1950s until 1970 when it recovered rapidly. "Distortions in relative commodity prices induced by commercial and exchange rate policies caused changes in factor prices that contributed to the massive outflow... This was an opportunity to become more land intensive..." (Garcia, p. 57).

Table 4. Index of prices for main inputs and implicit prices for agriculture, Colombia.

Year	Labor	Machinery	ACPM	Fertilizer	Seed	Insecticide	Prices paid
1970	100	100	100	100	100	100	100
1975	278	312	201	484	240	270	235
1978	651	477	660	669	418	395	442
1979	789	648	898	732	489	444	512
1980	1,079	816	1,130	943	585	586	599
1981	1,341	1,103	1,528	1,305	702	747	728
1982	1,654	1,164	1,662	1,364	770	813	908

	Annual rates of change	
	1973-81	1977-81
Prices received by farmers (crops)	20.0%	15.2%
Prices received by farmers (livestock)	18.8%	20.2%
Fertilizer prices	30.7%	24.1%
Pesticides prices	n.a.	21.3%
Seed prices	n.a.	24.8%

SOURCE: FAO Production Yearbook, 1983, p.312

Table 5. Gross value[a] of production by subsector, 1970-83.

Year	Crops			Livestock			Total
	Other than Coffee	Coffee	Subtotal	Beef and milk	Other	Subtotal	
1970	18,082	5,348	23,430	11,313	2,578	13,891	37,321
	(0.485)	(0.143)	(0.628)	(0.303)	(0.069)		
1971	20,072	4,745	24,817	13,727	3,133	16,860	41,677
	(0.482)	(0.114)	(0.596)	(0.329)	(0.075)	(0.404)	
1972	24,775	6,286	31,061	17,176	3,671	20,847	51,908
	(0.477)	(0.121)	(0.598)	(0.331)	(0.071)	(0.402)	
1973	30,720	8,090	38,810	23,632	5,196	28,828	67,638
	(0.454)	(0.120)	(0.574)	(0.349)	(0.077)	(0.426)	
1974	43,598	9,656	53,254	32,110	6,981	39,091	92,345
	(0.472)	(0.105)	(0.577)	(0.347)	(0.076)	(0.423)	
1975	53,932	12,123	66,055	38,324	9,612	47,936	113,991
	(0.473)	(0.106)	(0.579)	(0.336)	(0.085)	(0.421)	
1976	65,181	20,752	85,933	47,481	12,037	59,518	145,451
	(0.448)	(0.143)	(0.591)	(0.326)	(0.083)	(0.409)	
1977	86,214	37,681	123,895	60,705	13,074	73,779	197,674
	(0.425)	(0.186)	(0.611)	(0.300)	(0.089)	(0.389)	
1978	96,693	43,045	139,738	76,755	22,685	99,440	239,178
	(0.404)	(0.180)	(0.584)	(0.321)	(0.095)	(0.416)	
1979	120,141	49,997	170,138	96,496	28,207	124,703	294,841
	(0.407)	(0.170)	(0.577)	(0.327)	(0.096)	(0.423)	
1980	152,080	57,716	209,796	117,072	34,543	151,615	361,411
	(0.420)	(0.160)	(0.580)	(0.324)	(0.096)	(0.420)	
1981	189,107	69,938	259,045	149,618	44,057	193,675	452,720
	(0.418)	(0.154)	(0.572)	(0.330)	(0.098)	(0.428)	
1982	227,967	77,801	305,768	187,272	61,671	248,943	554,711
	(0.411)	(0.140)	(0.551)	(0.338)	(0.111)	(0.449)	
1983 (p)	265,426	101,841	367,267	225,177	74,380	299,557	666,824
	(0.398)	(0.154)	(0.551)	(0.338)	(0.111)	(0.449	

a. Recorded in millions of Col$.

SOURCES: DANE, Cuentas Nacionales de Colombia; and Departamento Nacional de Planeacion Unidad de Estudios Agrarios, Division de Comercializacion, Estadisticas, documento de trabajo, 5 junio de 1984.

The slowdown of the economy in 1978, was linked to the world recession and the after shock of the coffee bonanza. In per capita terms, GDP increased at 0.7% and agricultural GDP decreased by -0.4% per year in 1978-85. Area harvested decreased from 4.3 million hectares in 1978 to 3.8 million hectares in 1984 (Table 6). Terms of trade for agriculture, as measured by the ratio of sectoral deflactors for value added, were much lower in 1983 than in 1970, but they increased until 1977 and thereafter decreased (Table 7).

An analysis of the growth rate for the 17 major crops in 1970-84 revealed that 0.9% came from cultivated area while 2.5% came from higher yields and changes in crop composition. In that lapse, the annual growth in area cultivated for tree crops reached 1.8%, by 0.9% for cane crops (sugar and panela), and by 1.2% for grains (mostly sorghum).

Between 1977 and 1983, the wholesale price index for food increased annually by 4.8% more rapidly than the farm gate price index (Table 8). This suggests that reducing the costs of marketing is a key target in improving food supplies, since they tend to grow much faster than production costs.

After 1978, use of fertilizer has also decreased (Balcazar en Machado, SAC September'85), real prices of inputs increased, the overvaluation of the Colombian peso became more marked, and rural instability remained high, meaning that Colombian agriculture is now less competitive. Illegal, parallel, and black markets continued to be important with the subsequent impact on resource cost and allocation particularly on wages and land. Contraband from Venezuela and Ecuador (after sharp devaluations in both countries) is at its highest affecting agricultural supply, but stimulating demand. FENALCO estimates that contraband of agricultural products and inputs (wheat and corn flour, poultry meat, eggs, sorghum and feed, urea, machinery, vegetable oils, etc.) amounted to over US$1 billion in 1986. Food imports amount to about US$400 million or 7.5% of total imports (USDA Attache Report).

The slowdown of agriculture is the result of a number of factors that affect agricultural production. At first glance, there has been a protection policy for most agricultural products in Colombia. The internal price of most products has been higher than the international price; nominal protection indexes are positive (Garcia). However, to be able to conclude that there was effective protection, one has to consider the overvaluation of the Colombian peso. If the nominal protection is higher than the overvaluation, products are protected. In this sense, only products such as powdered milk, oils and fats, and wheat would be true importables, since they have been effectively protected even after making the adjustment for the overvaluation. Rice, coffee, and cotton, for example, have been discriminated against in this sense for the past two decades (Garcia).

Specific agricultural policies

These have been designed as alternative or compensatory policies. The targets have been commercial products, as we will now examine.

Table 6. Area (thousand hectares) harvested by groups of principal crops[a], 1950–84.

Year	Grains	Oil crops	Coffee	Cotton and tobacco	Cane crops	Beans and tubers	Tree crops	Total
1950	973.9	14.0	656.0	55.6	158.0	329.4	191.4	2378.3
1951	1134.2	14.0	660.0	59.7	168.0	378.5	194.7	2414.4
1952	1233.0	17.0	675.0	75.2	170.0	392.5	196.0	2758.7
1953	1090.0	17.0	831.0	85.1	166.5	373.5	197.4	2761.4
1954	1103.0	18.2	872.5	101.3	175.2	413.5	220.4	2904.1
1955	1243.5	21.1	816.2	101.5	178.1	395.7	234.0	2990.1
1956	1238.2	23.9	725.5	89.4	180.3	396.7	239.2	2893.0
1957	1040.0	22.0	790.4	85.1	177.6	402.2	247.5	2764.8
1958	1092.7	48.0	832.5	99.5	182.5	366.0	248.6	2869.8
1959	1153.0	41.0	858.7	153.5	181.8	349.5	259.9	2997.4
1960	1176.0	42.3	892.5	166.2	196.0	320.0	267.1	3060.1
1961	1159.1	48.7	831.5	165.8	199.2	302.5	271.4	2978.2
1962	1178.8	58.4	824.1	196.1	199.0	368.4	272.2	3097.0
1963	1119.2	74.5	810.0	164.2	207.6	356.4	282.6	3014.5
1964	1256.1	95.8	813.1	171.7	210.4	338.8	291.8	3177.7
1965	1439.8	117.7	812.0	159.7	209.0	354.9	265.9	3359.0
1966	1390.8	127.6	811.4	191.9	214.6	343.4	321.0	3400.7
1967	1249.7	110.2	810.6	195.5	223.7	363.4	325.0	3279.1
1968	1249.3	110.4	816.3	219.7	229.5	379.1	326.0	3330.3
1969	1112.5	129.9	816.0	260.0	235.8	381.8	325.8	3261.8
1970	1068.8	106.7	835.0	289.3	247.0	404.0	415.8	3366.6
1971	1102.9	115.9	836.0	242.0	247.0	405.9	423.0	3372.7
1972	1090.9	112.2	840.0	268.6	260.9	425.4	427.4	3425.4
1973	1115.6	107.5	1055.5	277.0	272.6	435.4	432.5	3695.9
1974	1180.0	104.7	1055.3	283.9	272.0	432.8	438.4	3767.1
1975	1184.9	145.1	1055.3	314.8	249.2	487.4	447.7	3884.4
1976	1237.5	89.7	1183.5	315.3	254.5	449.3	455.0	3984.8
1977	1174.5	97.8	1183.5	410.5	255.4	455.5	489.1	4066.3
1978	1399.9	118.0	1183.5	357.6	284.4	465.0	532.9	4341.3
1979	1383.5	122.3	1183.5	217.1	285.7	484.9	546.5	4223.5
1980	1336.5	126.9	1183.5	245.4	292.2	465.1	570.4	4220.0
1981	1361.0	88.5	1009.0	251.2	279.1	484.8	575.4	4048.0
1982	1453.4	93.3	1009.0	130.1	264.9	448.3	500.2	3899.2
1983	1314.6	103.9	1009.0	106.5	271.5	452.4	524.2	3782.1
1984	1255.0	97.2	1009.0	168.1	279.6	453.3	531.0	3793.2
Growth rate (%)								
1950–84	0.7	5.9	1.3	3.3	1.7	1.0	3.0	1.4
1960–84	0.3	3.5	0.5	0.0	1.5	1.5	2.9	0.9
1970–84	1.2	-0.7	1.4	-3.8	0.9	0.8	1.8	0.9
1950–60	1.9	11.7	3.1	11.6	2.2	-0.3	3.4	2.6
1960–70	-1.0	9.7	-0.7	5.7	2.3	2.4	4.5	1.0
1970–80	2.3	1.7	3.5	-1.6	1.7	1.4	3.2	2.3
1980–84	-1.6	-6.4	-3.9	-9.0	-1.1	-0.6	-1.8	-2.6

a. Grains - corn, rice, sorghum, barley, wheat
Oil crops - sesame, soybeans, oil palm
Cane crops - sugar cane, panela cane
Beans and tubers - beans, potatoes, cassava
Tree crops - plantain, export bananas, domestic bananas, cacao.

SOURCE: DNP-UEA.

Table 7. Measures of the internal terms of trade for agriculture, 1970-83.

Year	Ratio of sectoral value-added deflators (agriculture to nonagriculture)	Wholesale price ratio (agriculture to all consumer goods)	Ratio of agricultural producer price to	
			(Consumer price index)	(Wholesale index for consumer goods)
1970	0.966	0.885	0.846	1.056
1971	0.955	0.872	0.856	1.018
1972	0.991	0.863	0.879	0.994
1973	1.051	0.925	0.939	1.036
1974	1.067	0.983	0.938	1.009
1975	1.000	1.000	1.000	1.000
1976	1.006	1.021	1.046	1.035
1977	1.099	1.022	1.103	1.039
1978	0.978	1.055	0.905	0.855
1979	0.896	1.033	0.886	0.802
1980	0.806	0.975	0.871	0.765
1981	0.788	0.933	0.841	0.731
1982	0.786	0.952	0.850	0.693
1983	0.775	0.954	0.868	0.684
Rates of change (%)				
1970-75	0.69	2.47	3.40	-1.08
1975-80	-4.22	-0.51	-2.72	-5.22
1980-83	-1.30	-0.72	-0.11	-2.21

SOURCE: World Bank. 1986.

Table 8. Principal agricultural and nonagricultural price indexes, 1970-83.

Year	GDP	National accounts deflators			Wholesale price index				
		Total value added[a]	Nonagricultural value added[b]	Agricultural value added[b]	Overall	Agriculture[b]	All consumer goods	Overall consumer price index	Producer price index for 17 principal crops
1970	43.2	43.6	44.0	42.5	34.7	30.0	33.9	42.3	35.8
1971	47.8	48.2	48.7	46.5	38.7	34.6	39.7	47.2	40.4
1972	54.0	54.4	54.5	54.0	45.8	40.9	47.4	53.6	47.1
1973	64.9	65.2	64.4	67.7	58.6	54.6	59.0	65.1	61.1
1974	81.4	81.7	80.4	85.8	79.7	74.1	75.4	81.1	76.1
1975	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1976	125.5	125.7	125.5	126.2	122.9	124.0	121.4	120.1	125.6
1977	162.0	162.5	158.9	174.7	155.7	174.3	170.6	160.8	177.3
1978	189.7	191.1	192.1	187.8	183.2	210.6	199.6	188.6	170.7
1979	235.4	236.8	242.8	217.5	234.1	268.2	259.6	234.9	208.1
1980	300.3	302.2	316.0	254.7	290.8	330.1	338.6	297.3	258.9
1981	370.4	371.3	390.2	307.4	360.7	406.5	435.9	379.0	318.6
1982	363.0[c]	464.7	488.0	383.5	453.4	550.7	578.6	472.0	401.1
1983	n.a.	559.7[c]	589.4	456.5	551.9	684.8	717.7	565.3	490.7
Rates of increase (%)									
1970-83		21.7	22.1	20.0	23.7	27.2	26.5	22.1	22.3
1977-83		22.9	24.7	17.4	23.5	25.6	27.1	23.3	18.5

a. Total value added differs from GDP in that the former excludes tariffs and taxes on imports.
b. Agriculture is defined as crops and livestock excluding forestry and fishery products.
c. Preliminary data.

SOURCE: World Bank. 1986.

Price and commercialization policies. Four types of direct government intervention prevail in Colombia:

1. Output price supports.
2. Price fixing in output and input markets.
3. Agricultural export subsidies and taxes.
4. Agricultural trade restrictions including import tariffs and import/export licensing.

INA, created in 1944 and later restructured under IDEMA, has been the organization responsible for administering policies for support and warranty prices, stocks, imports and exports, and for conducting studies and extending credit (Silva, in Machado, 1986). Support prices have been implemented for commercial products (rice, cotton, wheat, sorghum, corn, soybeans, sesame, and barley) and for beans--the only traditional crop included in the list. These support prices have served mainly as a price floor although IDEMA's participation in direct purchases has been modest, except for wheat with purchases of 38% of production in 1970-82, sorghum 14.5% in 1982, and some rice. Generally, support prices have been similar to market prices, and have grown in real terms over the past 5 years; sorghum and corn had real price increases of about 12% in 1979-82.

In order to restrain price increases to urban consumers, IDEMA has occasionally imported food selling it at controlled prices (wheat flour, beans, milk, oils and fats, rice, and sugar) (Rivas et al., in press). In addition to support prices, negotiated prices have been set between the government and the private sector for products such as coffee, sugar, and milk, and minimum prices established for cocoa, and sisal as well as for fertilizers and pesticides.

Closely related to this is the program to build wholesale markets (Centrales de Abastos). There are three already in operation in Bogota, Medellin, and Cali and four more being built in Barranquilla, Bucaramanga, Pereira, and Cucuta. These facilities will improve marketing, especially of perishables such as cassava, where losses can be of considerable magnitude.

The main instruments of intervention in agricultural foreign trade have been tariffs, taxes, subsidies, and quantitative restrictions on imports and exports. Rice export permits have been granted only if domestic surpluses are anticipated. Taxes apply mostly to coffee exports. Protection to importables is reflected in the nominal protection rates measured by a comparison of the domestic and international prices (Table 9).

Credit policies. The three main policy tools used are forced financing (Law 5), low and controlled interest rates, and directed credit allocations. Two major institutions responsible for administering agricultural credit are the FFAP and Caja Agraria. Most of the credit supplied by FFAP is directed to commercial agriculture (90% of the funds rediscounted by FFAP have had that destination) (Martinez, in: Rivas et al., p. 23). Of Colombia's 1.2 million farmers, 75% are classified as small farmers. Eighty percent of Caja Agraria credit goes to about 440,000 small farmers (one-half of the target group).

Table 9. Protection rates by crop, 1970-83.

Crop	1970-74	1975-79	1980-83	1983
Imports				
Wheat	122.2	138.5	154.2	158.9
Sorghum	115.6	133.5	172.0	161.0
Corn	123.6	151.8	206.2	184.4
Soybeans	88.1	100.8	140.6	146.2
Barley	148.7	142.9	171.9	200.3
Exports				
Coffee	47.0	46.2	44.6	48.6
Tobacco	49.7	53.4	60.8	52.1
Cacao	83.0	54.4	60.8	79.4
Bananas	37.4	34.0	33.4	32.3
Sugar	61.4	81.1	111.5	156.7
Cotton	59.1	73.2	87.0	85.9
Rice	n.a.	104.6	129.7	150.7

SOURCE: DNP-UEA-DC, Estadisticas - Division de Comercializacion, Bogota, 5 junio 1984.

The compensatory power of credit has lost a great deal of its impact. Although agricultural credit grew at a rate of 2.2% in real terms in 1970-1984 (Table 10), its share in total credit went from 31% to 15% and its participation in the GDP went from 27.9% to 20.8% during that period. Interest rates charged by FFAP and Caja Agraria were subsidized and negative in real terms until 1982. With change in the financial market, rates went up significantly (Table 11).

More importantly, in real terms, agricultural credit decreased in 1980-83. Furthermore, while 52% of the sectoral credit in 1970 came from primary money dispursements, only 6.5% did so in 1981 (Montes, 1983) which explains the reduction in subsidy as part of the monetary policy agreed upon by international financing institutions. Caja Agraria had a crisis in 1984 when its real disbursements were 15.3% lower than the previous year. This is especially significant for small farmers--important clients of the Caja Agraria.

In terms of the type of commodities being financed, FFAP has concentrated its lending on a few commercial crops--irrigated rice, sorghum, soybeans, and cotton. For these crops, FFAP provides more than 90% of the total credit it supplies. On the other hand, Caja Agraria has financed a wide spectrum of commodities that are characteristic of small-farming systems (Table 12). Producer associations and banks provide most of the credit for coffee and rice.

The crop receiving most credit to value of production in 1974-83 was sorghum, with a ratio 0.43, followed by sesame (an export with 0.33), rice (0.33), cotton (0.38), wheat (0.19) and corn (0.19). For cassava and yams the ratio was only 0.06.

The three imports in that list (sorghum, corn, and wheat) are among the crops that have been most strongly protected; the ranking according to the Nominal Protection Coefficient (NPC) is barley, corn, sorghum, wheat, and soybeans (Table 9). The NPC has to be adjusted by the overvaluation of the currency, input taxes, and credit subsidies. Janssen calculated that at 30% overvaluation for sorghum the protection was no longer effective.

Research and extension policies

Government expenditures in agriculture have been quite profitable (60% rate of return in 1950-80) and have had a significant contribution to output growth (30% in that period according to Elias, 1985) although expeditures have decreased in per hectare terms between 1970 and 1980. Out of ten countries studied by Elias (the countries are Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru, Venezuela and the U.S.), Colombia had the highest government expenditure in agriculture per hectare of cropland in 1970 (US$217) while in 1980 (US$195) the expenditure was below the group average.

The Instituto Colombiano Agropecuario (ICA), created in 1962, aims to generate and transfer improved production technologies. The DRI program was created in 1970, with emphasis on food production to complement this effort with other production support services for the

Table 10. Total rural and agricultural new loans and outstanding portfolio in Colombia at constant prices (Col$ million, 1975)[a], 1974-83.

	New loans						Outstanding portfolio					
Year	Total loans	Index	Rural loans[b]	Index	Agricultural loans	Index	Total portfolio	Index	Rural portfolio[b]	Index	Agricultural portfolio	Index
1974	51,392	120.2	17,971	120.1	12,148	104.1	70,623	93.7	20,548	104.0	16,778	100.9
1975	42,757	100.0	14,965	100.0	11,672	100.0	75,345	100.0	19,756	100.0	16,629	100.0
1976	88,937	208.0	22,673	151.5	17,069	146.2	89,725	119.1	19,745	99.9	17,129	103.0
1977	113,994	266.6	24,623	164.5	19,936	170.8	98,136	130.3	23,509	119.0	21,048	126.6
1978	131,747	308.1	27,262	182.2	21,155	181.3	111,277	147.7	23,580	119.4	20,184	121.4
1979	133,614	312.5	27,349	182.8	22,048	188.9	103,762	137.7	22,197	112.4	19,313	116.1
1980	192,053	449.2	27,009	180.5	22,167	189.9	123,963	164.5	23,749	120.2	21,163	127.3
1981	134,213	313.9	22,693	151.6	17,457	149.6	141,371	187.6	23,860	120.8	21,015	126.4
1982	126,282	295.4	24,872	166.2	18,684	160.1	141,121	187.3	25,080	127.0	21,860	131.5
1983	128,883	301.4	25,702	171.8	20,375	174.6	159,404	211.6	26,166	132.5	23,143	139.2
Annual growth rates												
1974-78	26.5%		11.0%		15.0%		12.0%		3.5%		4.7%	
1978-83	-0.3%		-1.0%		-0.8%		7.4%		2.1%		2.8%	
1974-83	10.8%		4.1%		5.9%		9.5%		2.7%		3.6%	

a. All figures adjusted by GDP deflator.
b. Includes agriculture, marketing, and agroindustries.

SOURCE: World Bank.

Table 11. Evolution of the real rates of interest (%) for the FFAP and the Caja Agraria, Colombia.

		Caja Agraria		
Year	FFAP	Small	Medium	Large
1979	-4.8	-8.4	-4.2	-2.1
1980	-0.5	-6.2	-2.0	0.1
1981	-0.9	-4.3	1.0	8.0
1982	1.1	-2.6	2.9	10.3
1983	7.5	3.5	9.4	17.2
1984	6.0	2.0	7.9	15.6

SOURCE: Alvaro Balcazar, Observaciones sobre el manejo de las tasas de interés y la distribución del credito agropecuario.

ble 12. Cumulative agricultural credit in relation to areas harvested and production, by crop, 1974-83.

op	Credit extended[a] (Col$ million)	Area harvested[a] (000 ha)	Value of production[a] (Col$ million)	Ratio	
				(credit extended to area harvested)	(credit extend to value of production)
ce	54,374.5	3,944.1	162,662.9	13.8	0.33
tatoes	16,817.7	1,372.3	137,196.7	12.3	0.12
rn	17,226.8	6,069.1	92,241.2	2.8	0.19
antain	6,176.4	3,773.1	116,919.6	1.6	0.05
'anela" cane	6,883.7	1,858.6	123,404.2	3.7	0.06
ssava and yams	7,394.3	2,142.7	115,000.0	3.5	0.06
uit[b]	2,969.3	268.6	n.a.	11.1	n.a.
garcane	4,106.4	943.7	74,609.9	4.4	0.06
rghum	19,490.5	2,094.6	44,905.9	9.3	0.43
ya	5,416.2	615.3	21,829.8	8.8	0.25
same	924.2	251.3	2,724.9	3.7	0.34
cao	1,250.6	640.0	28,550.8	2.0	0.04
l palm	2,359.8	223.9	23,080.5	10.5	0.10
eat	1,217.3	375.3	6,330.8	3.2	0.19
tton	21,411.6	2,330.2	77,182.2	9.2	0.28
ffee	63,202.5	12,064.1	436,708.9	5.2	0.14
sal	204.9	272.4	n.a.	0.8	n.a.
bacco	1,714.1	302.2	16,034.8	5.7	0.11
Total	233,140.8	39,541.5	1,364,383.1	5.9	0.17
erage					
hort-cycle crops[c]	16,030.34	2,132.77	68,134.30	7.52	0.24
erennials	9,874.19	2,260.73	117,044.10	4.37	0.08
verall	12,952.27	2,196.75	90,958.87	6.20	0.14

Cumulative values over 1974-83, inclusive.
Annual yields for fruit are the total production over all species divided by the total area harvested in all species.
Rice, potatoes, corn, cassava and yams, sorghum, soya, sesame, wheat, and cotton.

URCE: World Bank. 1986.

small farmers, such as credit, social services and marketing. Potential beneficiaries are the 82,958 farmers or 8% of landowners with less than 20 ha in Colombia.

Within agriculture, it seems that research and extension have had a strong bias in favor of commercial agriculture, supporting the emphasis of the overall agricultural policies enforced.

Concluding comments

The modernization of agriculture made it more dependent on imported inputs, whose trade had been restricted. Agricultural credit was reduced in total credit from 31% in 1970 to 17% in 1981, input costs (labor, machinery, fertilizer, seed, etc.) grew faster than output prices (cost-price squeeze), public investment in research went from 0.46% in 1972 to 0.20% in 1982, and public expenditures in agriculture went from 25% in 1970 to 7.6% in 1981 (Prieto et al., 1986). However, government expenditures in agriculture are quite in line with those of other Latin American countries: in 1980 and per hectare of cropland, expenditures amounted to US$195 while per worker employed in agriculture they were US$377. (Elias, 1985).

From the viewpoint of Colombian producers, output prices are too low and yet they are not competitive in the world market (with the exception of coffee, bananas, and a few minor export crops). The opinion is that the resulting biases from the other policies have been so strong that agriculture (mainly coffee) has had to pay more than half of the industrialization costs (Valdes, 1986) with a loss of competitiveness that made necessary the implementation of compensatory policies. These policies were directed to tradeables (imports such as sorghum, corn, wheat, and soybeans) and exports such as rice (i.e., to commercial agriculture). While in the end, there was no effective protection for these crops, nontradeables (such as cassava) were left even in a worse relative condition, for they had to support the effects of protectionism through higher input prices and worse terms of trade for agriculture with no compensatory policies to stimulate their production. The incentives and subsidies have been such that they have created a flow from the small to the large farmer, from nontradeables (traditional) to tradeables (commercial) and from agriculture to the other sectors.

This partially explains the lack of dynamism that exists in food production (reflected in higher food imports) because the traditional sector supplies more than half of the energy and protein needs of the population (Table 13). For example, cassava, beans, plantains, potatoes, beef, and milk are mostly produced by this type of growers.

Status Quo of Cassava in Colombia: Supply and Distribution

Present status

The root is produced mostly by small farmers often from a complex production system. Intercropping with corn, yams, beans and/or cowpeas is frequent among small producers. On the Atlantic Coast, the largest

Table 13. Percent contribution of calories for the different food items in rural and urban areas by income groups in Colombia, 1981.

	Urban					Rural					
	Quintile					Quintile					
Type of food	I	II	III	IV	V	I	II	II	IV	V	
Meat	3.55	4.91	5.77	6.10	6.98	3.13	4.22	5.05	4.98	4.94	5.35
Beef	3.15	4.49	5.15	5.16	5.34	2.76	3.58	4.36	4.08	4.24	4.50
Pork	0.07	0.11	0.20	0.39	0.67	0.08	0.16	0.24	0.29	0.20	0.30
Poultry	0.08	0.11	0.21	0.32	0.59	0.03	0.16	0.18	0.23	0.18	0.27
Fish	0.25	0.21	0.21	0.23	0.39	0.26	0.32	0.26	0.39	0.32	0.28
Dairy and Eggs	4.78	6.15	7.22	8.04	9.17	4.91	6.15	6.59	5.97	7.57	7.09
Dairy	3.99	4.96	5.98	6.69	7.63	4.23	5.30	5.75	5.05	6.61	5.95
Eggs	0.79	1.19	1.24	1.34	1.54	0.68	0.84	0.84	0.92	0.96	1.14
Cereals	34.62	31.12	29.79	29.38	27.95	30.39	29.37	27.79	27.50	28.16	29.43
Rice	18.78	16.69	15.21	14.29	12.78	15.53	14.25	13.36	13.61	12.26	14.49
Maize	7.48	6.17	4.80	4.63	3.66	9.58	9.48	8.41	6.78	9.62	6.27
Wheat	7.54	7.32	8.58	9.08	9.28	4.43	4.96	5.26	6.06	6.02	7.41
Other	0.82	0.93	1.20	1.38	2.23	0.85	0.69	0.76	1.05	0.26	1.26
Roots and tubers	10.47	10.20	9.35	8.27	6.64	18.35	15.88	14.27	13.19	12.18	10.91
Cassava	2.82	2.58	2.50	2.32	1.54	9.23	8.04	7.26	5.69	6.02	4.13
Potato	7.53	7.39	6.54	5.71	4.83	8.68	7.60	6.78	7.29	5.80	6.52
Other	0.12	0.23	0.30	0.23	0.27	0.44	0.23	0.22	0.21	0.36	0.26
Pulses	2.58	2.50	2.54	2.29	2.18	1.89	2.05	2.12	2.26	2.25	2.27
Beans	2.40	2.35	2.32	2.00	1.91	1.52	1.90	1.93	2.04	2.14	2.04
Other	0.18	0.16	0.21	0.20	0.27	0.37	0.15	0.19	0.21	0.11	0.22
Other food items	44.00	45.12	45.34	45.93	47.08	41.34	42.33	44.19	46.10	44.90	44.95
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCE: Sanint et al. 1985.

producing region in the country, 35% of total incomes received from agricultural activities are generated by cassava. Within the small-farm system, 40% of all cultivated land is estimated to be in a cassava-cropping system. "Most often it is cultivated with maize and yam (40% of the time) or with maize alone (25% of the time). At present cassava monoculture is the second best alternative, which is practiced only if intercropping is not possible because of credit shortages" (Janssen, 1985). Production in the eastern region also follows a similar pattern.

Relatively large commercial plantations (over 20 ha) are more frequently found in the coffee region (Caicedonia, Pereira, Palestina), where land and labor are expensive. Intensive technologies are applied and yields are much higher (around 20 tons/ha). The variety "Chiroza" is the one preferred in the coffee region.

There is a wide geographic divergence of consumption according to the different regions of the country, but cassava is a major staple throughout the country. This is a reflection of cassava's ample adaptation to the heterogeneous geography of Colombia. The crop is found in the coffee-growing region up to 2000 meters above sea level, in the lowlands of the coast, in the acid savannas of Meta, and in the humid tropical forests of the Pacific region. This versatility is a great asset of the crop.

Production figures closely relate to consumption figures. By 1985, the major cassava producer was the Atlantic region, with 35.3% of the total, followed by the eastern region (29.4%) and the central region (24.4%) (Table 14). The same pattern is shown in regional per capita consumption figures (Table 15).

Time series data published by the Ministerio de Agricultura y Ganadería (MAG) has unexplainable abrupt breaks, especially from 1969 to 1970. The data are unreliable due to the various difficulties involved in collecting cassava production figures (many small dispersed producers, variable production cycle with different planting alternatives, multiple end uses, etc.) (Lynam and Pachico, 1982).

Data from MAG shows a decrease in cassava production at an annual rate of -1.3% for 1970-85. Consequently, per capita consumption for the period dropped at an annual rate of -3.3%. Yields do not show any significant trend (about 9 t/ha). The lower output can be explained by reductions in area planted. The reduction in supply has been accompanied by a steady demand, as reflected by real consumer price increases of 1.7% per year (Table 17).

<u>Fresh cassava consumption</u>. Cassava is an important food staple in Colombia, particularly to consumers in the northern part of the country (Atlantic Coast and eastern region), those in the rural sector, and in the poorest segments of the population. This is not to say that the root is not consumed by upper income groups. Actually, the highest per capita consumption is found among the rich of the rural sector in the Atlantic region (82 kg per capita in 1981, see Tables 16 and 18). Within that particular group, cassava accounts for 3.0% of food

Table 14. Area, production, and yields of cassava in Colombia, 1984.

Department or territory	Area (ha)	Production (t)	Yield (t/ha)	Percentage of total production
Santander	30,000	285,000	9.5	16.9%
Antioquia	22,100	174,590	7.9	10.4%
Cordoba	12,000	120,000	10.0	7.1%
Bolivar	15,000	120,000	8.0	7.1%
Atlantico	13,000	104,000	8.0	6.2%
Cundinamarca	9,000	90,000	10.0	5.3%
Sucre	8,000	80,000	10.0	4.8%
Magdalena	10,000	80,000	8.0	4.8%
Quindio	5,000	75,000	15.0	4.5%
Caqueta	8,000	64,000	8.0	3.8%
Tolima	7,000	63,000	9.0	3.7%
Huila	6,000	60,000	10.0	3.6%
Meta	7,000	56,000	8.0	3.3%
Cesar	5,500	55,000	10.0	3.3%
Guajira	3,500	35,000	10.0	2.1%
Norte de Santander	5,000	35,000	7.0	2.1%
Arauca	4,000	32,000	8.0	1.9%
Valle	2,600	31,200	12.0	1.9%
Boyaca	4,000	29,200	7.3	1.7%
Putumayo	5,000	25,000	5.0	1.5%
Caldas	1,500	22,500	15.0	1.3%
Nariño	1,300	16,000	12.3	1.0%
Cauca	1,600	16,000	10.0	1.0%
Risaralda	1,000	15,000	15.0	0.9%
Choco	0	0	ERR	0.0%
Total	187,100	1,683,490	8.998	100
By region				
Atlantic	67,000	594,000	8.866	35.3%
Eastern	55,000	495,200	9.004	29.4%
Central	42,600	410,090	9.627	24.4%
Pacific	25,500	63,200	11.491	3.8%
Territories	17,000	121,000	7.118	7.1%
Total	187,100	1,683,490	8.998	100.0%

SOURCE: Anuario Estadisticas del Sector Agropecuario, Mag/OPSA 1985.

Table 15. Quantities (kg/capita/year) consumed of cassava by urban and rural populations in five areas of Colombia, 1981.

Area		Income Quintile					
Atlantic		1	2	3	4	5	Total
	Urban	42.2	47.5	46.5	47.6	30.7	42.3
	Rural	61.8	73.2	77.0	81.0	82.0	72.6
	Total	54.3	61.4	59.7	56.0	39.4	54.4
Eastern							
	Urban	15.5	24.9	23.7	29.9	20.0	23.6
	Rural	39.5	37.6	46.1	32.4	36.8	39.0
	Total	31.9	61.4	59.7	56.0	39.4	31.8
Bogotá		2.9	4.5	6.9	7.4	9.4	7.2
Central							
	Urban	8.7	11.0	14.3	16.2	11.9	12.5
	Rural	29.7	38.3	34.6	43.2	32.2	35.4
	Total	18.0	33.0	21.4	23.5	15.4	20.5
Pacific							
	Urban	5.4	6.5	7.1	10.7	8.7	8.3
	Rural	12.4	17.1	22.2	25.5	23.9	17.3
	Total	9.9	11.9	13.7	13.8	9.7	11.6
Total							
	Urban	13.2	17.0	19.4	21.2	14.3	17.2
	Rural	34.6	41.4	46.6	45.5	44.3	41.1
	Total	24.7	28.5	29.1	26.8	18.3	25.5

Table 16. Percentage of subsistance consumption in total cassava consumption according to urban, rural, and regional areas in Colombia.

Area	Income Quintile	Percentage
Urban	1	16.8
	2	14.7
	3	14.0
	4	11.7
	5	9.7
	Average	12.8
Rural	1	68.2
	2	65.7
	3	59.4
	4	58.1
	5	45.9
	Average	62.2
Regional		
Atlantic		28.7
Eastern		51.1
Bogotá		4.2
Central		54.4
Pacific		44.1

Table 17. Summary of yearly rates of increase (%) for various commodities and factors that influence their consumption.

Consumption per capita		Consumption per capita	
Beef	0.1	Cassava	2.7
Pork	1.4	Potato	3.6
Poultry	4.4	Rice	4.1
		Wheat	1.6
Total production of poultry		Maize	-2.4
	6.7	Plantain	0.3
Real prices		Total production of cassava	
Beef	-0.4		5.1
Pork	0.1		
Poultry	-3.6	Real prices	
		Cassava	1.7
Relative price		Potato	-0.3
Beef/Poultry	3.1	Rice	-3.4
		Wheat	-3.0
Total Population	2.4	Maize	-1.2
Urban Population	3.5	Plantain	0.8
		Relative price	
Real income per capita	1.9	Cassava-Wheat	4.7
		Animal concentrated	10.5

Table 18. Cassava consumption, expressed as a percentage of total food consumption, by urban and rural dwellers in five regions of Colombia.

Region		Quintile 1	2	3	4	5	Total
Atlantic							
	Urban	4.6%	2.9%	2.7%	2.2%	1.3%	2.2%
	Rural	7.1%	6.7%	4.8%	4.0%	3.0%	5.2%
	Total	6.1%	4.9%	3.6%	2.6%	1.5%	3.2%
Eastern							
	Urban	1.9%	2.1%	1.6%	1.7%	1.1%	1.6%
	Rural	6.4%	2.9%	3.3%	2.2%	2.8%	3.5%
	Total	5.0%	2.6%	2.4%	1.9%	1.7%	2.6%
Bogotá	0.8%	1.0%	1.0%	0.9%	0.8%	0.8%	
Central							
	Urban	1.7%	1.5%	1.5%	1.4%	1.2%	1.4%
	Rural	3.9%	3.8%	3.3%	2.5%	2.7%	3.3%
	Total	2.7%	2.6%	2.2%	1.7%	1.4%	2.0%
Pacific							
	Urban	1.3%	1.1%	1.0%	1.1%	0.8%	1.0%
	Rural	1.7%	2.4%	2.0%	4.5%	1.4%	2.4%
	Total	1.6%	1.7%	1.4%	1.8%	0.8%	1.4%
Total							
	Urban	2.0%	1.7%	1.6%	1.4%	1.0%	1.4%
	Rural	4.8%	3.9%	3.5%	3.1%	2.7%	3.6%
	Total	3.4%	2.8%	2.3%	1.8%	1.2%	2.0%

expenditures and for 9.9% of the calorie intake. At lower income levels, although physical consumption is lower, a larger proportion of incomes is spent on cassava and contributes to caloric intake in a more significant way. Again in the rural Atlantic region, the lowest income groups spend about 7.0% of their total food expenditures on cassava and the root represents about 15% of their energy intake (Table 19).

The root is consumed mostly in its fresh form, and 62.2% of it is producer-consumed. Cassava consumption by producers on the Atlantic Coast is 170 kg per capita per year (Janssen, 1986). This shows the cassava's role as both a staple food and an income generator for small producers. The percentage of the crop that is actually consumed by the farmer decreases with income level. At the lowest quintile, 68.2% of consumption takes place at the farm level. Average per capita consumption, according to the DANE/DRI 1981 survey, is 25.5 kg at the national level, 41.1 kg at the rural level, and 17.2 kg at the urban level.

In the Atlantic rural zone, at the lowest income levels, cassava is the second highest source of calories (15%) after rice (25%) but ahead of plantains (12%), sugar (11%), and vegetable oils (10%). In the rural eastern zone and again at low income levels, cassava comes third as an energy source after potatoes and corn. Consumption of cassava in Bogota is not high in per capita terms (7.2 kg), but in any case it represents a sizable yearly amount (about 50,000 tons). Cassava consumed in Bogotá comes from Meta, Cundinamarca, and the central coffee region (northern Valle, Risaralda, and Caldas).

The abrupt and varied geography of the country, although allowing for the production of different, regionally adapted varieties, constitutes an obstacle to commercialization. The high perishability and high water-contents of the root as well as the cost of marketing a product produced on a relatively small-scale constitute important cost markups (Lynam and Pachico, 1982). Sharply segregated markets exist with ample price differentials. This is reflected by the inability of cassava grown on the Coast (the region with the lowest price) to enter the Bogota market (with the highest consumer price) although profit margins would adequately cover transportation costs. There is a sizable risk involved in entering the market. As a result, established intermediaries (producer and retailer) have good bargaining power.

Econometric analysis of demand

Both time series and cross sectional, household-budget data were analyzed in an effort to determine the main parameters influencing cassava consumption in Colombia.

Cross sectional data. The advantage of using these data lies in the possibility of exploring consumption patterns at a microeconomic level: by regions, by income levels, by type of household, etc. An important issue at hand was to establish both the price and income responsiveness of cassava consumption at varying income levels.

Table 19. Caloric contribution of cassava expressed as a percentage of total necessary calories, by urban and rural dwellers in five different regions of Colombia.

Region		Quintile					
		1	2	3	4	5	Total
Atlantic							
	Urban	9.8%	7.4%	6.3%	5.2%	3.0%	5.3%
	Rural	15.4%	16.5%	12.6%	9.5%	9.9%	13.4%
	Total	13.1%	12.7%	9.2%	6.4%	4.2%	8.5%
Eastern							
	Urban	2.9%	3.8%	2.7%	3.3%	2.1%	3.0%
	Rural	12.9%	7.5%	7.9%	4.5%	6.5%	8.2%
	Total	10.2%	6.3%	5.5%	3.8%	3.9%	5.9%
Bogotá	0.7%	0.8%	0.9%	0.9%	1.0%	0.9%	
Central							
	Urban	1.9%	1.5%	1.8%	1.7%	1.5%	1.6%
	Rural	7.0%	6.6%	5.3%	5.3%	4.0%	5.9%
	Total	4.4%	4.1%	3.2%	2.8%	2.0%	3.3%
Pacific							
	Urban	1.9%	1.1%	0.9%	1.0%	8.8%	0.9%
	Rural	2.6%	2.6%	2.2%	3.6%	3.4%	2.7%
	Total	2.0%	1.9%	1.4%	1.6%	1.1%	1.5%
Total							
	Urban	2.8%	2.6%	2.5%	2.3%	1.5%	2.2%
	Rural	9.2%	8.0%	7.3%	5.7%	6.0%	7.6%
	Total	6.6%	5.5%	4.4%	3.2%	2.2%	4.1%

Data from the household expenditure survey of 1981 conducted by DANE/DRI reveals that cassava consumption is quite responsive to income changes, especially at the lower quintiles, where it is elastic (1.47 and 1.23, see Table 20). More important, it is not only responsive to income changes but it is also quite responsive to changes in retail prices (Table 20). The average price elasticity for the country was calculated to be -0.88. The value of this parameter is similar to that calculated by Janssen on the Atlantic Coast (Janssen, 1986). Average income elasticity in Colombia is 0.20.

Time series data. Most analysis of this type of data have concluded that cassava is an inferior commodity, i.e., that income elasticity for consumption is negative. This result is obtained by regressing per capita consumption (which usually decreases over time) against continuously rising per capita incomes. The result clearly contrasts with measurements arising from cross sectional data. Why should the two measurements be so different?

Our hypothesis is that a primary element causing the decrease in per capita cassava consumption is urbanization. This element goes beyond price increases. It has important repercussions on market structure (decreases competitiveness) and therefore on volumes traded. Consequently, a model of demand for cassava with independent variables for prices (cassava price, wheat, rice), per capita real incomes, and number of people in the urban zones of the country was estimated.

The results show that cassava is quite responsive to its own price changes (elasticity of 0.43), to prices of other competing goods (rice has an elasticity of substitution of 0.09), to per capita real income (elasticity of 2.51) and to the proximity for urbanization (with an elasticity of -1.55, see Table 21). In other words, the major force behind the decrease in cassava consumption in 1970-85, was urbanization (through higher prices and restricted market access) and to a lesser extent the lower price of rice. Income growth, on the other hand, was a positive force in making the reduction less marked.

Other uses. Presently, there are about 40 small, drying plants of cassava that are being used in animal feed rations. These are located on the northern coast and in 1986 produced about 5000 tons.

The profitability of the plants, together with the advantageous position that the associations offer to members and neighbors in terms of employment, reduction of marketing risks, and earnings make them an attractive proposition, mainly to small farmers in those areas where there are marked dry seasons (4 months or more). The major advantage lies in the concept of market integration, where members are able to capture margins at several places within the marketing chain.

"In terms of other uses there is a large-scale starch plant on the north coast, which in 1970 manufactured a little over 1000 tons and two zones of small-scale, sour-starch producers in Cauca and Antioquia departments, producing an estimated 4600 tons, most of which went into the baking industry" (Lynam and Pachico, 1982). Converted from fresh cassava, starch production represents about 15,000 tons in Cauca (almost

Table 20. Elasticities of income and cassava price by quintile.

Quintile	Income	Price
1	1.47	-0.84
2	1.23	-0.92
3	0.27*	-0.93
4	0.64	-0.92
5	-0.04*	-0.83
Overall	0.20	-0.88

* Not significant at the 10% level of probability.

Table 21. Estimated elasticities from time-series data for fresh cassava, Colombia, 1965-84.

Own price	-0.43
	(3.09)[a]
Income	2.51
	(1.73)
Urbanization	-1.55
	(3.14)
Wheat price	NO
Rice price	0.09
	(2.16)

a. Values in parenthesis are t-statistics.

all of the production of that department). For the country, the amount is probably around 40,000 tons (2.3% of total production).

"The 1970 census estimated onfarm feeding at 504,000 tons (Ministerio de Agricultura, 1979)..... This represents about 8% of energy requirements of the small-farm swine production outside the Andean zone. This is considered a reasonable figure given the results of the survey" (Lynam and Pachico, 1982).

Potential demand for cassava

Cassava has the potential of playing a fundamental role in supplying food requirements to the population of Colombia in the near future. It can contribute directly to alleviate the energy deficits of the population and, indirectly, to the protein deficits by entering in the least-cost feed rations as a complement to other energy sources that are currently deficient in production (mostly sorghum and corn). We will briefly examine the carbohydrate and meat markets, in order to establish the potential future demand for cassava.

Carbohydrate foods. Cassava, along with rice, corn, wheat, potatoes, and plantains represent a major component of Colombian diets (Table 13). They accounted for 45% of the total calorie intake in 1981. In 1981, food expenditures represented about one-half of total consumption expenditures and the six products mentioned here represented about 25.6% of total food expenditures (Table 22).

In 1960-84, rice had the highest rate of per capita consumption increase (at 4.1% per year) closely followed by potatoes (3.6%) (Table 17). The widespread adoption of improved varieties, now growing in almost all of the area, became quite significant after 1967, when ICA and CIAT introduced the variety IR8 and other dwarf varieties developed for use in irrigated tropical areas. Today rice is the second largest recipient of subsidized agricultural credit in Colombia.

Potato production began to show a marked increase in 1972. Adoption of new technologies, more accessibility to subsidized credit, increased use of fertilizer, and increased stability at the farm level played important roles in stimulating higher yields and production. In 1977, 61% of potato output came from labor-intensive production (72% of the area) while the remaining 39% came from mechanized production (Sanint, 1983).

Plantains have shown some reduction in yields, due to the presence of new diseases (sigatoka). About 33% of the area planted in plantain is monoculture and the rest is intercropped, mostly as a shadow to traditional coffee plantations.

Wheat yields exhibited moderate growth, but production decreased annually by 5.6% in 1960-84, despite the protection from the import substituting policy. Per capita consumption of wheat increased at a rate of 1.6% per year in 1960-84 spurred by growing import volumes.

Table 22. Percent share of main food items in total food expenditure in Colombia, 1981.

Food item	National Average (%)	Urban (%)	Rural (%)
Beef	16.7	17.7	14.3
Dairy products	10.1	10.5	9.1
Sugar	8.7	8.0	10.4
Vegetables	7.1	7.6	6.0
Fruits	6.7	7.5	4.8
Rice	6.1	5.7	7.2
Oil	6.0	6.1	5.6
Potato	5.0	4.3	6.7
Plantain	5.0	3.9	7.6
Eggs	3.4	3.5	3.1
Bread	3.2	3.9	1.6
Maize	2.6	2.1	3.9
Beans	2.1	2.0	2.2
Cassava	2.0	1.4	3.7
Coffee	1.5	1.3	1.8
Other cereals	1.5	1.7	1.1
Fish	1.4	1.4	1.5
Poultry	1.3	1.6	0.8
Paste	1.2	1.3	1.5
Green peas	1.2	1.3	1.0
Pork	0.9	1.1	0.5
Lentils	0.7	0.8	0.4
Soft drinks	0.7	0.8	0.4
Wheat	0.5	0.4	0.7
Yam	0.3	0.3	0.3
Other tubers	0.3	0.3	0.3
Pulses	0.3	0.2	0.4
Chicken peas	0.2	0.2	0.4
Other foods	3.3	3.2	3.1
Total	100.0	100.0	100.0

Corn for human consumption also showed decreases equal to the annual growth of the population. The use of corn for feed has increased moderately (Table 23). Corn production is dualistic; about half of the area planted to corn is found in subsistence units, usually associated with other crops (cassava, yams, beans, etc.). Corn yields have remained virtually unchanged in 1960-84 although in 1974-84 they showed an increase of 1.2% per year while area planted had decreased annually by 1% in 1960-84.

Corn is another protected crop that has been unable to respond to the stimulus applied in the form of subsidized credit, research, and extension. Corn has one of the highest ratios of credit to value of production among all crops (0.19). However, imports have been frequently needed to meet domestic needs throughout the past 10 years.

Real retail prices reflect the impressive gains in rice yields over the past twenty five years. Prices fell at an annual rate of -3.4% from 1960 to 84. Wheat flour prices also fell considerably, reflecting IDEMA's policy of supplying this product at low prices to the urban consumer by means of imports.

Cassava prices increased at 1.7% and even more relevant was a drastic increase in its relative price with respect to wheat and rice. The cross price elasticity of cassava consumption with respect to the price of rice reflects the negative impact on consumption of this root resulting from the lower rice prices.

Meat consumption. Beef is the most prevalent meat in Colombian diets with annual consumption at 27 kg per capita, followed by poultry at 5.5 kg, and pork at 5.0 kg. The most dynamic of the three is the poultry industry; its most rapid growth occurred in 1970-78 with a 16% rate of increase. The recession affected this industry in 1979-85. Per capita poultry consumption was 1.33 kg in 1970. Per capita egg consumption went from 51.3 eggs in 1970 to 129.2 in 1984.

Beef supply has grown at rates similar to population rates and therefore no significant trend in its per capita consumption has been observed. Per capita consumption of pork grew annually by 1.4% between 1960 and 1984.

The dynamism of poultry production stems from the rapid adoption of new technologies that have made possible drastic price cuts over the past 15 years. The ratio of feed to meat went from 3.3 in the sixties to 2.1 in the eighties (Rivas et al., in press). An important element was the availability of subsidized credit which grew annually by 13.6% from 1974 to 1983. Another key element was the joint development of the feed and oil agroindustries, even in the face of the difficulties found in sorghum and soycake supplies (Machado, 1986).

Yet, because feed represents between 60% and 70% of the total costs in the poultry and egg industry, and feed is heavily dependent upon grain and oilseed production (commercial agriculture), which have been protected or have at least received more compensation than other crops, the industry has benefited from the prevailing policies. That is, the

Table 23. Cereal imports (thousands of metric tons) and use of maize as feed in Colombia, 1960-85.

Year	Total imports: Rice	Total imports: Maize	Total imports: Wheat	Maize as feed
	(thousands of metric tons)			
1960	0.0	6.0	143.0	129.9
1961	0.0	39.0	162.0	181.5
1962	1.0	0.0	159.0	184.2
1963	3.0	0.0	169.3	217.8
1964	0.0	20.0	183.8	200.4
1965	0.0	-2.0	188.1	184.4
1966	0.0	29.0	225.5	202.0
1967	0.0	32.0	177.6	228.9
1968	0.0	9.0	321.9	175.1
1969	16.0	-18.0	192.7	206.4
1970	-7.6	-6.0	318.6	222.2
1971	-0.4	47.0	348.2	203.0
1972	-4.5	34.0	416.0	206.9
1973	-31.3	125.0	358.8	203.2
1974	-1.9	39.0	438.8	215.3
1975	-115.6	-8.0	326.0	206.0
1976	-120.4	16.0	336.3	238.3
1977	-30.5	100.7	453.0	251.4
1978	-0.5	66.2	451.5	286.3
1979	-38.1	62.3	507.6	331.3
1980	-60.1	192.6	539.7	269.1
1981	-33.3	79.6	503.2	282.3
1982	0.0	89.5	567.2	300.9
1983	-35.3	68.7	599.6	283.6
1984	-40.4	0.0	632.6	287.4
1985	-52.3		628.1	

poultry industry is linked to both agroindustry and commercial agriculture, where the policy incentives have been located and will continue as such in the future.

In 1965-67 beef accounted for 82% of meat consumption, pork for 12%, and poultry for 6%, while in 1982-84 beef's share was reduced to 72%, and pork and poultry went up to 14% each, revealing an important contribution of poultry to meat consumption which could be linked to cheaper relative prices.

The feed agroindustry is dominated by three companies that control 60% of the market. Seventy-five percent of feed goes to poultry, and the other 25% goes to pork, dairy, and other industries (Machado, 1986).

Relations between the oil and cake producers, feed manufacturers and sorghum producers have been difficult, due to government intervention resulting from import license approvals and support prices for grains. Feed availability is a bottleneck to expanding the poultry industry. Policy has not favored use of sorghum, as was explained earlier. This is a crop whose production has not shown important yield advances and whose importation has been restrained. Local sorghum cultivation has expanded mainly in area planted with insignificant reductions in unit costs. Since it makes up for almost two-thirds of feed input requirements, it is imperative to reduce this cost by means of yield increases and/or a cheaper substitute. Dry cassava has a good potential to be a cheap substitute (Gomez et al., 1982).

Projected demand for cassava

The slow-down of Colombian food production, along with the fact that agriculture is locked in a high-cost scheme and that target crops selected to activate agricultural production have not responded adequately to the compensatory efforts implemented, indicate that the actual food deficits are likely to worsen into the near future unless important changes are incorporated in the food and fiber system.

Basic assumptions. Using the model estimated from time series data, we can project cassava consumption needs into the future. From the basic model:

Per Capita Consumption = Function (Prices, Income, Urbanization).

One can assume changes in the independent variables, and calculate the new levels implicit in the dependent variable. For Colombia we have assumed a rather conservative scenario in which per capita real income grows at an annual rate of 1.0% from 1985 to 2000, population grows annually by 1.5%, and the real prices of cassava and poultry decrease at -1.0% per year while other retail prices remain constant in real terms.

Fresh cassava. Prospects for carbohydrate production are not bright should the trends observed so far in the eighties continue. Only potato output has shown some growth in these years. Rice productivity and supply have been stagnant for the past 6 years and its real price has increased. Wheat imports have been growing rapidly while wheat production remains stagnant. This trend implies an improvement in demand for cassava in the mid-term range.

If we assume that current marketing and production practices will prevail, cassava production will not be able to meet the expected increases in demand, and further increases in cassava's real retail price would result. However, there is reason to believe that the new storage technology for fresh cassava will have a favorable impact on both demand and quantities traded, especially in the urban markets.

Important price fluctuations at the farm level can be observed throughout the country: Col $8 to Col $10/kg on the Atlantic Coast, Col $12 to Col $15/kg in Santander (eastern region), Col $18 to Col $25/kg in the coffee region (chiroza variety). These differences are magnified at the consumer level: Col $20/kg in Barranquilla (Atlantic region), Col $25/kg in Bucaramanga (Santander, eastern region), and Col $100/kg in Bogota.

In addition wholesale prices of agricultural goods have been growing faster than producer prices in Colombia. It is quite clear that technology expressly directed at lowering marketing costs, such as the storage of fresh cassava in plastic bags, can bring important benefits to both producers and consumers nationwide.

It has been calculated that cassava from the Atlantic region can be sold in Bogota at about Col $40/kg with this technology. Corabastos (the central wholesale market in Bogota) presently buys at Col $60 to Col $70/kg, i.e., 50% higher than what would be possible with the adoption of the new proposed storage technology. A reduction of this magnitude in the price of cassava implies a 44% increase in per capita consumption (elasticity times price decrease or, -0.88 x -50%). For the case of Bogota, an increase of volumes traded of 29% and a reduction in waste of about 15% (from 30% today to 15% expected) are calculated.

The most relevant point here is that consumers will pay less while producers will receive more (Janssen and Wheatley, 1985) by means of a significant reduction in waste and marketing costs, as well as the emergence of stronger markets. These results will be the result of a breaking of geographic barriers to entry due to lower perishability and therefore, of an increasing access from more distant production points. Finally, combined demand and supply effects are achieved, resulting in motivation for adoption of better production and marketing technologies.

Therefore, the assumption of a reduction in the retail price of cassava rests initially on the implementation of the new storage technology. In this case the reduction rate in price could be much higher than the one proposed for this exercise. An additional assumption for projections is that with this technology, commercialization losses of cassava will be reduced from an estimated present level of 25% to 15% in the fresh market. If there is a parallel development in the drying industry, losses will be reduced to 5% since the remaining 10% which is not suitable for the fresh market due to quality problems (small size or broken), and that is currently left in the field could be utilized by this industry. Therefore, the final effect on additional production requirements will be 20% less due to better crop usage.

Taking the initial level of per capita consumption implied by MAG (44.5 kg), per capita consumption by the year 2000 will be 41.5 kg resulting from the negative impact that urbanization has on cassava consumption. Total consumption will go from 1683 tons to 1731 tons. Additional land of 7.153 thousand hectares will be required and 1717 new jobs will be generated each year (Table 24).

Dry cassava. The major requirements for the development of this type of industry are present now. It is likely that if some compensatory measures are directed to this activity (similar to the ones applied to grains, for example), the industry will flourish quickly. We have established that dried cassava is:

Profitable at the farm level under the present price and cost structure of the country. If the policy bias were to be ameliorated, conditions would be even more favorable.

Profitable at the feed plant level: dry cassava enters in the least-cost feed formulations at around 90% of the price of sorghum (the main substitute).

It is attractive to the end user, since feed quality remains virtually unchanged.

To estimate feed needs by the year 2000, both poultry and pork production are projected, using time series data. For poultry, it is further assumed that the same ratio of meat to egg production will be maintained into the future. There will also be a 10% share for other uses (mainly dairy). This is reasonable in view of past trends. Demand estimates for poultry consumption indicate that it is quite responsive to price and income changes (elasticities of -0.46 and 0.88, respectively, see Table 25). Also, the decreasing price of poultry has had a negative impact on beef consumption (cross price elasticity of 0.66).

Considering the same assumption on poultry price and income and population rates of growth in 1984-2000, per capita poultry consumption will rise from 5.0 to 6.9 kg and pork consumption will increase from 5.3 to 5.9 kg. These are the two main users of feed.

In terms of feed requirements, total requirements will go from 1579 tons in 1984 to 2786 tons in 2000, mostly due to poultry feed increases. Sorghum and yellow corn requirements will be 1811 tons.

Sorghum production will keep a strong annual growth of 4.0% per year. Even so, imports will increase from 42,000 tons in 1984 to 633,000 tons in 2000. With a 10% use of dry cassava (279,000 tons) in feed formulations, sorghum imports would be decreased to 354,000 tons--a savings of US$28 million.

Table 24. Projections for time series model for the year 2000, Colombia.

Dried cassava		
Annual rates of growth (%)		
Per capita real income	1.0	
Population	1.5	
Real retail price poultry	-1.0	
Sorghum production	4.0	
Variable levels	1984	2000
Population (millions)	27.9	35.5
Per capita consumption of (kg)		
Beef	27.2	27.2
Pork	5.3	5.9
Poultry	5.0	6.9
Pork meat production	149.0	210.1
Poultry meat production	140.9	246.3
Total feed production	1,578.5	2,785.9
Pork feed production	272.1	380.9
Poultry feed production	1,207.6	2,151.7
Maize/sorghum		
Implicit use	1,026.0	1,810.8
Imports	41.9	632.5
Dried cassava		
Percent in feed	10.0%	
Required production		278.6
Maize/sorghum imports		353.9
Foreign exchange earnings (US$ in millions)		28.1
Fresh/dried cassava conversion		2.5
Cassava yield/hectare		10.0
Fresh cassava labor/ha		60.0
Dried cassava labor/t		3.1
Required fresh cassava (000 t)		523.4
Required hectares		52,337.6
New jobs created		16,043.4
Fresh cassava		
Annual rates of growth (%)		
Per capita real income	1.0	
Population	1.5	
Real retail price fresh cassava	-1.0	

Cont.

Table 24. Cont.

Variable levels		1984	2000
Population		27.9	35.5
Per capita consumption of fresh cassava (kg)		44.5	41.5
Fresh cassava production		1,659.4	1,730.9
Commercialization losses		25.0%	15.0%
Production increase			71.5
Additional hectares for cassava			7,153.0
New jobs generated			1,716.6

Final balance for fresh and dried cassava	Consumption		
	Total	Direct	Dried
Additional production for			
Fresh cassava (000)	595	72	523
Required hectares	59,490	7,153	52,338
New jobs generated	17,760	1,717	16,043

	1984	2000	1984	2000
	(000t)		(US$ in millions)	
Reduction of annual losses for fresh cassava commercialization with new technologies (10% fresh, 10% feed)	331.9	346.2	$54.8	$57.1

Table 25. Estimates of demand elasticities for poultry from time-series data, Colombia.

Own Price	-0.46
	(10.45)[a]
Income	0.88
	(10.86)
Beef Price	0.61
	(10.86)
Pork Price	-1.14
	(5.60)

a. Values in parenthesis are t-statistics.

An additional 523,000 tons of fresh cassava will be required which would require about 52,338 ha (at 10 tons/ha) and 16,043 new jobs would be generated.

Crop losses will be substantially reduced also. Given the previous assumption that there will be a reduction of 10% in fresh cassava marketed and another 10% of the root that is presently unacceptable for fresh consumption and would serve as input for drying, we have an annual reduction in crop losses of US$57 million.

In summary, if both markets were to be combined (fresh and dry), annual requirements of cassava would be 595,000 t, 59,490 ha would be cultivated, and 17,760 additional workers would be employed.

Concluding Comments

Colombia is heavily dependent upon the agricultural sector as the major source of growth, employment, and foreign exchange. Sustained growth was possible in the sixties and more so in the seventies, until 1978 when the country was affected by the regional recession. From 1978, there has been a reduction in the area harvested of 500,000 ha. International reserves went from US$5 billion in 1978 to US$2 billion in 1984 and increased to US$3 billion in 1986. Agricultural GDP decreased in per capita terms in 1978-85.

Unemployment has worsened, malnutrition is increasing, and food production has not responded adequately to the growing needs. Import restraints contributed to keep food import at stable levels.

The country is locked into a high cost structure resulting from the predominance of coffee and the adverse effects of the illegal crops in the sector. Overvaluation of the Colombian peso was drastically reduced in 1985 when a 50% rate of continuous devaluation was implemented, but most crops are still not competitive by international standards.

Compensatory policies have been in effect to reduce the adverse effects of macroeconomic and trade policies on the sector. They have taken the form of price and credit policies. Commercial agriculture has been the target; importables such as grains, oilseeds, wheat, and milk and exportables such as rice and sesame. Rice, however, has had trade restrictions that amount to negative protection.

These policies have ignored a vast agricultural sector, which has been discriminated against by other sectors of the economy and by the chosen products within the sector. Special emphasis has to be placed on nontradeables, such as cassava which has been unable to compete for resources with other more-favored crops.

Cassava consumption has been adversely affected by the rapid urbanization within the country. It means higher prices for the consumer as well as market access restrictions. During 1970 to 1984 cassava consumption decreased the most among the carbohydrate group. Yields are still low (9 t/ha is the national average). The crop is still fundamental for small producers, poor consumers, and those living in the rural areas. Producer-consumption represents a significant share (40.3% at national level).

Income elasticity is quite high at low income levels (close to 1.5). Price response has also be important: elasticities of -0.88 from cross sectional data (long-term elasticity) and -0.43 from time series (shorter-term elasticity) were estimated. There has been substitution away from rice in the period analyzed (1970-1984).

In the meat sector, there has been strong growth of the poultry and egg industry at the expense of beef consumption. The relative price of chicken has decreased considerably with respect to prices of pork and beef. Income elasticity and price elasticities for poultry were found to be significant and important in determining the rapid growth of its consumption. This growth brought high demand pressures to the feed industry and therefore to commercial feed inputs such as sorghum (Table 26) and oilseed cakes. These crops have been unable to meet the challenge, constituting a bottleneck for a more rapid development of the industry, in the face of the import restraint policies enforced.

There is a high and growing demand for fresh cassava but unless marketing constraints are reduced (by implementing the new storage technology developed by International Development Research Centre (IDRC)-CIAT) real retail prices will keep rising, marketing margins will remain high, and market access will be quite restricted. Consequently, there will be little or no incentive to adopt technologies more demanding of input usage. It is imperative to make improvements in the commercialization of cassava to meet the growing needs of the population.

Dry cassava production (Table 27) is just starting on commercial scales and it is proving to be profitable for farmers involved as well as to feed manufacturers and end users. In terms of domestic resource cost, it is more effective than growing sorghum. Therefore, dry cassava has an important role to play in filling the gap left by sorghum production and in filling the needs of one of the most dynamic industries in the country, namely the feed industry.

Given cassava's ability to grow on marginal lands, its intensive use of labor and its unexploited yield potential, cassava appears as a strong candidate to reduce the important calorie and protein deficits of the Colombian population, to generate employment and increase income levels among small farmers, and to save foreign exchange by substituting for imported foods.

Table 26. Economic parameters of sorghum production on the Atlantic Coast region of Colombia, 1984.

Investments per hectare	Nominal price (US$)	Correction factor	Corrected price (US$)	Economic life time (years)
Tractor + equipment	347	0.83	288	10
Combine	119	0.82	98	10
Spraying airplane	25	0.65	16	10

Production costs per hectare	Units needed		Nominal price/unit (US$)	Correction factor	Corrected price (US$)
Land	1		75	1.0	75
Land preparation	1		77	0.57	44
Seeds	15	kg	1.69	1.0	75
Pre-emergent herbicide	3	liters	4	0.74	9
Application	2.2	hours	4.2	0.57	5
Insecticides	3	flights	7	0.59	12
Application	5	flights	7.5	0.75	17
Fertilizer	100	kg	0.35	0.83	29
Application	1.2	hours	3.3	0.57	2
Harvest	33.6	sacks	1.5	0.57	29
Loading	1		4.35	0.75	3
Transport	1		5.3	0.57	3
Second collection	2	persons	4.2	0.75	6
Other harvest costs			1.67	1	2
Technical assistance	1	person	8.3	0.90	8
Plot management and control	4	mandays	4.2	0.80	13
Other costs			10.8	1.0	11
Costs of first harvest					302

Cont.

Table 26. Cont.

	Units needed		Nominal price/unit (US$)	Correction factor	Corrected price (US$)
Mowing and burning	1		8.75	0.80	7
Fertilizer	60	kg	0.35	0.83	17
Application	1	hour	3.3	0.57	2
Insecticides	2	flights	7	0.59	8
Application	2	flights	7.5	0.75	11
Technical assistance an control	2	mandays	4.2	0.80	7
Harvest	11.2	sacks	1.5	0.57	10
Other harvest costs			5.8	0.90	5
Transport	1	hour	4.9	0.57	3
Benefits from cattle grazing			-4.2	1.0	-4
Cost of ratoon					66
Administration costs	10% of national costs			0.90	45
Transport to mill	2.8	tons	8.3	1.00	23
Total costs					436
Yield:	2800 kg				

Cash flow per hectare	Year 0	1	2	3	4	5	6	Residual value
Investments	-201	-201						161
Costs of extension service	-8	-4						8
Production costs	-109	-436	-436	-436	-436	-436	-327	
Foreign exchange saved		448	448	448	448	448	448	
Cash flow	-318	-193	12	12	15	12	115	169

Table 27. Economic parameters of dried cassava production using facilities with 1500 m^2 on the Atlantic Coast region of Colombia, 1984.

Investments per plant:	Nominal price (US$)	Correction factor	Corrected price (US$)	Economic life-time (years)
Concrete drying floor	6562	0.84	5512	20
Warehouse	1650	0.84	1386	20
Fence	93	0.89	83	5
Cover for chipper	75	0.87	65	15
Chipper	626	0.9	563	10
Motor	1187	0.7	831	5
Scale	188	0.66	124	10
Wheelbarrows	225	1.0	225	5
Spades	56	1.0	56	5
Rakes	38	1.0	38	2
Gatherers	38	1.0	38	2
Sacks	750	1.0	750	2
Plastic Cover	938	1.0	938	4
Unforeseen	5% of investments		530	8
Working capital			5062	
Total investments			16201	
Cassava production:				
Tractor + equipment	15263	0.83	12668	10

Production costs of the cassava/maize intercropping system per hectare:

	Units needed	Nominal price (US$)	Correction factor	Corrected price (US$)
Machinery				
Plowing	2.5	17.5	0.57	25
Disking	1.0	17.5	0.57	10
Furrowing	10.0	17.5	0.57	10
Internal transport	1.5	14.0	0.57	12

Cont.

Table 27. Cont.

	Units needed	Nominal price (US$)	Correction factor	Corrected price (US$)
Labor				
Seed preparation	1	4.2	1.0	4
Planting cassava	6	4.2	1.0	25
Planting maize	2	4.2	1.0	8
Chemical weed control	2	4.2	1.0	8
Manual weed control	35	4.2	0.72	105
Pest control	2	4.2	0.8	7
Cassava harvesting	20.7	4.2	0.54	47
Maize harvesting	6	4.2	0.75	19
Inputs				
Maize seed	10 kg	0.18	1.0	2
Insecticides	1 treatment	11.75	0.59	7
Herbicides	1 treatment	16.67	0.74	12
Land	1 ha	75	1.0	75
Administration costs	10% of national costs			10
Benefits from cattle grazing	-4.2			-4
Total costs				405

Cassava yield : 10345 kg/ha

Maize yield : 1000 kg/ha

Processing costs per facility:

	Units needed	Price/unit (US$)	Correction factor	Corrected price (US$)
Fixed costs				
Maintenance		423	1.0	423
Administration		1500	0.75	1125
Land-rent		42	1.0	42

Cont.

Table 27. Cont.

	Units needed	Price/unit (US$)	Correction factor	Corrected price (US$)
Variable costs				
Labor	1008 mandays	4.2	0.5	2100
Fuel	1008 liters	0.125	2.0	252
Transport	403 tons	12	1.0	4838
Other costs	1008 tons	0.67	1.0	672
Total processing costs				9452

Cash flow per plant:

	Year							Residual
	0	1	2	3	4	5	6	value
Investments in drying plant	-5569	-5569		-825		-1763	-1196	7113
Working capital	-2531	-2531						5062
Operation costs		-9452	-9452	-9452	-9452	-9452		
Investments in cassava production	-6334	-6334						5067
Production costs	-13139	-39417	-39417	-39417	-39417	-26278		
Institutional investments	-7500	-5625						9469
Foreign exchange saved with maize (corrected for transport costs)		15947	15947	15947	15947	15947	15947	
Foreign exchange saved with cassava		55709	55709	55709	55709	55709	55709	
Cash flow	-35074	2727	22787	21962	22787	21024	34710	26712

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PARAGUAY: POTENTIAL DEMAND FOR CASSAVA

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Macroeconomic Policy and Agriculture

In this section the evolution of the Paraguayan economy, in the light of the set of policies implemented, is analyzed. Emphasis is placed on the role of agriculture and, within it, the role of cassava. As it is well known, Paraguay is by far the largest per capita producer of cassava in the world, with over 750 kilos per year. This singular situation will be discussed in terms of both production and consumption factors influencing this crop.

Economic policy context

Paraguay has had in the past two decades one of the more impressive rates of growth among Latin American countries and the world. Its economy is based on the agricultural sector, which contributes 27% of the gross domestic product (GDP), 50% of employment, and 95% of exports. Agricultural contribution to GDP dropped from 39% in 1960 to 27% in 1984. Of the current share, 16.2% corresponds to crops, 7.8% to livestock, and 2.7% to forestry. Construction, the big winner, grew from 1.5% in 1962 to 7.1% in 1981, and to 6.2% in 1984 (Table 1). Stable policies have been the trademark of this development.

Of the 3.7 million people in the country, 56% still live in the rural areas. Population growth for 1970-85 was 3.2% per year (Table 2). Urban population grew faster at 4.4%. Per capita income was about US$1,777 in 1985.

Recent growth of the Paraguayan economy can be divided into three distinct periods. From 1950 to 1971, from 1972 to 1981, and from 1982 to present. In 1950 to 1971 the basis for development was laid out and the country's economy expanded at a modest rate (4%).

In 1972 the construction activity was accelerated. Itapúa and the road to Brazil had a great impact on the economy. In the seventies, Paraguay achieved one of the highest rates of growth of Latin America and the world. Specifically, in 1970-80, Paraguay had the highest rates of annual growth of real GDP at 8.6%, of agriculture at 7.3%, and of industry at 10.6% among Latin American countries (Table 3). In 1972-81, the total value of production increased at an annual rate of 7% for crops, 5% for livestock, and 6% for forestry (Ground, 1984).

The seventies also witnessed a rapid expansion of agricultural exports. Two crops were instrumental to this export growth: cotton (a small farmers crop) and soybeans; which expanded in 1972-79 by 470% and 350%, respectively. Total exports grew at 7% per year and imports grew at 12.5% annually. Exports were stable in value and composition (Table 4) while imports were mostly related to the infrastructure development that took place with foreign capital.

The road to Brazil through Puerto Stroessner put an end to trade dependence with Argentina and, in view of the fixed rate policy in effect from 1960 to 1982, illegal trade flourished in Paraguay (Rodríguez, 1984).

Table 1. Structure of gross domestic product by economic sectors.

Economic sector	Year							
	1960	1970	1975	1980	1981	1982	1983	1984
	(% over constant values of 1982)							
Primary production								
Crops		16.1	16.7	14.5	15.3	15.6	15.6	16.2
Livestock		11.0	11.0	7.9	7.4	7.7	7.8	7.8
Forestry		3.2	3.0	2.7	2.6	2.5	2.5	2.5
Wildlife and fisheries		0.1	0.1	0.1	0.2	0.1	0.2	0.2
Subtotal production primary	38.8	30.4	30.8	25.2	25.5	25.9	26.1	26.7
Secondary production								
Mining	0.1	0.1	0.2	0.3	0.4	0.4	0.4	0.4
Industry	17.3	18.4	16.8	17.6	16.8	16.4	16.2	16.4
Construction	2.4	2.4	3.2	6.6	7.1	6.7	6.5	6.2
Subtotal production secondary	19.8	20.9	20.2	24.5	24.3	23.5	23.1	23.0
Total production of goods	58.6	51.3	51.0	49.7	49.8	49.4	49.2	49.7
Production of services								
Electricity	0.6	0.8	1.2	1.8	1.7	2.2	2.1	2.1
Water and sanitary	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.4
Transportation and comm.	4.0	3.9	4.6	4.3	4.1	4.2	4.3	4.3
Trade	18.4	26.5	25.3	27.0	27.0	26.6	26.6	26.3
Central government	4.4	5.7	4.3	3.8	4.2	4.5	4.5	4.5
Housing	3.6	3.6	3.3	3.1	3.1	3.0	3.0	2.9
Other services	10.2	8.0	10.1	10.0	9.8	9.8	9.9	9.8
Total production of services	41.4	48.7	49.0	50.3	50.2	50.6	50.8	50.3
Total GDP	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

SOURCES: Secretaría Técnica de Planificación, División de Estadística y Cuentas Nacionales, with data from the Banco Central del Paraguay.

Table 2. Statistical profile of Paraguay.

Area (km^2)	406.752				
Population: total 1985 (43.9% urban)	3.691.000				
Annual growth rate 1970-85	3.2				
Birth rate (1984)	38.9				
Mortality per 1000 inhabitants (1984)	7.7				
Infant mortality per 1000 live births (1984)	52.9				
Life expectancy at birth (1984)	68.0				
Percentage of literacy (1984)	92.0				
Labor force by sector (1982)	(Percentages)				
Agriculture	49.6				
Mining	0.1				
Manufacturing	13.6				
Construction	7.5				
Others	31.9				
	1981	1982	1983	1984	1985[a]
Real production			(Growth rates)		
Total GDP (market prices)	8.7	-1.0	-3.0	3.1	4.0
Agricultural sector	10.1	0.4	-2.4	5.9	4.6
Manufacturing sector	4.3	-3.7	-4.2	4.5	5.0
Construction sector	16.7	-6.0	-5.7	-2.4	-1.0
Commerce sector	8.4	-2.2	-3.1	1.8	4.8
Central government			(Percentages of GDP)		
Current revenues	8.3	9.3	8.0	8.0	7.9
Current expenditures	7.5	8.7	8.9	7.6	7.0
Current savings	0.8	0.6	-0.9	0.4	0.9
Capital expenditures	3.7	2.1	1.7	3.3	2.5
Deficit or surplus	-2.8	-1.5	-2.6	-2.9	-1.5
Domestic financing	2.5	1.5	1.9	1.9	1.8
Money, prices, and salaries			(Growth rates)		
Domestic credit	36.9	9.3	23.1	20.0	17.7
Public sector	59.3	77.5	228.8	28.6	42.2
Private sector	15.4	5.4	2.6	17.3	9.2
Money supply (MI)	-14.0	-7.6	22.7	32.0	25.8
Consumer prices (annual average)	14.0	6.7	13.5	20.3	25.2
Real wages	5.3	-2.8	-7.1	-3.5	-2.2
Exchange rate			(Annual average)		
Official rate (to the US$)	126.0	126.0	201.0	240.0	240.0
Real effective exchange rage (Index 1980 = 100)	101.4	105.4	119.0	132.7	168.2
Terms of trade (Index 1980 = 100)	104.6	88.0	83.8	112.7	105.9
Balance of payments			(Millions of dollars)		
Current account balance	-374.4	-365.3	-247.4	-313.2	-106.3
Merchandise balance	-373.8	-296.8	-225.3	-287.8	-125.0
Merchandise exports (FOB)	398.6	373.3	326.0	361.3	322.9
Merchandise imports (FOB)	-772.3	-670.1	-551.4	-649.1	-447.9
Net services	-6.4	-73.1	-28.1	-34.7	4.6
Capital account (net)	431.0	319.4	239.3	282.0	70.5
Change in net reserves (- = increase)	-43.4	58.9	-3.1	-14.7	88.7
External public debt			(Millions of dollars)		
Disbursed debt	709.2	940.0	1145.1	1286.7	1460.4
Debt service actually paid	70.7	80.7	84.5	117.6	226.8
Interest payments/export of goods and NFS			(Percentages)		
	5.1	6.6	8.9	6.9	9.6

a. Preliminary estimate.

Table 3. Growth of gross domestic product (annual mean rates), Paraguay.

Country	GDP total		Agriculture		Industry	
	1960-70	1970-80	1960-70	1970-80	1960-70	1970-80
Argentina	4,3	2,3	2,4	2,3	5,9	2,0
Bahamas	-.-	-.-	-.-	-.-	-.-	-.-
Barbados	6,3	2,0	-.-	2,5	-.-	1,3
Bolivia	5,6	4,5	3,2	3,2	7,4	3,9
Brazil	6,1	8,8	3,1	5,2	6,0	9,5
Colombia	5,2	5,9	3,8	4,7	5,9	4,9
Costa Rica	6,1	5,6	5,6	2,4	8,0	8,0
Chile	4,5	3,1	2,3	2,2	5,2	1,7
Dominican Republic	5,1	6,3	2,3	3,4	7,2	8,5
Ecuador	5,3	7,6	2,5	4,1	6,9	8,9
El Salvador	5,6	3,0	3,9	2,0	7,5	3,0
Guatemala	5,5	5,6	4,4	4,8	6,9	7,3
Guyana	3,2	4,5	0,9	1,9	4,2	3,1
Haiti	0,6	4,2	0,9	2,2	0,6	7,1
Honduras	5,2	3,8	5,4	1,9	6,2	4,9
Jamaica	5,6	-0,3	1,4	2,8	6,4	-2,2
Latin America	5,7	5,8	3,4	3,3	6,3	6,2
Mexico	7,0	4,5	3,7	2,4	8,6	6,9
Nicaragua	6,9	1,2	6,0	1,3	10,7	1,2
Panama	7,8	3,8	5,3	1,4	10,4	1,5
Paraguay	4,4	8,6	3,0	7,3	6,5	10,9
Peru	5,0	3,1	4,2	-0,6	5,1	3,6
Suriname	7,4	2,9	-.-	6,0	-.-	0,7
Trinidad and Tobago	4,2	4,9	-.-	-0,4	-.-	5,1
Uruguay	1,6	3,2	3,0	0,5	0,9	4,7
Venezuela	6,0	4,5	5,3	3,8	3,9	2,2

SOURCE: ECLAC (United Nations Economic Commission for Latin America and the Caribbean). [In Spanish: CEPAL (Comisión Económica para América Latina de las Naciones Unidas).]

Table 4. Commodity composition, Paraguay.

Commodity for export	Year				
	1960	1970	1975	1981	1985
	(Percent distribution)				
Wooden products	14.9	19.7	15.8	12.3	3.2
Livestock products	35.2	26.7	19.5	2.3	2.3
Tobacco	5.9	9.0	6.8	2.2	2.0
Cotton	1.1	6.3	11.4	43.7	45.5
Soybean	-.-	-.-	9.9	16.1	31.7
Sugar	0.3	-.-	3.8	-.-	1.1
Vegetable oils	5.7	10.9	6.0	7.6	5.5
Essential oils	3.7	3.2	5.5	2.2	1.8
Quebracho extract	10.9	3.1	1.4	1.9	1.3
Other	7.4	21.1	19.9	11.7	3.5
Total	100.0	100.0	100.0	100.0	100.0

Commodity for import	Year	
	1970	1981
	(Percent distribution)	
Food	8.2	6.4
Other consumption items	14.4	21.0
Primary and intermediate goods	39.3	17.0
Fuels and lubricants	16.4	18.8
Capital goods	21.7	36.8
Total	100.0	100.0

The country has now become sensitive to the disequilibriums arising from policies created by its two giant neighbors, Argentina and Brazil.

Unemployment dropped from 5% in 1972 to 2.2% in the first semester of 1982. During this period labor force expanded at 4%, inflation rate was under 14.%, real agricultural wages grew by 3.3% per year, and labor productivity in agriculture increased by 5.5% (Ground, 1984).

Despite the rapid economic growth and expansion of aggregate demand, inflation was controlled by expanding imports and by conducting a fiscal policy that was countercyclical in nature.

However, in 1982 the country entered in its third economic period when the construction sector slowed down and world recession set in. An increased divergence between the official and the free market exchange rate took place. The current account balance has been in the deficit since 1978 (Table 5). This, together with the drying up of capital inflows from hydroelectric projects and with the rapid rise in international interest rates, has led to a sharp reduction of international reserves--dropping from US$818 million in 1981 to US$352 million in 1985--and to the accumulation of external payment arrears (USDA Ag. Situation Report).

External public debt reached US$1.5 billion in 1985. Real GDP decreased for two consecutive years (-1.0% in 1982 and -3.0% in 1983) to resume growth in 1984 and 1985 at 3.1% and 4.0%, respectively (Table 2).

Exchange rate distortions have favored contraband, and it is estimated that over 30% of all trade is illegal (Rodríguez, 1984, EP v. 1, p. 371). The fixed-rate policy, together with acute fluctuations in the general price level and Argentine and Brazilian exchange rates of the last ten years, explains the importance of illegal trade in the country and the changes in flow from one country to the other.

Informal channels are more open to nonperishable products that require little handling and have easy access to both Argentine and Brazilian markets such as soybeans and cattle.

Policy environment

Given the overwhelming importance of agriculture, it is logical that most of the government's action has been directed toward promoting its development. However, direct intervention has been minor. The policies enacted have been directed mainly at colonizing frontier lands, improving land tenancy, developing better infrastructure, and stimulating agricultural exports.

The highlights of the Paraguayan policy direction have been the occupation and development of agricultural frontiers, for example, the infrastructure developments at Iguazu and Yacyreta, the road to Brazil, and the relocation of families in new colonies away from Asunción. The Instituto de Reforma Agraria (IRA) and, from 1963, the Instituto de Bienestar Rural (IBR) have been in charge of relocation, land adjudication, and redistribution of property.

Table 5. Foreign trade: CIF imports and FOB exports (in millions of dollars), Paraguay

	1970	1978	1979	1980	1981	1982
Imports						
Crops	10.0	26.1	37.3	38.3	42.6	35.6
Wheat byproducts	(4.3)	(4.9)	(8.3)	(11.1)	(13.9)	(6.8)
Fruits	(0.1)	(0.9)	(1.0)	(1.1)	(1.7)	(2.2)
Tobacco	(3.7)	(10.7)	(17.3)	(14.3)	(10.0)	(11.7)
Fuel and lubricants	6.1	59.6	87.5	129.5	94.6	154.2
Other	47.7	232.0	312.7	349.2	368.9	391.7
Total imports	63.8	317.7	437.7	517.1	506.1	581.5
Exports						
Crops	26.0	192.6	242.2	229.5	240.6	268.6
Cotton	(4.0)	(100.0)	(98.6)	(105.8)	(129.3)	(122.4)
Soybean	(1.5)	(41.6)	(81.3)	(45.3)	(52.5)	(91.0)
Vegetable oils	(7.0)	(16.8)	(19.1)	(17.0)	(22.4)	(18.8)
Cake and expellers	(2.5)	(3.9)	(8.0)	(21.9)	(14.2)	(12.1)
Tobacco	(5.8)	(9.2)	(8.5)	(10.1)	(6.5)	(5.9)
Vegetables	(0.3)	(2.4)	(3.2)	(8.1)	(4.3)	(8.4)
Coffee	(0.9)	(0.2)	(4.2)	(2.3)	(1.3)	(0.3)
Livestock products	18.0	32.3	11.8	4.4	6.8	9.0
Meat	(15.0)	(23.4)	(15.2)	(1.0)	(0.0)	(2.0)
Leather	(2.4)	(7.9)	(6.2)	(3.1)	(6.6)	(6.8)
Forestal products	19.4	29.3	48.5	74.7	45.6	51.1
Other	0.7	2.8	2.6	1.6	2.6	1.0
Total exports	64.1	257.0	305.2	310.2	295.5	328.8
Agricultural balance						
Agricultural exports	63.4	254.2	302.6	308.6	292.9	328.8
Agricultural imports	10.0	26.1	37.3	38.3	42.6	35.6
Balance	53.4	228.0	265.3	270.3	250.3	293.2
Commercial balance						
Total exports	64.1	257.0	305.2	310.2	295.5	329.8
Total imports	63.8	317.7	437.7	517.1	506.1	581.5
Balance	0.2	-60.8	-132.5	-206.9	-210.6	-251.7

SOURCE: Banco Central del Paraguay.

Another important policy aims to promote exports--a permanent theme since 1956 when the International Monetary Fund (IMF) approved a loan to subscribe to the Stabilization Plan. The Guarani depreciated from 60 to the U.S. dollar in that year to 126 in 1960 and stayed at that official level until 1982. The creation of CEPEX in 1969 was instrumental in promoting exports (Franco, 1984).

Livestock products and essential oils decreased in exports as cotton and soybeans became predominant (Tables 4 and 5). Import composition was related mostly to infrastructure development that used foreign capital.

Fiscal policy is directed mostly at taxing property. The failure to implement significant new tax measures was the basic factor causing current government revenue to slip from 9.3% of GDP in 1982 to an estimated 7.9% in 1985, one of the lowest revenues from tax in Latin America (IDB, 1986 Report, ESPLA).

The present exchange rate policy is weak: it counteracts export promotion efforts, drains government resources, and overvalues the Guarani. While the free market rate was above G600 per U.S. dollar during 1986, the official rate for debt payments is G126 per U.S. dollar and G240 for commercial transactions. Transfers and subsidies paid by the government are equivalent to 25% of government expenditures, largely because of the burden imposed by the implicit subsidy in the payment of foreign debts (IDB 1986 Report ESPLA).

This policy therefore devalues export earnings and stimulates unaccounted exports and higher imports--a difficult situation to handle when the country's reserves are low.

Agriculture in Paraguay

Almost all agricultural production takes place in the eastern region which constitutes 37.5% of the country. The remaining 62.5% produces only 3% of the country's cotton and 2% of sugar. However, 38% of livestock, the predominant activity, is produced by that region (Fletschner, 1984).

Only wheat and soybean are produced in commercial areas larger than 10 ha. The average area for other crops is one ha (Table 6). Food crops grow more slowly than export crops (Fletschner, 1984).

Agricultural production has grown by increasing production areas, but yields have remained virtually stagnant. Cultivated areas increased at the annual rate of 9.4% in 1972-81, remaining constant in 1982-83 and 1983-84 (Table 7). After 1984 agriculture began to recuperate at annual growth rates of 11% and 15%, in 1985 and 1986 respectively (USDA Report).

Although agricultural exports account for over 90% of total registered exports, there is a low degree of export income diversification (Table 4), for example, 47% of agricultural exports are cotton, 33% are soybeans, and 2% are livestock.

After 1978 agricultural prices fell by over 30% with respect to the other products in the economy (Table 8). Internal terms of trade for

Table 6. Crops production, Paraguay, 1981.

	Area harvested (ha)	Total production (t)	Average yield (kg/ha)	Average area (ha)
Cotton	243,952	341,647	1,400	1.8
Rice	23,398	44,478	1,901	1.7
Green pea	2,040	1,632	800	0.4
Sweet potato	11,304	75,053	6,639	0.4
Sugarcane	48,569	2,154,713	44,350	1.2
Onion	2,191	7,789	3,555	0.4
Field bean	8,564	7,377	861	0.6
Maize	290,812	468,227	1,610	1.0
Cassava	178,205	2,012,389	11,293	0.9
Peanut	35,207	36,041	1,024	0.7
Potato	789	3,018	3,824	0.5
Cowpea	49,940	42,184	852	0.6
Soybean	396,125	761,185	1,922	13.5
Tobacco	7,706	11,587	1,504	0.6
Castor oil	13,953	14,829	1,063	1.1
Wheat	49,222	60,911	1,237	16.1

SOURCE: Ministerio de Agricultura y Ganaderia. 1981. Censo Agropecuario.

Table 7. Effects of the occupation of frontier lands on the level of activity and registered exports, 1972-83, Paraguay[a].

	1972-1981	1973	1974	1975	1976	1977	1978	1979	1980	1981	1981-1983	1982	1983
	(Rates of growth)												
Cultivated land													
Total	9.4	14.2[b]	14.2[b]	14.4[b]	9.1	5.9	5.5	7.9	7.1	7.2	-	-	-
Internal market	3.0	10.1	13.0	14.5	8.1	-4.9	-3.7	-1.4	6.0	-7.0	-	-	-
External market[c]	24.5	38.3	19.6	13.5	13.2	51.4	29.9	20.8	9.0	29.7	-	-	-
Value of agricultural production	8.2	7.9	10.9	3.3	4.7	15.6	6.2	6.5	10.6	8.2	-	-4.4	-6.3
Gross value	8.9	7.4	13.0	2.3	4.7	16.0	4.9	6.2	10.5	16.1	-	-3.7	-6.3
Internal consumption	3.8	1.1	10.7	-0.9	1.7	2.5	1.1	8.7	4.4	5.2	-	5.9	-2.7
Export[c]	26.6	59.1	25.0	16.7	16.7	62.2	13.1	1.2	23.1	35.2	-	-17.0	-12.5
Forest products	7.6	2.5	11.0	9.3	-1.9	9.1	7.9	14.0	12.3	4.8	-	-5.0	-2.0
Production value per ha													
Agriculture	-1.1	-5.3	-2.1	-9.7	-4.1	9.2	0.8	-1.4	3.2	1.0	-	-	-
Gross value	0.5	-5.9	-1.2	-10.6	-4.8	8.2	0.7	-0.2	3.4	0.7	-	-	-
Internal consumption	-0.1	-8.2	-1.6	-13.5	-5.9	-7.7	5.0	7.3	-1.4	12.9	-	-	-
Export[c]	1.8	15.0	4.6	2.9	2.9	7.2	-12.7	-16.3	13.0	4.1	-	-	-

a. Provisional figures only, subject to revision.
b. Estimate
c. Cotton and soybean.

SOURCES: Ministerio de Agricultura y Ganaderia; Banco Central del Paraguay.

Table 8. Index of implicit prices (constant Guaranis 1977), Paraguay.

Year	Total GDP	Agricultural GDP
1958	26.4	23.9
1959	29.6	26.4
1960	34.8	31.9
1961	37.2	33.7
1962	40.5	37.3
1963	41.5	39.0
1964	42.5	40.0
1965	51.6	40.3
1966	45.5	42.4
1967	44.3	39.1
1968	45.1	40.7
1969	46.6	42.7
1970	47.5	44.0
1971	50.3	47.8
1972	54.7	54.1
1973	66.1	72.0
1974	81.7	82.2
1975	87.2	90.1
1976	91.6	91.4
1977	100.0	100.0
1978	110.4	108.6
1979	113.1	133.0
1980	155.5	148.8
1981	181.3	166.1
1982	192.5	165.9

SOURCE: Banco Central del Paraguay.

agriculture have deteriorated. This partially explains the slower growth of the sector in the eighties. Compensatory policies have been directed only to export crops (cotton and soybeans), wheat and sugarcane, and to livestock, leaving food crops unprotected. In the face of growing inflation, this constitutes a dangerous policy to follow.

Before 1960, livestock was the predominant economic activity and the main source of exports. By 1962, crops contributed slightly more than livestock to the agricultural GDP. Today, crops account for two-thirds of the agricultural GDP and have displaced livestock products as the dominant foreign exchange earner (Tables 1 and 4).

Hog production is important, but as a backyard operation. Growth in production has been high, partly because fresh cassava is an important animal feed (Regunaza and Kugler, CIAT). However, there are few industrial-level operations dedicated to derivatives of pork production.

Poultry production is still dualistic, that is, characterized by a scattering of very small-scale rural producers and one industrial company (Pollos Pechugon) supplying 90% of the Asunción market. Growth in production has been high, based on abundant supplies of maize and soybeans.

Within crops, the major economic crops are soybeans, followed by cotton, cassava, and maize in that order (Table 9). Maize and cassava are key products to the settlers of the newly colonized frontier areas. Most of the production of these two crops is consumed onfarm both as food and as feed. Soybeans and cotton constitute cash crops and are also important in the process of capital accumulation necessary for colonization.

Typically, a 20-ha lot located in a new colony starts with subsistence agriculture. About 3 ha are initially cultivated--two ha are used for crops for onfarm consumption (maize, cassava, cowpea) and the other hectare is planted to a cash crop (tobacco, cotton, or petit grain). During the second stage, as deforestation progresses, the farmer cultivates up to 5 ha. Again, 2 ha are for food crops while the other 3 ha are used for cash crops (cotton, tobacco, maize, soybeans). By now, he owns oxens to prepare the land.

The third stage starts with a large investment to deforestate about 6 ha. Contract work is employed for land preparation and cultivation--local input intermediaries play an important role here.

In the oldest IBR colonies, a fourth stage has been taking place. Purchases, sales, and rentals of land have taken place, together with more deforestation, to widen the property size. Machinery has also been purchased. Soybeans, rotated with wheat, are a preferred crop in larger areas, together with mechanized maize (World Bank, 1984).

Throughout the settlement process, livestock is acquired and, consequently the land reserved for cassava and maize cultivation for feeding pigs and poultry increases. Cassava becomes a strategic crop, not only because of its resistance to droughts, but also because it is available throughout the year. It is not unusual to find cassava stored in the ground for two to three years, in different plots of the farm.

Table 9. Contribution of agriculture and crops to GDP, Paraguay, 1984.

Share of GDP	Percentage
Total agriculture	26.7
Soybean	20
Cotton	15
Cassava	14
Maize	6
Sugarcane	5
Other	40

SOURCE: USDA. 1985. Agricultural situation report for Paraguay.

Specific agricultural policies

In Paraguay, government action has preferred developing an adequate environment for agriculture rather than exerting a marked direct intervention on a product-by-product basis.

Producer prices has roughly followed international prices, reflecting the low degree of government intervention. Cotton and soybean (the main export crops) have a nominal protection coefficient (NPC) close to unity. Wheat, however, receives substantial protection in an effort to promote self-sufficiency in this commodity, as does sugarcane--to substitute local alcohol for imported oil (World Bank, 1984, Appendix tables).

Although there are no measurements of the effective protection coefficient (EPC), use of inputs in agriculture is low; consequently, the NPC should be an approximation of the EPC.

Along with the colonization scheme, other policies have contributed to the vigorous expansion of agriculture in the country. The most relevant are those dealing with price and commercialization, credit, and research and extension.

Colonization. Between the agricultural census of 1956 and that of 1981, the structure of land tenancy underwent profound changes as a result of mobilizing families to the frontier areas of eastern Paraguay.

Over 59% of those farms recorded in the 1956 census, 35% of those farms recorded in the 1981 census and 85% of those farms established between the two censuses had been created by IRA and IBR. In the eastern region, the proportion of the area covered by farms with more than 20,000 ha decreased from 40% to 20% during that period (Ground, 1984).

In terms of population growth, between 1962 and 1982, the traditional area of settlements in the southwest expanded at 1.8% per year; for minifundia it was even lower--at 0.7%--while the rest of the eastern region had a population expansion of 4.0% per year. It is also important to note that urbanization occurred at a slower pace than in other countries of Latin America (Ground, 1984). More than half of the population (54%) still live in rural areas.

Between 1972 and 1981 agricultural area expansion occurred at 9.4% per year, with export crops leading the growth at 24.5% per year. Food crops expanded at 3.0% per year (Table 7).

Price and commercialization policies. In conjunction with industry, exporters, and producers, the government sets reference prices for cotton and soybeans. There are also minimum prices for wheat and sugarcane. The goal is to obtain foreign exchange with export crops and save it through import substitution.

In an effort to compensate export crops from the increasing overvaluation of the currency, export and import taxes affecting soybeans and cotton have been lowered, and a multiple level exchange rate was designed.

Soybean and cotton manufacturers use a form of forward contracting with producers. Producers obtain seeds, chemicals, and money ahead of planting time. The price of the crop is announced by the Ministry of Agriculture (MAG) and is used as a guide in negotiations.

Wheat, which is usually cultivated in rotation with soybeans and mechanized, has been protected by means of import quotas, minimum prices, and directed subsidized credit. The Ministry of Agriculture has silos to clean, dry, and store wheat under a system of credit warrants. However, with an output of 184,000 tons for 1985, imports still amounted to 82,000 tons for that year (USDA Ag. Sit. Report).

The minimum price for wheat in 1985 was G85 per kilo (US$142 per ton) at the free and fluctuating rate of about G600 per dollar. This price encouraged inflows of wheat from Argentina (about 75,000 tons or 30% of total) and outflows to Brazil (similarly large amounts) where the free market minimum price for wheat is higher.

A new element in the commercialization of perishable crops was the creation of DAMA (Dirección de Administración del Mercado de Abasto) in 1982 near Asunción. It is estimated that over 90% of perishable products reaching Asunción go through this market first. The most important crop in terms of volume is cassava, with over 40,000 tons per year (Table 10).

The arrival of products is monitored and daily listings of volumes; tradings; and maximum, mean, and minimum prices are available for each product. Price and volume data are posted in the market area so traders can also monitor the current prices levels. Daily, weekly, monthly, and yearly reports on volumes and prices will be compiled--which will be an excellent source of information when fully operational.

Cassava is the product with the greatest volume traded in this center--10-12 trucks a day are required to supply the needs of DAMA. Attempts are being made to coordinate their arrivals, since sometimes 15 trucks can arrive at once, causing price falls. The market has also standardized the size of sacks at 50-60 kg of roots per sack. During this year a standard size of 25 kg will also be introduced. This is the usual quantity purchased by small traders and will therefore avoid repacking.

Credit. Agricultural credit has a share of about 27% of the total credit, which coincides with its contribution to GDP. Credit for crops accounts for about 16% of the total while livestock credit accounts for 11% of the total (Table 11).

The major institutions in charge of administering credit are Banco Nacional de Fomento (BNF) and Crédito Agrícola de Habilitación (CAH) for crops, Fondo Ganadero (FG) for livestock, and Instituto de Bienestar Rural (IBR) which makes arrangements for land acquisition. While BNF usually requires property titles as loan collateral, CAH lends to small farmers who are members of associations without requiring collateral. Intermediaries continue to be an important source of credit. The three institutions provide credit at subsidized rates, specify activities for credit (mostly commercial crops and cattle activities), and force financing (50% of private banks' portfolio, at least). In 1985,

Table 10. Volume of cassava (in tons) entering Asunción's "Mercado Abasto", Paraguay.

Month	Year 1982	Year 1983
January	3,203	2,791
February	3,240	3,310
March	3,809	3,878
April	3,545	3,267
May	3,745	4,065
June	3,922	4,762
July	3,914	4,981
August	3,667	5,389
September	3,776	5,205
October	3,890	4,419
November	3,291	3,168
December	3,132	1,787
Total	43,134	47,022

SOURCE: Mercado Abasto. Monthly records. Asunción, Paraguay.

Table 11. Private sector credit according to economic activity (in millions of Guaranis and percentage), Paraguay.

	1960	1970	1980	1981	1982	1983
			(In millions of Guaranis)			
Total	4.9	19.1	133.2	159.1	174.6	183.1
Agriculture	1.3	4.5	17.6	21.6	24.1	29.2
Livestock	0.5	3.2	11.3	13.8	18.3	20.0
Industry	1.5	3.4	23.3	28.2	32.4	37.4
Commerce	1.1	4.9	34.4	44.3	47.9	42.1
Export	0.3	2.0	15.2	13.7	12.5	15.3
Construction	--	0.3	20.9	25.1	26.6	27.8
Other	0.2	0.8	10.5	12.3	12.7	11.3
			(Percentage)			
Total	100	100	100	100	100	100
Agriculture	27	24	13	14	14	16
Livestock	100	17	8	9	11	11
Industry	31	18	18	18	19	20
Commerce	22	26	26	28	27	23
Export	6	10	11	9	7	8
Construction	-	2	16	16	15	15
Other	4	4	8	7	7	6

SOURCE: World Bank, 1984.

interest for agricultural credit is around 17%, with an inflation rate of 26%. Credit for cassava is seldom available (Carter, 1986).

Research and extension. A clear dichotomy exists between these two activities within MAG: the agricultural research institution (DIEAF) conducts basic research while the Servicio de Extensión Agrícola-Ganadera (SEAG) does applied research and extension.

In 1977, MAG evaluated 21 crops under the following criteria: value of production, exports, imports, volume of production, annual rate of growth, value of industrial production, and market perspectives. The resulting ranking by order of importance was cotton, tobacco, soybeans, cassava, wheat, and maize. Of these products, cassava receives least attention from DIEAF which concentrates its efforts on cotton, tobacco, soybeans, and wheat (World Bank, 1984, v. 2, p. 14).

In 1985, SEAG signed an agreement with the International Development Research Centre (IDRC) and Centro Internacional de Agricultura Tropical (CIAT) to conduct cassava research on several aspects of production and utilization. At present, SEAG's main crop programs are cotton, tobacco, wheat, soybeans, maize, rice, and cassava.

Concluding comments

Direct government intervention has been low. However, agricultural policies have a clear bias in favor of export crops, livestock, and import substituting crops, that is, wheat and sugarcane.

To compensate for overvaluation of the Guarani, export taxes are low and interest rates on credits for those crops are kept low. These measures do not correct the problem and also introduce distortions in the internal resource allocation since the vast agricultural production of food crops is kept at a disadvantage vis-a-vis export crops. A similar experience in Brazil led to lags in the production of food and a significant inflation of food prices took place in the eighties. The same situation may be repeated in Paraguay, where inflation is taking off dangerously and food production is not keeping up with demand.

Status Quo of Cassava in Paraguay: Supply and Distribution

Present status

Cassava is the major crop in Paraguay by volume of production and employment, and third by value of production after soybeans and cotton. As of 1985, its contribution to GDP is 2.8% (Table 9). Paraguay is the world's largest per capita producer of cassava with over 750 kilos and, by total production, is second in Latin America, after Brazil, with 2.5 million tons (Table 12).

Fresh cassava production and consumption. Its per capita consumption is higher in the rural areas, where it reaches 340 kilos per year (Carter, 1986), than in urban areas where it is about 120 kilos per year. Total annual per capita consumption is about 260 kilos (Table 13).

Table 12. Area harvested, production, and yield for cassava during the Agricultural Campaign of 1982-83 and 1983-84, Paraguay.

Department	1982-1983			1983-84		
	Area harvested (ha in thousands)	Production (t in thousands)	Yield (t/ha)	Area harvested (ha in thousands)	Production (t in thousands)	Yield (t/ha)
Paraguay overall	180.0	2,502.0	13.9	182.4	2,533.6	13.9
Concepción	9.6	155.5	16.2	9.7	157.1	16.2
San Pedro	21.8	412.0	18.9	22.1	417.7	18.9
Cordillera	13.6	123.8	9.1	13.8	125.6	9.1
Guaira	12.8	121.6	9.5	12.9	122.5	9.5
Caaguazú	31.1	438.5	14.1	31.5	444.2	14.1
Caazapa	12.8	232.9	18.2	13.0	237.9	18.3
Itapúa	24.5	382.2	15.6	24.8	386.9	15.6
Misiones	3.8	51.3	13.5	3.8	51.3	13.5
Paraguari	17.1	191.5	11.2	17.4	194.9	11.2
Alto Paraná	12.1	220.2	18.2	12.3	225.1	18.3
Central	5.3	15.9	3.0	5.3	15.9	3.0
Ñeembucú	3.7	25.5	6.9	3.7	25.5	6.9
Amambay	5.2	49.9	9.6	5.2	49.9	9.6
Canendiyu	5.9	83.2	14.1	6.0	85.2	14.2
Presidente Hayes	0.2	3.1	15.7	0.2	3.2	15.8
Alto Paraguay	0.02	0.2	11.5	0.02	0.2	11.6
Chaco	0.01	0.01	12.5	0.01	0.1	12.5
Nueva Asunción	0.001	0.02	15.5	0.001	0.02	15.5
Boquerón	0.4	6.2	15.4	0.4	6.2	15.5

SOURCES: Dirección de Censo, MAG; Estadísticas Agropecuarias.

Table 13. Consumption of major carbohydrates, Paraguay.

Year	Consumption (t in thousands)					Total carbo-hydrates (t in thousands)	Share among carbohydrates (%)				
	Cassava	Sweet potato	White rice	Maize	Wheat		Cassava	Sweet potato	White rice	Maize	Wheat
1968	274.5	61.0	12.2	31.6	32.6	411.9	66.7%	14.8%	3.0%	7.7%	7.9%
1969	274.8	65.3	17.5	31.6	32.3	421.5	65.2%	15.5%	4.2%	7.5%	7.7%
1970	275.3	66.0	26.2	31.6	32.7	431.7	63.8%	15.3%	6.1%	7.3%	7.6%
1971	274.4	65.3	21.7	31.6	32.5	425.6	64.5%	15.4%	5.1%	7.4%	7.6%
1972	273.9	57.4	25.2	30.6	31.2	418.3	65.5%	13.7%	6.0%	7.3%	7.5%
1973	272.4	57.8	28.5	32.8	31.5	423.0	64.4%	13.7%	6.7%	7.8%	7.4%
1974	267.8	53.6	32.3	33.0	31.2	417.9	64.1%	12.8%	7.7%	7.9%	7.5%
1975	263.1	57.4	32.0	36.0	31.0	419.5	62.7%	13.7%	7.6%	8.6%	7.4%
1976	252.1	58.6	38.9	36.6	30.7	416.9	60.5%	14.1%	9.3%	8.8%	7.4%
1977	241.6	58.6	33.3	37.4	31.7	402.6	60.0%	14.6%	8.3%	9.3%	7.9%
1978	235.1	65.4	32.9	37.2	32.2	402.8	58.4%	16.2%	8.2%	9.2%	8.0%
1979	230.0	66.5	33.9	37.0	32.8	400.2	57.5%	16.6%	8.5%	9.2%	8.2%
1980	233.0	37.3	32.1	37.7	33.5	373.7	62.4%	10.0%	8.6%	10.1%	9.0%
1981	231.6	39.1	36.3	37.5	32.6	377.2	61.4%	10.4%	9.6%	9.9%	8.6%
1982	241.3	40.9	37.8	37.6	33.0	390.6	61.8%	10.5%	9.7%	9.6%	8.4%
1983	231.8	41.5	38.9	37.7	37.7	387.6	59.8%	10.7%	10.0%	9.7%	9.7%
1984	257.1	45.8	40.4	37.7	34.1	415.1	61.9%	11.0%	9.7%	9.1%	8.2%

Only about 15% of production reaches the market (400,000 tons) from where it is distributed accordingly: urban consumption (about 215,000 tons); rural consumption (probably for sale as fresh food, 70,000 tons); and processing (about 115,000 tons). Our estimates indicate that of the one million tons or so that are consumed in fresh form, less than one-third is purchased (285,000 tons), while the rest is consumed onfarm.

About 85% of production is destined for onfarm use. It is mainly used as food for the family and as feed for pigs and chicken. Cassava accounts for about 30% of all calories consumed by the farming population (Diagnóstico de la Situación Alimentaria....). It plays a fundamental role in the expansion of frontier land because it is hardy, has a multiplicity of end uses, requires few purchased inputs, is very tolerant to prolonged droughts such as the 1985-86 drought, and can be stored in the ground for several years.

With respect to production figures (Carter, 1986), the 1981 agricultural census recorded 178,937.25 ha of cassava cultivated in a similar number of farms, but did not distinguish between newly sown cassava and cassava plants of one year or more. Data by Lynam (1986) show cassava production areas to be highest in Brazil (1,987,300 ha) followed by Colombia (208,000 ha), and thirdly, Paraguay. Paraguayan yield levels, at about 14 tons/ha, are the third highest in Latin America (Lynam, 1986) after Mexico and Barbados, relatively small producers.

Within Paraguay, production is concentrated in the eastern, wetter, half of the country (Table 12). The area sown to cassava is greatest in the departments of Caaguazú, Itapúa, and San Pedro. These are areas of relatively recent colonization. Areas most recently colonized, with small populations, have smaller areas of cassava, for example, Amambay and Canendiyu. The department "Central" has less cassava than its neighbors, despite its high population.

The proportion of farmers growing cassava in the departments of eastern Paraguay is lowest in Central, and highest in Caazapa. The average area of cassava sown per farm is highest in the departments with the lowest total area, Amambay and Canendiyu. Average area of cassava per farm (in eastern Paraguay) is lowest in Misiones, Central, Paraguari, and Ñeembucú.

The two departments selected for the SEAG-CIAT-IDRC projects, Caaguazú and Paraguari, have the highest proportion of farms (90% and 88%, respectively) growing cassava (Carter, 1986). However, the difference in cassava production area between the two is proportionally larger than the difference in number of farms. This is due to the smaller area per farm sown in Paraguari. Because of the recency of colonization in Caaguazú (30-50 years), soils are more fertile than those in Paraguari, where farming has been long established.

Cassava production for urban consumption is concentrated in the departments of Caaguazú for the Asunción market, and Alto Paraná, also for Asunción and Ciudad Presidente Stroessner.

Econometric analysis of demand for fresh cassava. In the absence of a consumers' household food expenditure survey, only time series data were used to calculate the effects of changes in incomes, prices, and urbanization trends on per capita consumption of cassava. The period of 1968-83 was analyzed (Table 14).

Total production of cassava grew at a smaller annual rate (2.3%) than that of the population (3.2%) with the consequent drop in per capita consumption. At the same time, the real retail price of cassava increased at an annual rate of 1.4% (Table 15).

Urban population grew at 4.4% per year. Urbanization has a negative effect on cassava demand because it causes increases in marketing costs and therefore higher prices. Because the root is highly perishable, its competitiveness in the urban market place is also reduced, which means lower volumes are being traded.

The model proposed to estimate per capita demand for cassava includes its own real retail price, real retail prices of other carbohydrates, per capita real incomes, and total urban population as independent variables.

Parameter estimates show that important determinants in the reduction of per capita consumption of cassava are the higher price for this root and the reduction in the real price of wheat flour. There has been substitution in the consumption of cassava in favor of wheat (cross price elasticity of 0.07), but it has not been very strong.

Urbanization and rising incomes also were factors in the observed reduction but all elasticities are small in absolute value (Table 16).

Other Uses. Cassava is also used for starch production in eastern Paraguay. Starch is produced on a small scale in many households, as well as in a semi-industrialized form in some places. The quality is generally poor, which limits possibilities for sale.

According to SEAG, 300 farms in the project region also operate the starch-processing plants. Taking a mean of 1500 kg per day capacity and a 20% conversion rate, a total of 300 kg of starch per day is produced. A plant working at a capacity of 1500 kg of roots per day for 20 days a month will require 300 tons of roots per year. The total industry in this region therefore needs 300 x 300 = 90,000 tons/year. This is more than double the volume handled by DAMA in Asunción and demonstrates the current size and importance of the starch market to just one cassava-producing region of Paraguay. However, starch manufacture is an important utilization which must be considered in any development project.

Large-scale industrial plants for producing dried cassava chips have been proposed several times in Paraguay but never implemented. However, a small-scale rural industry producing "popi" or sun-dried cassava chips for later milling and use as a flour for human consumption does exist. It remains a small localized industry with little prospect of growth because the apparent preference for cassava starch-based products. A Paraguayan law requires the incorporation of 5% cassava flour from "popi" into all bread, but this is ignored, partly because of quality problems and partly because of the availability of cheap Argentinian wheat through contraband.

Table 14. Summary of annual rate of growth of key agricultural parameters, Paraguay, 1968-83.

Livestock		Crops	
Per capita consumption		Per capita consumption	
Beef	-3.2%	Cassava	-1.5%
Pork	2.7%	Sweet potato	-3.0%
Poultry	3.2%	Rice	2.3%
		Wheat	0.5%
Total production of poultry	3.5%	Maize	1.6%
Real retail prices		Total production of cassava	2.3%
Beef	-0.4%		
Pork	0.1%	Real retail prices	
Poultry	-0.8%	Cassava	1.4%
		Sweet potato	-0.3%
Relative price		Rice	-1.2%
Beef/Poultry	0.3%	Wheat	-2.1%
		Maize	-1.4%
Other factors			
Total poulation	3.2%		
Urban population	4.4%	Relative price	
Real income per capita	4.0%	Cassava/Wheat	3.5%

Table 15. Real retail prices (in Guarani) of carbohydrates, Paraguay.

Year	Cassava	Sweet potato	White rice	Maize	Wheat	Population	CPI
1968	19.31	23.17	111.97	111.97	88.80	2.17	25.9
1969	18.94	22.73	106.06	106.06	87.12	2.23	26.4
1970	19.31	23.17	108.11	108.11	88.80	2.29	25.9
1971	17.79	21.35	99.64	99.64	78.29	2.36	28.1
1972	16.03	22.44	99.36	99.36	67.31	2.43	31.2
1973	21.05	21.05	107.89	105.26	81.58	2.51	38.0
1974	25.32	25.32	111.81	111.81	94.94	2.60	47.4
1975	24.19	34.27	110.89	108.87	86.69	2.69	49.6
1976	23.21	25.15	106.38	85.11	108.32	2.79	51.7
1977	24.35	24.35	95.65	102.61	90.43	2.87	57.5
1978	24.65	24.65	109.40	97.07	75.50	2.97	64.9
1979	30.92	30.92	97.50	90.37	66.59	3.07	84.1
1980	24.00	24.00	82.00	83.00	65.00	3.17	100.0
1981	20.83	20.83	81.52	86.96	63.41	3.27	110.4
1982	20.12	20.12	103.24	83.99	63.87	3.37	114.3
1983	18.89	18.89	96.48	105.92	65.44	3.47	148.2

Table 16. Estimates of demand elasticities for fresh cassava and poultry meat from time series data[a]

	Fresh cassava		Poultry meat
Own price	-0.10 (4.62)	Own price	-0.33 (6.39)
Income	-0.13 (7.03)	Income	0.59 (10.73)
Urbanization	-0.13 (5.52)		
Wheat price	0.07 (5.38)	Beef price	-0.15 (3.10)
Rice price	NO (2.78)	Pork price	0.53 (6.49)

a. Values in parentheses are t-statistics.

Problems and opportunities in cassava production. The proposal for the SEAG-CIAT-IDRC Cassava Project (Brun et al., 1985) defines a number of problems of cassava production and suggests some alternatives for research to seek solutions. Primarily, the systematic loss of soil fertility in old established cassava-producing regions around Asunción (Departments of Central, Cordillera, and Paraguari) is identified. Although not stated, this is partly a result of increasing pressure on the land from a growing population and the consequent reduction in farm size and bush-fallow periods.

Cassava production for the Asunción market has therefore shifted to more recently colonized areas, particularly Caaguazú, where soil fertility is higher and therefore yields are higher. However, the same soil problems are likely to develop there, since no change in agricultural practices has occurred. In fact, most farmers in Caaguazú came from the central areas which surround Asunción.

Cassava from Caaguazú is of better quality and cheaper than that from areas nearer Asunción. However, the greater distance to market means greater deterioration of roots before they reach the consumer, and so higher prices. The quality of roots varies greatly and a high proportion is rejected.

Brun et al. (1985) identify opportunities for improving onfarm animal feeding using cassava and for improving starch production and starch quality. They underline the need to characterize and classify the diverse cassava germplasm which Paraguay possesses. The project's broad objective is to make available suitable technologies to increase production, productivity, and the processing of cassava in Paraguay. The project will test available postharvest technology and include studies of actual production processes, onfarm feeding, and socioeconomic conditions.

The project also has an important agronomic research component. Methods of improving actual production systems using technology already developed by CIAT (such as selection of seed, planting densities, and seed storage) will be tested under Paraguayan conditions. Experiments, using legumes as protective cover crops and legume rotations, will attempt to address the soil fertility problem. Successful components will then be extended over larger areas.

Potential demand for cassava. Demand for fresh cassava for human consumption is very strong. This causes a high farm price for the root, making cassava production one of the most profitable crop activities in the country. Moreover, it requires little use of limited resources such as capital, while needing large amounts of available resources such as labor. Its use in feeding pigs makes cassava an indirect source of protein and cash for rural families (World Bank, 1984).

However, the high price paid to farmers means that, at present, dried cassava for the commercial production of animal feed is economically less attractive to both farmers and food manufacturers than fresh cassava and maize. However, dried cassava may become profitable in the future and the country should remain aware of technical advances in this activity.

The prospect for dried cassava as an animal feed depends on technical factors also. The long cold season (May-September), which is also the driest part of the year, makes natural drying in Paraguay a different prospect to that of the tropical regions. A small pilot plant would be required to determine the technical feasibility of drying under these conditions. Possibly, tray drying could be used to take advantage of wind during the colder season, for example, popi is produced by drying on trays.

A possibility does exist for the production of cassava chips for export, although the economics of this are unclear under the present exchange rate policy of Paraguay. The Instituto Nacional de Tecnología (INT) has experience in cassava drying both for human consumption and animal feed and on large (industrial) and small (rural) scales of production. This makes it an obvious cooperating institute in any project.

Carbohydrate foods. Among the five major carbohydrates destined for human consumption in the country, by volume, cassava accounts for two-thirds and supplies one-half of the total calories consumed (Table 13). Per capita rice consumption is still low (11 kg) by Latin American standards, maize, and wheat (about 35 kg each) have increased their share and sweet potatoes have had a substantial decline.

The most notorious change in prices has been the rapid reduction of the real retail price of wheat flour during the period 1968-83, at 2.1% per year, although per capita consumption of wheat did not show a significant increase associated with the important price drop. Among the major carbohydrate foods, cassava was the only one that registered a sustained price increase during the period of analysis, 1968-83 (1.4% per year), implying that production did not keep pace with demand for the root.

The fastest increase in per capita consumption occurred with rice (at 2.3% per year) in response to lower prices (its real retail price had a growth rate of -1.2% per year). This was possible due to the rapid adoption of improved varieties (mainly CICA type), which now cover two-thirds of total area planted to rice (Dalrymple).

Per capita consumption of maize also increased in response to lower prices during 1968-83. Maize production increases (8.5% per year) were mostly the consequence of area expansion (at 6.5% per year); yields have remained low at 1.5 tons/ha (MAG and IICA, 1985).

About 35% of maize produced in Paraguay is destined for human consumption, 25% goes to the food industry, and 35% is fed directly to animals (MAG and IICA, 1985). Maize is favored by creditors because of the ease of credit recovery; storage capacity is sufficient; and profitability is similar to that of soybeans. Given the existence of hybrid varieties which provide an ample spectrum of planting dates, maize can play an important role in the newly colonized areas of eastern Paraguay, especially in the southeast, where soil and climate conditions are good. In that area, maize competes with soybeans and wheat, whereas sweet potatoes have registered the fastest reduction in per capita consumption due to stagnation in production and area planted.

Prospects for cassava production are good, given the important role that the crop plays in the expansion of frontier lands and in view of the renovated interest shown by the government in this crop. Maize is also likely to continue its vigorous expansion should the tendency toward commercialization continue. Incentives for this crop are good and it stands high among official priorities.

Rice production has the potential to develop fast, given the low average national yields at present time (around 2 tons/ha) and a move towards irrigated areas, using improved varieties. A substantial real price reduction could take place under these circumstances. However, increases by volume in per capita consumption will not be important since demand is still low (11 kilos per year).

Wheat is expected to continue its response to the protection it receives, although yield increases have not been as important as area expansion. Further price reductions will be at the expense of higher subsidies or increased contraband from Argentina. Expansion of soybean areas favors wheat production as well. The opportunity cost for wheat under this type of rotation is much lower than in the case of single cropping.

Past trends already observed in carbohydrate consumption are most likely to prevail in the midterm.

Meat consumption. Paraguay has been characterized by a relatively high per capita consumption of meats. However, the change in composition among the three dominant types of meat has been important during the past two decades (Table 17).

In 1968, per capita beef consumption was around 50 kilos, followed by pork (17 kilos), and poultry (3 kilos). By 1984, per capita consumption of beef dropped to 29 kilos, pork increased to 25 kilos, and poultry reached almost 5 kilos. Poultry had the fastest annual growth in per capita consumption at 3.2%.

It is very difficult to establish trends for livestock production. For beef the quality of the data is poor. Pork and poultry production systems are still dualistic in nature, although with only a small segment of producers being industrialized.

Beef products were the main source of exports in the sixties but today these are almost nil. This fact, together with the reduction in per capita consumption at 3.2%, implies a reduction in total beef production. However, this does not seem to be the case: productivity is not high--steers are slaughtered at 4-5 years of age at the weight of only about 350 kilos; there is a 50% conversion to carcass and extraction; and productivity is estimated at about 10% on the basis of 7 million head (or 700,000 head), and yet by 1985 there have been increases in pastures area and improvements in management systems that have created doubts about total production figures.

The World Bank estimates and extraction rate of 13%, which on the basis of about 10 million head (or 1,300,000 head), produces a 600,000 head

TABLE 17. Trends in per capita consumption and relative prices of meats, Paraguay, 1966-83.

Year	Type of meat			Total meat (kg)	Relative retail prices	
	Beef (kg)	Pork (kg)	Poultry (kg)		Beef to poultry	Pork to poultry
1966	49.4	16.7	3.2	69.3	1.62	1.04
1967	45.0	17.4	3.3	65.7	1.69	1.04
1968	46.4	17.8	3.2	67.3	1.80	1.03
1969	44.1	18.1	3.0	65.3	1.68	0.99
1970	45.6	18.5	3.0	67.1	1.73	0.96
1971	42.8	18.8	3.1	64.7	1.60	0.92
1972	38.1	19.2	3.2	60.5	1.89	1.12
1973	31.3	19.5	4.0	54.7	1.99	1.16
1974	33.2	19.8	4.0	57.0	1.62	1.09
1975	28.8	20.4	3.9	53.2	1.76	1.25
1976	27.7	21.2	3.9	52.8	1.99	1.32
1977	30.7	21.6	4.0	56.3	1.23	0.83
1978	27.8	22.8	4.2	54.9	1.39	0.88
1979	32.2	25.2	4.4	61.9	1.78	1.12
1980	31.6	25.6	4.6	61.8	1.93	1.21
1981	29.9	25.3	4.6	59.9	1.90	1.19
1982	28.7	24.9	4.7	58.3	1.56	1.14
1983	28.9	25.2	4.6	--	--	--

difference with official figures. This surplus is believed to go to Brazil, as contraband, on foot. Given the vast, dry, flat frontiers and the favorable policies for beef in Brazil it is easy to maintain this type of activity.

Hog livestock estimates for 1985 are 1.2 million head. There are only a few industrial-level operations dedicated to derivatives of pork production. Pork production in Paraguay is performed by small enterprises and with traditional methods. Almost all farms in the eastern region (80%) have pigs (Regunaza-Kugler, p. VI-18) and 97% of pork production comes from that region. The extraction rate is low (106%) while carcass weight at 1.5 years of age oscillates around 62 kg/head. Efficiency is low and only native breeds are found.

Pig nutrition is based on maize and fresh cassava, complemented with milk whey, leftovers, and "cocotero" (the fruit of a wild palm, Acrocornia selerocarpa, abundant in the region, and an important source of protein). No additives are used to supplement this energy-based nutrition. The system is very low cost since a minimum of management is involved (1.7 hours per day to produce 1-4 kg of pork, and family labor) (Regunaza and Kugler, p. VI-22).

About one-half of pork production is destined for home consumption and the other half is sold. This is therefore another important source of cash, has flexibility, and can be adjusted to meet cash needs as they arise, particularly as cash is an important constraint to small farmers in new settlements (Carter, 1986).

Production of chicken is dualistic in nature with the commercialization of broilers dominated by one company (Pollos Pechugon which has 90% of the Asunción market) and a scattering of small backyard operations that complement food and cash requirements to rural farmers.

Should present trends continue, both pork and poultry will see their market shares expanded at the expense of beef. The animal feed industry may also experience rapid growth what with ensured supplies of maize and soybean meal.

Pork production will be favored by the increasing number of new settlements. Beef prices will increase as a result of growing contraband trade with Brazil.

Projected Demand for Cassava

The potential in Paraguay for the technology of storing fresh cassava in plastic bags is enormous because: the treatment is economic, storage losses are sufficiently large to warrant the adoption of the treatment, and volumes of cassava are traded. Any reduction in waste will have a significant impact on the efficiency of resource use and allocation.

Use of dry cassava in animal feed is not economically attractive at present. The farmer could sell his fresh cassava at G15 per kilo to the drying plant, and at that price, dried cassava from the plant could compete with maize. But the farmer will prefer to either sell the cassava in the fresh market at about G30 per kilo or grow maize for the feed industry and in both cases will receive better returns than from drying cassava (Table 18).

Assuming that dry cassava enters at 10% in food formulations (substituting 18,200 tons of maize as of 1984) about 45,000 tons of fresh cassava would be needed or 1.5% of total production for one year. This amount is less than half of what has been estimated is being used for starch production.

Use of fresh cassava as animal feed on the farm was estimated at about 835,000 tons in 1984. This figure is impressive and indicates that a major effort should be done to better understand the role of cassava in the system.

It is clear that cassava is of paramount importance in the process of frontier expansion, a process that may continue over a long period of time given that about 90% of land suitable for crops is still unexploited (Fletschner, 1984, p. 52) and that the population growth rate is rapid.

Basic assumptions

Using the model estimated for demand for fresh cassava, total demand is projected to the year 2000. From that projection, additional production is calculated and the amount of new hectares cultivated is also shown, as well as the number of new jobs required.

The following rates of annual growth for 1983-2000 are assumed:

Population growth will continue at 3.0% per year.

Real GNP will grow at a moderate 4.5%, that is, per capita GNP will grow at 1.5%.

The real retail prices of cassava and wheat flour will decrease at 1.0% per year.

It is assumed that, with the adoption of the new storage technology for cassava, this goal is easily attained. Wheat subsidies are supposed to continue, allowing a decrease in its real price too.

It is also assumed that the proportions of fresh cassava that are used for human consumption and to feed pigs remain unchanged. Yields remain at 13.9 tons/ha.

The proportion of waste in the commercialization of cassava is assumed to be reduced from 20% to 10% with the use of the new storage technology which is expected to ameliorate losses and allow an increase in consumption based on those savings.

Fresh cassava consumption. Under these conditions, it was estimated that per capita consumption for the year 2000 will be 242.8 kilos (down from 271.9 kilos in 1983). Given the population increase and the assumption of constant proportions in use, total cassava production will

Table 18. Sources of direct cost segretation in the production of fresh cassava, dried cassava, and maize, Paraguay[a].

Source of direct cost	Total costs	Cost/ton (fresh)	Equ./ton (dried) (2.5 conversion)
Land	18,000	1,295	3,237 Land
Labor	67,400	4,849	12,122 Labor
Capital	29,015	2,087	5,218 Capital
Total	114,415	8,231	20,578 Total
Dried cassava production			
Source of direct cost		Cost/ton (dried)	Total cost/ton (dried)
Land		16	3,253
Labor		3,108	15,230
Capital		8,705	13,923
Total		11,828	32,406
Sale price, 75% price of maize			56,000
Gross margin per ton of dried cassava			23,594
Yield of fresh cassava		13,900	
Maize production			
Source of direct cost		Total	Cost/ton
Land		9,000	3,600
Labor		28,925	11,570
Capital		40,100	16,040
Total		78,025	31,210
Sales price		70,000	
Gross margin per ton of maize			38,790
Yield of maize, (ton/ha)		2.5	

a. Costs shown in Guaranis.

Table 19. Projections of fresh cassava needs for year 2000, Paraguay.

Per capita consumption of cassava in 1983	271.9 kilos
Population in 1983	3.5 millions
Annual population growth	3.0 %
Population in year 2000	5.7 millions
Percent human consumption in total	37.7 %
Cassava production	2,505
Annual growth in real price of cassava	-1.0 %
Annual growth in real price of wheat	-1.0 %
Annual growth per capita real income	1.5 %
Per capita consumption of cassava in year 2000	242.8 kilos
Cassava production	3,727
Yield/ha	13.9 tons
Hectares in 1983	182,400
Additional hectares	78,800
Labor per ha (SEAG)	67
New jobs generated per year	21.122

have to increase by 1,095,000 tons, requiring 78,800 new hectares (43% increase) and generating 21,122 new jobs (Table 19).

Savings in commercialization, assuming a waste reduction of 10% in trade of fresh cassava, valued at G35 per kilo and with a free market rate of G600 per U.S. dollar, will reach US$2.1 million each year by the year 2000.

Conclusions

The importance of cassava in Paraguay is evident even to the outside casual observer: it is found virtually everywhere in eastern Paraguay; it generates more employment than other crops; produces the most, by volume; is the third, in terms of GDP contribution, after soybeans and cotton; it is the most important source of carbohydrates; and, together with maize, constitutes the basic source of animal feed for pigs. Pigs supply 43% of all meat consumed in the country and its consumption has been growing faster than the rate of population growth.

In the colonization process, cassava is fundamental: it is a convenient and reliable staple and can generate cash when sold or, indirectly, by feeding animals. It has always been present in over 90% of those farms recorded in the censuses as the most common of all crops. The farmers continuously cultivate about one ha of cassava, and leave the roots in the ground for periods of two or more years.

The government has not directly intervened very much in agriculture, allowing market forces to dictate the output, and farmer prices for most crops are aligned with world prices. Export and import-substituting crops, however, have been favored through price support and credit policies.

Although cassava has not been directly favored by the prevailing price and credit policies, the colonization policies, together with improvement of infrastructure such as roads and the wholesale market of DAMA have resulted in the expansion of production beyond already high levels. They also resulted in a more efficient system of commercialization for fresh cassava.

The present project signed by SEAG/IDRC/CIAT in 1985 to explore aspects of production and utilization shows the high priority that the crop has for the economy of the country. Two basic aspects of research in cassava demand and use merit close attention: first, the adoption of new storage technology in which cassava is stored in plastic bags, and, second, the role of fresh cassava in animal feed for pigs.

Prospects for production are good, given the important role that the crop plays in the expansion of frontier lands (which is a continual process) and the recently renewed interest that the government has shown in the crop. Demand will continue to grow and if yields remain the same, close to 80,000 new hectares will need to be cultivated by the year 2000 to satisfy this growth.

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PERU: POTENTIAL DEMAND FOR CASSAVA

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Macroeconomic Policy and Agriculture

The economic policy context

During the past 35 years the Peruvian economy has stagnated. Real per capita GDP grew at less than 1% per year, one of the lowest rates of growth in the world.

In the past twenty years, the policies have been characterized by industrial protection within an import-substitution environment, with high government intervention accompanied by a chronically overvalued exchange rate, fiscal deficits, high inflation, rapid rural-urban migration, a heavy per capita foreign debt burden, and a long run of declining growth. These manifestations are all the result of the policy environment as well as of outside factors such as unstable terms of trade and variable climatic conditions. Careful analysis of economic performance leads to the conclusion that the unstable and slow growth should be attributed primarily to man-made policies (Nogues).

Socioeconomic policies can be divided in four periods: before 1968, between 1968 and 1979 (under military rule), between 1979 and 1985 (under the Acción Popular Democratic Government), and after 1985 (under the APRA Government).

While total real GDP grew over the period 1950-85 at an annual 3.5%, that of agriculture stagnated at 2.0%, well below the 2.7% annual growth of the population. In 1950-68, real GDP grew at a sound 5.3% per year to slow down in 1969-74 to 4.3% per year. The country entered a deep recession in 1975. Real per capita GDP decreased at an annual 1.9% in 1975-85, while per capita agricultural GDP decreased at an annual 1.0% in that same period (Table 1). The worst year was 1983 when, due to climatic adversity, real per capita GDP decreased by 9.4% and agricultural GDP contracted by 7.6% (Table 2). Annual inflation went from around 30% in 1975 to 163% in 1985.

The policy environment

Until 1968, policies were characterized by moderate industrial protection, reduced state interventionism, and relatively liberal market policies. In 1968 the country's political administration changed sharply to a military government that designed a set of policies oriented to transform the structure of property-holding, reduce foreign dependence, and achieve sustained growth in an environment of improved social justice (Alvarez R., Apuntes 16). Consequently, Peru went from having one of the lowest shares of state participation in total investment to a vast public bureaucracy such as Petro Peru, Pescaperu, Minero Peru, Centromin Peru, Electroperu, sugar coops, EPSA, and ENCI (Lowenthal, A.F., Apuntes, p. 27). Government participation in investments went, particularly in banking and mining, from 13% in 1968 to 23% in 1975.

Table 1. Total and agricultural GDP (in millions of Sols), 1973, Peru.

Year	Real GDP	Agricultural GDP	Agriculture in GDP (%)
1970	352,596	51,701	14.7
1971	370,336	52,759	14.2
1972	376,501	51,490	13.7
1973	392,559	51,687	13.2
1974	421,933	53,582	12.7
1975	441,073	53,564	12.1
1976	449,987	54,372	12.1
1977	449,738	54,302	12.1
1978	447,470	53,478	12.0
1979	465,939	55,575	11.9
1980	483,840	52,575	10.9
1981	503,663	58,643	11.6
1982	504,401	40,330	8.0
1983	444,040	55,207	12.4
1984	464,910	62,329	13.4
1985	471,884	63,638	13.5

Annual growth rates[a]

Period	GDP	Agric. in GDP
1970-75	4.4%	0.6%
1975-80	1.6%	-0.1%
1980-85	-1.4%	3.0%
1970-80	3.1%	0.5%
1970-85	1.9%	0.6%

Agricultural growth rates

	Share of GDP	Share of labor force
1950-55	22%	55%
1961-65	15%	50%
1971-75	13%	48%
1981-85	12%	38%

a. Rates of growth calculated by author.

SOURCE: Cuentas Nacionales del Perú, INE.

Table 2. Statistical profile, Peru.

Area (km²)	1,280,219
Population: total 1985 (67.3% urban)	19,696,000
Annual growth rate 1970-85	2.6%
Birth rate (1984)	36.4
Mortality per 1000 inhabitants (1984)	10.3
Infant mortality per 1000 live births (1984)	94.9
Life expectancy at birth (1984)	59.6
Percentage of literacy (1984)	84.2
Labor force by sector (1980)	(Percentages)
Agriculture	40.0
Mining	1.2
Manufacturing	14.5
Construction	4.4
Others	39.9

	1981	1982	1983	1984	1985
Real production			(Growth rates)		
Total GDP (market prices)	3.1	0.9	-12.0	4.7	1.5
Agricultural sector	9.9	3.0	-10.2	12.9	2.1
Mining sector	-4.8	8.3	-7.4	6.4	5.2
Manufacturing sector	-0.1	-2.7	-17.3	2.8	3.4
Construction sector	11.0	2.3	-21.5	1.5	-13.2
Central government			(Percentages of GDP)		
Current revenues	17.9	17.5	14.2	16.2	17.4
Current expenditures	17.7	17.3	19.2	17.3	17.1
Current savings	0.2	0.2	-5.0	-1.1	0.3
Capital expenditures	5.2	4.2	3.9	4.0	3.3
Deficit or surplus	-4.9	- 3.9	-8.9	-5.0	-2.9
Domestic financing	3.4	0.9	3.4	1.5	-0.1
Money, prices, and salaries			(Growth rates)		
Domestic credit					
Public sector	100.0	23.2	146.6	-73.3	-210.0
Private sector	111.8	95.8	102.0	127.9	102.0
Money supply (M1)	46.2	36.9	91.7	128.0	235.2
Consumer prices (annual average)	75.4	64.5	111.1	110.2	163.4
Real wages	-1.7	2.2	-16.7	-15.3	-15.7
Exchange rate			(Annual average)		
Official rate (Peruvian Sol to U.S. dollar)	0.42	0.70	1.63	3.47	10.98
Real effective exchange rate (Index 1980 = 100)	86.4	85.8	92.8	94.7	105.9
Terms of trade (Index 1980 = 100)	82.9	72.3	71.3	72.2	70.0
Balance of payments			(Millions of dollars)		
Current account balance	-1,725	-1,513	-872	-252	66
Merchandise balance	-555	-402	295	1,008	1,097
Merchandise exports (FOB)	3,249	3,106	3,019	3,149	2,967
Merchandise imports (FOB)	3,804	3,508	2,724	2,141	1,869
Net services	-1,337	-1,268	-1,387	-1,419	-1,158
Transfers	167	157	219	159	127
Capital account (net)	485	942	1,213	1,061	601
Change in net reserves (- = increase)	654	163	89	-250	237
External public debt			(Millions of dollars)		
Disbursed debt	6,009	6,934	8,702	9,824	10,510
Debt service actually paid	1,915	1,526	781	609	617
Interest payments/export of goods and NFS			(Percentages)		
	13.1	14.3	10.7	7.5	9.4

SOURCE: IDB. 1986. Economic and Social Progress in Latin America.

Severe distortions in factor and product market rose amidst a prolonged period of slow and unstable growth with accelerating inflation and failure by the administration to keep the economy in macroeconomic balance. Among the most significant distortions were (Nogues; Alvarez):

Increasing importance of state-owned enterprises and nationalization of foreign firms.

Ambitious land reform processes that eliminated the most productive land markets.

Highly negative real interest rate ceilings.

High wage taxation and labor market segmentation coming from a strictly enforced labor tenure system. Workers were entitled to tenure after they have been in the job for 3 years.

Important fiscal incentives for investment that led to the adoption of very capital intensive technologies.

Significant barriers to foreign direct investment.

Export and import restrictions and state trading, together with foreign exchange controls and periodic overvalued domestic currency, within an import-substitution strategy.

The result of the policy-induced distortions and state interventions was to transform Peru, by the late seventies, from a social system characterized by liberal principles and policies during the fifties, to a very tightly controlled and distorted economy.

"Distortions and controls eliminated not only foreign competition, but also domestic competitive forces. The consequences have been disastrous. Income distribution objectives have apparently failed to be met. Also, during the sixties and seventies, while the world economy was booming, Peru lost a clear opportunity to continue the growth impetus that it showed during the fifties". (Nogues, Trade liberalization: some lessons from Peru's experience).

The country entered a new phase of economic activity with the arrival of a democratic government in 1978. A stabilization program was immediately drawn. The fiscal deficit was reduced, an important real devaluation took place which led to significant improvements in the trade and current account balances as well as to major increases in foreign exchange reserves which went from negative US$-1.025 in 1978 to positive US$1.276 in 1980. However, the stabilization plan left most of the policy-induced distortions mentioned earlier unchanged.

In 1980, the government implemented a trade liberalization approach. Up to that moment the trade regime was characterized by across-the-board import-licensing procedures where all foreign goods similar to those domestically produced could not be imported. By September of 1980 the government substituted the import prohibitions by added-value tariffs characterized by a maximum tariff of 60% and reduced export taxation considerably (J. Nogues). It is important to stress the fact that the liberalization effort did not have a substantial impact on agriculture. For basic foodstuffs, the government maintained a monopoly to import and commercialize them.

The system of mini-devaluation followed by a maxi-devaluation was adopted and fiscal measures were implemented (higher taxes and prices, lower expenditures). Strict money supply goals were formulated with the International Monetary Fund (IMF) and closely followed and monitored.

The experiment of liberalization was short lived. The economy had a sluggish performance characterized by fiscal deficits, recession, and inflation due in part to unusually strong weather adversities in 1983 related to the El Niño ocean stream when real GDP decreased by 12.0% (Table 2). Acute current account deficits were compensated by inflows coming from foreign loans.

Halfway through 1985 the government changed hands from a conservative, market-oriented leadership to a left-leaning group dedicated to market and price control, with agriculture very high on its list of priorities.

An emergency plan was designed to reactivate the economy of the country and improve expectations. The following measures were adopted:

Elimination of the IMF standby agreement.

Devaluation by 12% and freezing of exchange rate.

Control of fiscal expenditures in current rather than investment items.

Restrictions on imports, reversing the liberalization trend of the previous government.

Increasing the minimum wage by 50%, medium-level salaries by 30%, and freezing top-level salaries.

Reduction of cost of other inputs to compensate for higher labor costs, especially interest rates. Agricultural loan rates went from 180% in July to 39% in October 1985. Later, a differentiated regional structure was developed, favoring first the mountain areas (Sierra), then the jungles (Selva), and finally the coastal areas (20%, 35%, and 55%, respectively).

Price controls. In particular, food prices were frozen and, for perishable commodities, a board formed by government representatives (Ministries of Economics and of Agriculture), intermediaries, and producers met every other week to determine wholesale and retail prices.

A maximum of 10% of export revenues destined for servicing foreign debt requirements. By 1986, debt service (principal and interests) was similar in size to total export revenues (about US$3.5 billion but debt service was held at US$350 million).

In summary, the policies of industrialization by import substitution that characterized the Peruvian economy since the sixties, led to a steady decrease of the real exchange rate until 1977, when it recovered slightly in 1978 and 1979, coinciding with the trade liberalization strategy, and fell again during the eighties.

Declines in the real exchange rate have harmed the agricultural sector, especially in the production of agricultural tradeables, and have led to increased domestic consumption of those items (imported cereals and exportables), reduced the contribution of agriculture to growth and to the balance of payments, and made the country more dependent on imported food (Valdes and Alvarez; Nogues). An aggressive governmental presence in the sector contributed to the blocking of competitive forces without and within the sector. Important imbalances, rather than being resolved, were perpetuated.

Agricultural Policies

The analysis of Peruvian agriculture must begin with a sharp differentiation of performance in agricultural production between geographical regions: Coastal, Selva, and sierra. The lack of a determined effort to achieve a balanced regional growth is evident: the three highly differentiated regions communicate poorly among themselves.

The coastal region, dominated by the high pressure system of the Pacific, is extremely dry. Coastal farmers are the richest and possess middle-sized farms which operate under relatively modern conditions and are totally dependent on irrigation. They supply the bulk of agricultural products. The majority (over 55%) of the country's population live in this region. Access to the other two regions is expensive.

The Sierra is characterized by small farmers who have limited resources, were untouched by the agrarian reform, and whose contributions to the coastal markets have been declining, except for beef and dairy products.

The Selva is a new frontier with a dynamic agricultural sector, but separated, almost isolated, from the main markets by the Andes. The local population (over 3.5 million) is self-sufficient and is growing surpluses of maize and rice (two of the crops with the highest direct government intervention) and important coca plantations. However, the infrastructure is inadequate, especially the roads leading to the coast. Transport from the Selva to Lima is not only expensive (at US$100 per ton), but also unreliable due to frequent landslides and other disruptions to traffic flow. This is particularly constraining to the commercialization of perishable commodities such as roots, tubers, and vegetables and constitute a major obstacle to development.

The agricultural share in GDP dropped from 24% in the fifties to 12% in the eighties (Table 1). This is particularly disturbing, particularly as the country's overall economic performance during that period was dismal. Industrial protectionism has been implemented at the expense of agriculture, a bias that has been aggravated by specific policy actions within the sector such as the ambitious agrarian reform of the seventies, severe distortions in factor and product markets, and widespread government intervention that reduced or eliminated competitive forces in practically all markets.

Regional imbalances, together with an agricultural policy that has had a clear urban bias, led Peru to become increasingly dependent on food imports. It is much easier to reach Lima and other coastal towns by sea than from the Selva or the Sierra.

Specific agricultural policies

Some agricultural policies are part of the general macroeconomic goals of the government while others appear like isolated policies to compensate for the negative effects of the general policies, for example, the agrarian reform is a general policy while subsidized credit is a specific policy. The policies can be grouped into input-and-product policies, commercialization, credit, and research and extension.

Price and trade policies implemented after 1968. Producer prices for internationally traded crop commodities, that is, wheat, maize, rice, cotton, and sugar, with the occasional exception of maize, have been kept at prevailing real exchange rates. (Orden et al.; Univ. Minn.). This, in conjunction with trade policies adverse to agriculture and to an overvalued exchange rate, have added up to a severe policy discrimination against the agricultural sector in the past two decades.

Consumer prices, on the other hand, have been kept artificially low. The main beneficiaries have been wheat, rice, sugar, dairy products, oils, and imported maize. In 1969, the annual food subsidy of the central government represented approximately US$100 million in real 1973 prices. In 1983 this figure was approximately US$200 million, equivalent to 20% of the fiscal deficit (Franklin et al., 1983). Rice received 53% and imported wheat received 32% of the food subsidy budget. It was estimated that in 1980, the food subsidy amounted to 2.7% of total consumer expenditures and 1.8% of GDP. According to a recent study (Franklin et al.), the impact of these food subsidies may have been somewhat regressive. Such subsidies discriminate strongly against roots and tubers.

Commercialization of rice was, and still is, performed by ECASA (Empresa Comercializadora de Arroz S. A., the state rice trading agency), while wheat (over 90% is imported), was, and is, handled by ENCI (another state agency). ENCI also trades with cotton, selling to local mills at prices below the price received for export sales.

Producer prices were kept generally low (Valdes and Alvarez). The active role of the state in the commercialization of certain crops such as maize, cotton, rice, and wheat, and visible distortions in the prices of such inputs as land, water, transportation, fertilizer, credit, and machinery (also pushing them to levels lower than their costs to the economy), inefficiently dictated resource allocation among intervened products and also away from those crops excluded from government favors.

Transportation subsidies have encouraged some movement of resources from the coast to other regions, but at an insufficient level. The State absorbs most of the cost of transportation subsidies by standardizing producer and consumer prices for each crop throughout the country. However, the private sector cannot compete with the State in those crops where the system operates and, as a result, existing inefficiencies are often perpetuated.

As a result of the implemented agricultural policies the production of cassava and potatoes decreased at annual rates of about 7.5% and 6.0% in 1966-83, while imports of wheat grew at a 3.0% per year and those of coarse grains, that is, maize and sorghum grew at 3.7% in the same period. Among the five carbohydrate products considered in this study, only rice showed an increase in production over the period--at around 3.7% per year. In this particular case, new varieties and improved cultivation technologies, together with government subsidies and commercialization, played a major role in the relative success of the crop.

The agrarian reform of Velasco, based on compulsory establishment of farmers associations without providing advice or credit to their leaders, caused a deterioration in the performance of those institutions (Paz). Table 3 shows that expansion of production areas did not contribute to expanded agricultural output in 1970-80.

The liberalization of imports and of domestic and external marketing in 1979-85 gave the private sector a chance to obtain their own inputs directly. However, state trading agencies kept a high degree of intervention through the retention of important price distortions that are still present in the economy. Staples were subjected to price control, that is, unhulled rice, yellow and white sugar, domestically produced oilseeds, cotton as seeds and meal, hard yellow maize and grain sorghum, wheat and wheat flour, and butter and milk in several forms (Paz; CGIAR Study Paper 12). The liberalization of the economy, although short lived, had a positive impact on agriculture, whose GDP, recuperated at an annual 3.0% in 1980-85 as compared with the -0.1% of 1975-80 (Table 1).

Another democratic government came to office in mid-1985. Almost absolute control of the food-producing sector was reimposed. ENCI assumed exclusivity in imports of wheat, maize, sorghum, oilseeds, and dairy products. Tariffs were revised for those products and an administered pricing system for food products was designed for both producer and consumer levels.

The major feature of the new government is the emphasis placed on agriculture and the effort to promote development of the traditionally neglected regions of the country: the "South trapezoid" of the Sierra, and the Selva. Important input and output price incentives were created to this end and credit rates and availability were designed to differentiate in favor of those regions. However, unless major infrastructure improvements are undertaken, particularly in the case of roads, these policies cannot be taken as serious and permanent endeavors to achieve a more balanced agricultural growth and to increase food production to above population growth rates.

In the long run, agricultural production in the Sierra and the Selva should be justified by their own efficiency (including lower transportation costs) rather than by the subsidies of monopolistic state trading agencies. These monopolies have narrowed the production base to a few protected grains, and have not allowed crops with obvious agronomic advantages such as potatoes and cassava to enter, at a significant level, the Peruvian diet.

Table 3. Average annual growth rates of agricultural output, total inputs (including traditional inputs), and residual, by decade, 1950-80, Peru.

Output and sources of growth	%
1950-60	
Output	2.00
Total inputs	0.96
Land	0.22
Labor	0.61
Capital	0.13
Residual	1.04
1960-70	
Output	3.20
Total inputs	1.07
Land	0.11
Labor	0.93
Capital	0.03
Residual	2.13
1970-80	
Output	0.90
Total inputs	1.49
Land	0.00
Labor	0.56
Capital	0.93
Residual	-0.59
1950-80	
Output	2.00
Total inputs	1.18
Land	0.11
Labor	0.70
Capital	0.37
Residual	0.82

SOURCE: Elias, V. 1985. IFPRI report, No. 50, Oct.

Agricultural credit. The abrupt changes in the direction of policies were reflected in the operation of the financial system as well. State intervention in this sector was high. This meant that commercial banking was rapidly displaced from agriculture. In 1950, 65.1% of agricultural loans came from commercial banks which lend mostly to cotton and rice in the coast (Table 4). By 1980, this percentage was down to 5.7% (from 12.3% in 1950) and represented only 1.9% of their credit portfolio (Peru, el Agro en Cifras). However, the Agrarian Bank (BAP), known earlier as the Agricultural Development Bank, accounted for 34.9% of these loans in 1950 while by 1980 its share had gone up to 94.7%.

In real terms, total agricultural credit grew fast in 1950-68, only to stagnate afterwards, coinciding with the slowdown of agriculture (Table 5).

Composition of credit by crops of destination changed abruptly, with cotton receiving over 50% of agricultural loans in the late sixties but participating with only 18.3% in 1983. The contrary occurred to rice, which participation increased from about 15% in the late sixties to 46% in 1983 with important gains in areas financed (Tables 6 and 7).

Interest rates were kept consistently below inflation rates, especially after 1975 (Table 8), constituting an added element of discrimination against crops not so favored by this subsidy such as cassava.

Research and extension. Government expenditures in agriculture are low in comparison to other countries in Latin America in terms of expenditure per person employed in the sector but they are about average when analyzed in terms of expenditures per area harvested (Elias). These outlays grew fast in the sixties and seventies, particularly for irrigation and agrarian reform. The National Farm Research, Extension and Education System was given a high priority in the sixties, but in the seventies the government assigned priority to the agrarian reform. Its research activities concentrated on the requirements of the coastal region, covering sugarcane, cotton, rice, maize, beans, potatoes, and sweet potatoes. The private sector had strong research programs on sugarcane and cotton in the sixties, when Peru had among the highest yields worldwide.

The Agricultural Promotion and Research Institution (INIPA) was created in 1981. Five national priority programs were established: potatoes, maize, rice, grain cereals (wheat, barley, and oats), and grain legumes (Paz). The National Livestock Program was created in 1985. The most successful of these programs has been rice, for which several new varieties have been introduced, helping to significantly increase yields and production in the Selva, but having no significant effect on productivity in coastal areas. Yields of crops under the other programs have not shown significant improvements over the past two decades (Paz).

Table 4. Evolution in real terms of agricultural credit (in millions of 1970 Sols) granted by the main institutions of the national financing system, 1950–1983, Peru.

	Banking system						Nonbanking system							
	Banco Agrario		Commercial banking		Subtotal		Private financing		COFIDE		Subtotal		Total financial system	
Year	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
1950	620	–	1,155	–	1,775	–	–		–	–	–	–	1,775	–
1955	1,230	14.7	2,640	18.0	3,870	16.9	–		–	–	–	–	3,870	–
1960	3,230	21.3	2,415	–1.8	4,735	4.1	–		–	–	–	–	4,735	–
1965	4,030	4.5	2,706	2.3	6,736	7.3	–		–	–	–	–	6,736	–
1970	7,193	12.3	1,540	–10.7	8,733	5.3	nd.[a]	–	–	–	–	–	8,733	–
1971	7,554	5.0	1,513	–1.7	9,067	3.8	nd.	–	nd.	–	nd.	–	9,067	3.8
1972	8,221	8.8	1,608	6.2	9,829	8.4	15	–	nd.	–	15	–	9,844	8.5
1973	8,489	3.2	1,473	–8.3	9,962	1.3	20	33.3	nd.	–	20	33.3	9,982	1.4
1974	9,240	8.8	1,265	–14.1	10,505	5.4	60	200.0	nd.	–	60	200.0	10,565	5.8
1975	9,369	1.3	1,102	–12.8	10,471	–0.3	60	0	nd.	–	60	0	10,531	–0.3
1976	8,911	–4.8	905	–17.8	9,816	–6.2	50	–16.6	nd.	–	50	–16.6	9,866	–6.3
1977	7,890	–11.4	722	–20.2	8,612	–12.2	32	–36.0	559	–	591	1,022.0	9,173	–7.0
1978	6,728	–14.7	455	–36.9	7,183	–16.5	21	–34.3	529	–5.3	550	–1.9	7,733	–15.6
1979	6,235	–7.3	378	–16.9	6,613	–7.9	38	80.9	354	–33.0	392	–28.7	7,005	–9.4
1980	8,506	36.4	516	36.5	9,022	36.4	41	7.8	–	–	–	–	–	–
1981	10.033	18.0	843	63.4	10,876	20.5	64	56.1	–	–	–	–	–	–
1982	8,794	–12.3	1,010	19.8	9,808	–9.8	89	39.1	–	–	–	–	–	–
1983	–	–	960	–4.3	–	–	59	–33.7	–	–	–	–	–	–

a. nd. = no data available.

SOURCE: Peru: El Agro en Cifras.

Table 5. Agricultural credit share in total credit (%) granted by the different sectors of the national financing system, 1950-1980, Peru.

	Banking system				
Year	Banking improvement	Commercial banking	Total	Nonbanking system	Financing system
1950	28.3	12.3	15.3	-	15.3
1955	23.5	16.3	18.0	-	18.0
1960	48.9	14.4	25.0	-	25.0
1965	42.4	11.0	19.6	-	17.1
1970	49.0	6.6	22.6	nd.[a]	17.9
1971	45.7	5.5	20.2	nd.	15.8
1972	41.1	5.1	19.0	0.1	14.8
1973	37.7	4.4	17.6	0.1	13.9
1974	38.6	4.1	18.8	0.3	14.5
1975	36.3	3.3	17.3	0.3	13.4
1976	35.5	3.0	18.1	0.3	13.5
1977	33.5	2.8	17.4	3.6	14.0
1978	33.4	2.2	16.7	4.0	13.7
1979	36.1	1.7	16.9	4.3	14.5
1980	42.0	1.9	17.0	nd.	nd.

a. nd. = no data available.

SOURCE: 1950-1960 Superintendencia de Banca y Seguros.
1965-1979 Cuentas Financieras del Perú BCR, cited by Salaverry Llosa, op.cit.
1979-1980 Cuentas Financieras del Perú BCR.

Table 6. Loans (millions of Sols) granted by Banco Agrario by type of crop, 1960–1983, Peru.

	Cotton		Rice		Coffee		Sugarcane		Fruit		Maize		Potato		Wheat		Other		Total	
Year	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
1960	441	59.2	128	17.2	35	4.7	4	-	26	3.4	22	2.9	44	5.9	9	1.2	35	4.7	744	100.0
1965	846	55.5	203	13.3	95	6.2	34	2.2	50	3.2	121	7.9	82	5.3	5	0.3	88	5.7	1,524	100.0
1970	855	27.9	1,037	33.9	250	8.1	100	3.2	117	3.8	223	7.2	224	7.6	4	0.1	239	7.8	3,058	100.0
1971	1,235	31.0	1,246	31.3	245	6.1	324	8.1	124	3.1	333	8.3	165	4.1	14	0.3	272	6.9	3,976	100.0
1972	1,244	31.9	1,120	29.1	212	5.5	268	6.9	132	3.4	360	9.3	205	5.3	13	0.3	310	8.0	3,844	100.0
1973	1,778	34.3	1,568	30.2	168	3.2	364	7.0	169	3.2	412	7.9	291	5.6	13	0.2	406	7.9	5,178	100.0
1974	2,414	33.1	2,130	29.3	244	3.3	640	8.7	247	3.4	566	7.7	514	7.0	62	0.8	463	6.4	7,283	100.0
1975	2,552	22.6	3,956	35.0	351	3.1	561	4.9	475	4.2	1,388	12.3	1,056	9.3	85	0.7	857	7.6	11,282	100.0
1976	3,827	24.1	5,599	35.3	422	2.6	421	2.6	614	3.8	2,042	12.9	1,414	8.9	85	0.5	1,439	9.0	15,865	100.0
1977	4,964	23.5	7,197	34.1	726	3.4	713	3.3	847	4.0	2,416	11.4	2,315	10.9	101	0.3	1,820	8.6	21,099	100.0
1978	10,133	32.1	8,884	28.2	1,639	5.2	726	2.3	1,644	5.2	3,112	9.8	3,552	11.2	144	0.4	1,654	5.2	31,488	100.0
1979	22,031	32.9	18,733	28.0	3,028	4.5	2,687	4.0	2,584	3.8	5,253	7.8	5,160	7.7	270	0.4	7,053	10.5	66,804	100.0
1980	40,222	21.3	34,252	18.2	5,910	3.1	8,415	1.3	(1)	(1)	7,201	3.8	13,571	7.2	394	0.3	84,681	44.9	188,646	100.0
1981	50,806	23.8	76,734	35.9	4,654	2.1	12,660	5.8	(1)	(1)	14,217	6.7	29,985	14.0	432	2.0	23,942	11.2	213,430	100.0
1982	62,658	22.2	111,641	39.5	6,528	2.3	12,772	4.5	(1)	(1)	21,188	7.5	28,144	9.9	282	0.09	39,254	13.9	282,467	100.0
1983	96,265	18.1	244,583	45.9	16,131	3.0	20,467	3.8	(1)	(1)	33,137	6.2	64,188	12.1	302	0.05	57,178	10.7	532,251	100.0

SOURCE: El Agro en Cifras.

Table 7. Area (ha) receiving credit from the Banco Agrario according to type of crop, 1970-1983, Peru.

Year	Cotton	Rice	Maize	Coffee	Potato	Sorghum	Bean	Wheat	Sugar cane	Jute	Other	Total
1970	77,926	86,604	32,500	34,950	15,075	2,750	6,908	1,057	4,588	4,368	30,412	297,138
1971	100,899	90,929	46,731	36,321	11,111	5,700	9,036	2,900	14,222	5,439	26,998	350,286
1972	91,712	71,628	47,504	27,743	13,033	9,359	9,969	2,555	15,066	3,505	26,781	318,595
1973	111,542	87,159	49,325	21,426	15,351	7,170	10,742	2,165	11,405	2,455	31,749	350,489
1974	116,508	83,317	49,698	25,030	21,732	5,095	11,206	7,950	11,733	1,188	36,190	369,647
1975	101,862	120,173	82,378	26,320	28,383	12,869	13,466	7,783	16,246	1,899	54,422	465,301
1976	106,418	125,187	103,612	28,329	29,664	21,370	14,035	5,936	9,109	3,115	58,730	505,505
1977	97,896	122,338	94,879	30,573	31,079	23,624	12,347	5,476	9,044	4,461	55,215	486,932
1978	106,718	105,039	78,633	43,729	31,482	18,017	13,713	4,811	7,994	4,760	48,200	463,190
1979	126,363	120,690	76,244	45,292	29,505	21,034	15,243	4,579	6,335	4,891	49,590	499,946
1980	139,524	130,156	68,591	49,939	38,776	21,267	13,549	4,300	8,183	2,912	51,509	528,706
1981	119,133	162,598	84,889	35,577	50,053	15,219	18,375	3,364	11,484	2,837	61,987	565,516
1982	105,138	159,291	79,303	36,883	38,889	15,687	13,569	1,787	35,002	3,505	59,273	548,337
1983	71,790	161,306	101,712	36,391	46,008	13,263	4,919	805	5,104	1,936	11,080	454,314

SOURCE: El Agro en Cifras.

Table 8. Public banking nominal and real interest rates (%) for agriculture, 1960-1980, Peru.

Year	Interest rates on loans for food crops	Changes in Lima's Consumer Price Index[a] (2)	Approx. of the real rate of interest (1)-(2)
1960	7	7.9	-0.9
1961	7	5.9	1.1
1962	7	6.6	0.4
1963	7	6.0	1.0
1964	7	9.8	-2.8
1965	7	16.4	-9.4
1966	7	8.9	-1.9
1967	7	9.8	-2.8
1968	7	19.1	-12.1
1969	7	6.2	0.8
1970	7	5.0	2.0
1971	7	6.8	0.2
1972	7	7.2	-0.2
1973	7	9.5	-2.5
1974	7	16.9	-9.9
1975	7	23.6	-16.6
1976	10 (10 + 4)[b]	33.5	-23.5
1977	10 (10 + 4)[b]	38.1	-28.1
1978	24 (24 + 2)[b]	57.9	-33.9
1979	27 (27 + 2)[b]	67.7	-40.7

a. Conceptually, Lima's CPI is not an adequate index by which to deflate the real interest rate on farm credit. However, no other price index was available.

b. The figures in parentheses show the nominal rate of interest. For instance, 14% in 1976: the producer was charged 10% and the Treasury paid the difference (4%).

SOURCE: Valdes and Alvarez.

Concluding comments on agricultural policies

Valdes and Alvarez analyzed the growth of agriculture among different commodity groups over the past three decades. They show how production of food for urban consumption, that is, rice, beef, pork, poultry, and mil, had a fairly dynamic growth rate of 3.5% or more over the period. Production of export crops, that is, cotton, sugar, and coffee, grew very fast in the fifties, stagnated in the sixties, and had a slow growth in the seventies. Aggregate production of Sierra items such as wheat, barley, potatoes, and maize virtually had no growth at all during these 3 decades.

In response to protectionism, the food industry grew fast but with a high degree of concentration in terms of market power as well as regionally. Important oligopolies, receiving significant levels of foreign capital, emerged in wheat milling, animal feeds and poultry raising activities, oilseeds and fat, and dairy products. The major processing plants were located in and around Lima (Lajo). These industries found it easier to lobby for imported foodstuffs which conveniently arrived at the port, were of homogeneous quality, and were accompanied by credit packages and other attractive concessions, than to purchase those inputs produced by their own country.

As a result, the emergence of important food and animal-feed processing industries in the country was not accompanied by a significant response in the production of local raw materials.

The general policy scheme leaves perishables (and therefore not tradeable at a market disadvantage within the system. Tradeables are protected by exchange rate distortions linked to protectionism and by the implicit and explicit set of consumer and producer subsidies directed to these crops. Nontradeables such as potatoes and cassava are therefore produced and marketed within a high cost structure.

Status Quo of Cassava in Peru: Supply and Distribution

Fresh cassava is an important staple in the rural sector of Peru, where it contributes about 3% of the caloric intake of the population. It is also important in the Selva where per capita annual consumption is over 150 kilos and in some areas represents 3% of food expenditures. According to the ENCA survey of 1972, Lima accounts for 8% of the total national consumption, while the rural areas account for 72% of that total. The survey established that about 65% of root and tubers, especially cassava, are consumed in the Selva where 75% of cassava in Peru is produced on family farms (Table 9).

Total cassava production declined at an annual rate of 7.5% over the 1966-83 period (Table 10). Most of the production comes from the Selva (75%). Cajamarca is the major producer with 25% of the total, most of which comes from Jaen in the northern Selva. Then comes Loreto with 15% (in the Selva) and Cuzco (12%) in the Sierra (Table 11).

Clearly, the rapid process of urbanization which occurred in Peru during the past three decades has been detrimental to the consumption of

Table 9. Annual consumption of cassava and relative importance in the food budget, 1972, Peru.

	North coast		Upper Selva		Lower Selva		North Sierra		Metropolitan Lima	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural		
% Exp. food		0.91%	1.20%	1.30%	1.70%	2.90%	0.80%	1.40%	Lower	0.41%
Kg/family		10.1	76.5	99.9	196.0	na	na	na	income level	24.0
	Central coast		South coast		South Sierra		Central Sierra		Medium	0.4%
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	income level	21.0
% Exp. food	0.4%	0.4%	0.5%	0.4%	0.1%	0.1%	0.20%	0.3%	Upper	0.2%
Kg/family	22.6	16.0	28.0	15.0	1.0	0.5	9.6	5.4	income level	12.9

SOURCE: ENCA. National Survey on Food Consumption.

Table 10. Production and trade of major carbohydrates (in thousands of tons), Peru.

Year	Production					Imports			Populat. (in millions)
	Cassava	Potato	White rice	Soft maize	Wheat	White rice	Yellow maize and sorghum	Wheat	
1960	413.6	1,397.8	357.6		146.1	38.2	0.8	349.4	10.0
1961	406.8	1,492.3	331.9		153.9	12.9	21.4	416.3	10.3
1962	390.1	1,416.2	374.2		152.8	1.2	10.0	485.0	10.7
1963	437.6	1,427.0	269.9		152.6	1.4	7.5	362.3	11.0
1964	496.5	1,531.1	351.5		143.2	47.6	15.7	392.7	11.4
1965	449.3	1,568.2	290.5	33.4	146.7	91.9	4.6	463.5	11.7
1966	486.8	1,498.9	374.0	108.5	145.0	78.7	6.7	493.1	12.0
1967	506.8	1,711.7	461.4	119.7	152.2	58.8	0.9	492.6	12.4
1968	399.1	1,526.3	286.2	89.0	112.9	47.6	59.1	629.6	12.7
1969	449.9	1,855.5	444.4	121.8	136.7	37.0	6.3	681.7	13.1
1970	498.3	1,929.5	586.7	133.4	125.4	15.3	1.7	521.6	13.5
1971	481.9	1,967.9	591.1	136.9	122.2	0.0	0.4	695.6	13.8
1972	446.0	1,713.4	482.3	144.9	122.1	0.0	104.1	618.0	14.2
1973	460.3	1,713.1	483.5	148.8	122.6	(55.2)[a]	223.2	389.4	14.6
1974	468.9	1,722.4	494.2	151.8	127.4	(6.5)	238.2	586.8	15.0
1975	399.7	1,639.6	536.8	157.8	126.3	78.2	362.7	797.9	15.4
1976	402.5	1,667.0	570.4	145.2	127.5	81.8	278.1	601.1	15.8
1977	414.0	1,615.6	594.0	230.6	115.4	0.0	222.9	842.3	16.2
1978	410.0	1,695.3	467.8	210.8	104.4	26.4	149.5	686.1	16.7
1979	402.6	1,695.1	560.4	213.1	102.1	204.4	153.8	798.2	17.1
1980	352.5	1,379.7	420.4	151.8	77.1	226.1	500.0	854.8	17.6
1981	327.1	1,678.6	712.1	196.9	118.5	105.7	503.0	927.5	18.1
1982	324.1	1,799.6	775.5	232.9	100.9	58.9	530.0	991.7	18.6
1983	361.3	1,199.8	797.6	173.1	75.8	95.3	425.0	967.0	19.2
1984	356.8	1,462.6	1,133.8	205.5	88.2	47.6	115.0	964.0	19.6

a. Numbers in brackets signify exports.

SOURCE: Ministerio de Agricultura. Peru: El Agro en Cifras.

Table 11. Cassava production area (ha) by agricultural region, Peru.

Agricultural region	Total
Total	361385
Tumbes	-
Piura	2734
Lambayeque	13688
La Libertad	12410
Ancash	9814
Lima	8785
Ica	1056
Arequipa	878
Moquegua	-
Tacna	-
Cajamarca	86232
Amazonas	17074
San Martin	25554
Huanuco	16628
Pasco	11585
Junin	20395
Huancavelica	-
Ayacucho	7474
Apurimac	87
Cuzco	41817
Puno	1691
Loreto	56081
Ucayali	16249
Madre de Dios	11154

SOURCES: Ministerio de Agricultura, OSE.
Boletin Estadístico de la Producción Agrícola, 1983.

fresh cassava in the country. Transport costs from the Selva to the coastal urban settlements are high due to high losses in commercialization. While other carbohydrates receive government support and are given massive subsidies such as wheat, maize, and rice, cassava is not subsidized and therefore is more expensive to the consumer (Table 12).

Fresh cassava consumption. In the mid-sixties, per capita consumption of cassava in Peru was around 40 kilos while in the mid-eighties it was about 18 kilos, which corresponds to a rate of growth of -4.9% per year in 1966-83 (Tables 13 and 14).

Lima accounts for about 8% of the national market, or around 30,000 tons, resulting in a consumption of 5 kilos per capita annually. A survey conducted by Centro Internacional de Agricultura Tropical (CIAT) in 1986 among 170 households reveals that cassava consumption decreases as income rises. It is consumed 1.5 times per week, mostly at lunch, and peaks during the months of December, January, and February (Table 15).

The survey reveals that cassava is a preferred food by consumers but that it is difficult to store, its quality varies greatly, and it is expensive (Table 14). All these features are closely related to the perishability of the product. Reducing perishability is therefore a must if fresh cassava consumption is to increase in the Peruvian urban markets.

By February 1986, when the survey was conducted, a picture of high marketing margins, typical of other years, was found in the Satipo-Lima cassava traders chain (Table 15).

Econometric analysis. The declining per capita consumption of cassava in Peru (at an annual 4.9% in 1966-83) was accompanied by a rapid trend of urbanization in the country and by government monopolies to ensure abundant and cheap supplies of wheat and rice which showed markedly low prices with respect to that of cassava (Table 12). At the same time, the country underwent a period of deep recession associated with a sharp decline in real per capita income at 1.2% per year over 1966-83.

The model used estimates per capita consumption of cassava as being dependent upon its own price, the price of other carbohydrates, per capita income, and a proxy for urbanization. Money variables are all in constant prices.

The proxy for urbanization is intended to capture the fact that due to the high perishability of the crop, an increasing degree of concentration of consumers in urban areas means a reduction in the level of competitiveness in the markets for fresh cassava. The reduction is a consequence of the emergence of natural barriers to entry and very high risks confronted by distant suppliers. Consequently, price increases are higher than they would have been in a more competitive environment.

Results show significant responses in per capita consumption of fresh cassava to its own price, the price of wheat and rice, and the variable for urbanization, while per capita income is not a significant variable at this level of aggregation (Table 16).

Table 12. Retail prices of carbohydrates sources (in Sols per kilo), Peru.

Year	Cassava	Potato	White rice	Soft maize	Bread	CPI general
1960	2.15	2.05	3.30	2.20		4.7
1961	2.10	2.06	3.15	2.25		4.9
1962	2.08	2.08	3.04	2.31		5.3
1963	2.65	2.65	3.63	2.67		5.6
1964	2.68	2.61	4.18	2.85		6.1
1965	4.13	4.16	4.30	3.60	4.03	7.8
1967	4.04	3.32	5.60	3.90	4.15	8.5
1968	4.86	3.95	6.86	4.70	4.25	10.1
1969	5.07	4.29	7.30	4.79	4.40	10.8
1970	5.32	4.06	8.80	5.17	4.50	11.3
1971	5.68	3.96	8.80	5.64	4.50	12.1
1972	5.70	5.11	8.80	5.87	4.50	13.0
1973	5.96	6.12	8.80	6.58	5.40	14.2
1974	5.58	5.47	10.56	7.75	6.50	16.6
1975	9.91	9.17	13.16	9.63	7.80	20.5
1976	10.96	9.39	18.14	12.86	12.50	27.4
1977	14.26	18.57	23.35	17.56	15.17	37.8
1978	20.06	18.61	36.52	28.50	27.29	59.6
1979	47.96	39.88	67.67	47.82	43.86	100.0
1980	84.27	89.20	94.42	136.72	68.23	159.2
1981	145.71	110.40	143.78	282.41	76.95	279.2
1982	211.45	286.47	227.36	445.00	100.00	459.2
1983	595.76	689.76	468.54	1,054.00	573.36	969.5
1984	774.67	783.05	1,235.28	1,558.00	1,205.26	2,038.1

SOURCE: INIPA, Datanpro, Ag. 1985. 1973 Prices.

Table 13. Per capita consumption of selected carbohydrates (in kilos per year), Peru.

Year	Cassava	Potato	White rice	Soft maize	Wheat	Total	Share of cassava (%)
1960	41.3	139.5	26.5		14.6		
1961	39.4	144.6	22.4		14.9		
1962	36.3	131.9	23.4		59.4		
1963	39.6	129.2	16.5		46.6		
1964	43.7	134.7	23.5		47.2		
1965	38.4	134.1	21.9	2.9	52.2	249.5	15.4%
1966	40.5	124.6	25.2	9.0	53.1	252.4	16.0%
1967	41.0	138.4	28.2	9.7	52.1	269.3	15.2%
1968	31.4	120.0	17.6	7.0	58.4	234.3	13.4%
1969	34.4	141.8	24.6	9.3	62.5	272.7	12.6%
1970	37.0	143.3	30.0	9.9	48.1	268.3	13.8%
1971	34.9	142.3	28.6	9.9	59.2	274.9	12.7%
1972	31.4	120.7	22.8	10.2	52.1	237.1	13.2%
1973	31.6	117.5	19.7	10.2	35.1	214.0	14.7%
1974	31.3	115.0	21.8	10.1	47.7	225.9	13.9%
1975	26.0	106.5	26.8	10.2	60.0	229.5	11.3%
1976	25.4	105.4	27.6	9.2	46.1	213.7	11.9%
1977	25.5	99.4	24.5	14.2	58.9	222.6	11.4%
1978	24.6	101.6	19.8	12.6	47.4	206.0	11.9%
1979	23.5	98.9	29.9	12.4	52.5	217.1	10.8%
1980	20.0	78.3	24.6	8.6	52.9	184.3	10.8%
1981	18.1	92.6	30.2	10.9	57.7	209.5	8.6%
1982	17.4	96.6	30.0	12.5	58.6	215.1	8.1%
1983	18.9	62.6	31.2	9.0	54.4	176.1	10.7%
1984	18.2	74.5	40.3	10.5	53.6	197.0	9.2%

SOURCE: Compiled by author, based on: Peru: El Agro en Cifras; and INE.

Table 14. Responses (%) of consumers to survey on cassava, potato, rice, and sweet potato, Peru.

	Cassava	Potato	Rice	Sweet potato
These products cannot be easily stored	85	36	24	28
Quality of these products is too variable	80	80	52	53
Much of these products is wasted during preparation	32	50	67	56
Risky to buy these products because of their quality	85	51	30	35
These products were bought on day of consumption	79	35	27	32
These products are easy to prepare	83	97	93	87
These are very nutritional products	71	89	44	64
These products are always available	62	64	85	78
These products are tasty	75	88	78	76
These products are indispensable in meals	40	88	85	41
At the moment these products have a good price	32	50	67	56

SOURCE: CIAT Survey, 1986.

Table 15. Monthly wholesale and retail marketing margins (%) for cassava, potato, and plantain, 1984, Lima, Peru.

Average		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
51.7	Cassava	49.0	43.0	30.4	51.1	56.3	73.9	52.2	54.2	62.6	52.6	52.9	57.2
33.9	Potato	41.0	28.7	35.2	48.5	47.9	44.4	35.4	39.9	33.9	11.7	20.5	35.9
32.7	Plantain	23.1	40.8	32.1	19.0	25.6	12.8	23.9	59.8	42.3	65.0	23.9	32.8

CASSAVA: February 1985, marketing margins, Satipo-Lima.

Farm price (Satipo Area)	1.20 Intis/kg
Wholesale price, Lima	4.00 Intis/kg
Retail price, Lima	6.50 Intis/kg
Transport cost, Satipo-Lima	1.00 Intis/kg

SOURCE: Compiled by author from Ministerio de Agricultura; INIPA.

Table 16. Summary of annual rates of growth (%), Peru.

Meats		Crops	
Per capita consumption		Per capita consumption	
Beef	-2.6	Cassava	-4.9
Pork	-0.9	Potato	-3.5
Poultry	7.0	Rice	1.1
		Wheat	0.1
Poultry total production		Maize	1.4
	9.7		
Real retail prices		Cassava total production	
Beef	2.3		-2.2
Beef	-0.9	Real retail prices	
Poultry	-4.1	Cassava	0.2
		Potato	1.8
Relative price		Rice	-1.5
Beef/Poultry	6.3	Wheat	-0.8
		Maize	4.5
Other			
Total population	2.7	Relative price	
Urban population	3.9	Cassava and wheat	1.3
Per capita real income	-1.2	Animal concentrate	4.6
Maize and sorghum imports	3.7	Maize and sorghum production	0.4

SOURCE: Compiled by author.

The results confirm the hypotheses that government policies which protect and subsidize wheat and rice are partly responsible for the lower consumption of this local staple, and that urbanization is also responsible for the reduction in demand.

Potential demand for cassava

Cassava has the potential to become a basic carbohydrate source in Peru in the near future. It can contribute directly to improve the calorie intake of the population and, very importantly, it can also contribute to the production of animal meats by entering in feed formulations, complementing other energy sources that are currently deficit in their local production (mostly sorghum and maize).

Carbohydrate foods. Carbohydrate consumption has experienced important changes in composition toward grains and away from roots and tubers during the past two decades, as a result of government policies directed to favor cereals and exclude roots and tubers from its plans.

While per capita consumption of cassava and potatoes dropped from 4.9% in 1966 to 3.5% in 1983, that of rice and soft maize increased at 1.1% and 1.4%, respectively, and wheat showed no significant change at 0.1% per year. Furthermore, the relative prices of cassava and potatoes increased with respect to those of rice and wheat. Soft maize exhibits higher per capita consumption and higher real retail prices. This points at a difficult data problem rather than consumer behavior; it is difficult to separate data on soft maize from that on yellow maize for direct human consumption, onfarm feeding, and industrial use, even when accounting for changes in onfarm consumption and commercialization of the two kinds of maize. For that reason, data for soft maize exhibits atypical behavior (Table 12 and 13).

Annual per capita consumption of wheat oscillated around 55 kilos over the 1966-83 period. Local production increased from 150,000 tons in the early sixties to just over 80,000 tons in the eighties, while imports increased from about 400,000 tons to almost 1 million tons during the same period. The price of both domestically produced and imported wheat was controlled until 1984 at below world levels on entering flour mills. Domestic wheat (mostly soft whole grain) for uses other than flour milling did not have a controlled price. In 1981, nearly 120,000 tons were produced locally and yet only 67 tons, that is, almost nil, went to milling (Orden et al.): it is mostly consumed directly, especially in the Sierra. The milling industry is therefore totally dependent on imports.

Imports are based on a quota system for millers administered by ENCI. Starting in 1984, millers (who now absorb 90% of local production) must buy a share of local wheat at free and higher-than-import prices. A consumer wheat-flour price subsidy exists so that mills have paid much less for flour going to bread and noodles, which are basic items in the diets of poor Peruvians (Asagro).

In 1985, the new APRA Government again reinforced this position of making wheat one of the basic foodstuffs by formulating a strategy of the popular bread based on a less restrictive milling rate of 87% (in contrast to the usual 75%) and providing a higher subsidy for the resulting bread. For a country with serious foreign exchange restrictions, this strategy, based on imported food, may be difficult to maintain.

Rice is the other staple cereal in Peru. ECASA has had monopoly rights to market both domestic and imported rice. Milling of rice is performed by private firms under contract to ECASA. The price of unpolished rice is fixed by the government. To sell rice to a local mill, the producer needs an income order from the regional ECASA office.

In Lima ECASA sells the rice directly to retailers and charges some transport costs. In other parts of the country, retailers must pick up the rice from ECASA or the designated rice mill.

Producer prices have maintained around a 15% margin in favor of Selva producers over coastal producers. Consumer prices for ordinary rice (up to 35% of broken grains) are fixed, while superior (up to 2%) and extra (up to 5% broken grains) qualities are uncontrolled. The price structure that appears in Table 17 still prevails but due to rampant inflation, producer prices of polished rice equivalent were S/3500 in early 1985 while the consumer price of ordinary rice went up to S/2910 (Programa de Abastecimiento, Arroz, 1985). In 1986, paddy rice had a support price of US$230, or about US$350 for white rice equivalent at 14% humidity, a price well above the import cif (Callao) price of US$215.

Per capita consumption of white rice is close to 30 kilos per year (45 kilos of paddy rice). About three quarters of production comes from the northern part of the country with the Selva (San Martin, Loreto, Ucayali) showing a significant growth. However, commercialization of surpluses from the Selva constitutes a major bottleneck due to inadequate roads to Lima (Programa de Abastecimiento, Arroz 1985).

In the early eighties, rice was the subject of massive state support and promotion. While in 1980, the percentages of food subsidies destined for imported wheat and rice were 28% and 17%, in 1983 these percentages were up to 32% and 53%, respectively. In the same period, the rice production area financed by BAP increased by 25% and total production almost doubled from 420,000 to 791,000 tons. Rice production peaked in 1984 with over 1 million tons being produced. By 1985, production was around 950,000 tons and for 1986 it was much lower and about 350,000 tons of rice had to be imported (Noticias Fedearroz, Marzo, 1987). The decrease in production is the result of both drought in the north and a new support program for maize which started in December 1985 that gave maize a higher support price (I3.30/kg versus I3.20/kg for rice), as well as ample credit facilities.

In Lambayeque, the most important rice-producing department, rice production area dropped from 52,000 ha in 1984-85 to 4,400 ha in 1985-86, while maize increased from 7,000 ha to 15,000 ha and cassava decreased from 488 ha to 451 ha (CIPA II, Ing. J. Celis, unpublished). Drought and the new price-and-credit policies have had a negative impact on rice, a positive impact on maize and no effect on cassava.

Table 17. Distribution of costs in the production, processing and marketing of rice, and official prices, September, 1982, Peru.

Distribution of costs (%)

		Percent of final value
Farm price (polished rice equivalent)		74.2
Processing		20.1
Hulling	7.4	
National weighted transportation	9.3	
Spoilage	0.6	
Other	2.8	
Wholesale profit	0.0	
Retail distribution		5.7
Local transportation	1.8	
Spoilage	0.0	
Other	1.0	
Retailer profit	2.9	
		100.0

Official prices

Farm price	Unpolished rice	Polished rice equivalent
Coastal	200	300
Selva	220	330
Processed prices	**Wholesale**	**Retail**
Grade of rice		
Ordinary (corriente)	252	270
Superior	436	480
Extra	591	650
Imported	350	385

SOURCE: Ministry of Agriculture (DGAIC). Programas de abastecimiento 1981: arroz. Lima, Peru.

Per capita consumption of potatoes has been decreasing rapidly, at 3.5% per year in 1966-83, while its real retail price increased at an annual 1.8% during the same period. Most of this decrease came as a reduction in production in central Sierra because of a rapid growth in production costs, a deterioration in the terms of trade for potatoes, and the deficient and decreasing government support activities for the crop in the area in terms of research, extension, and credit (Scott). Again, government action appears as the major influence encouraging dietary patterns away from locally produced roots and tubers to local and imported cereals.

Meat consumption. Total per capita consumption of meats has grown relatively fast in Peru in the 1966-83 period due to a rapid expansion in production of poultry meat. The three meats added up to about 18 kilos per capita each year by the mid-eighties with half of those coming from poultry (Table 18). Fish consumption is relatively high at an annual 12 kilos per capita, but has been decreasing (Tagle). In the mid-sixties, the relation of beef to poultry consumption was around 2.0 while in the mid-eighties it reversed to 0.55 (from half to almost twice as much poultry). The relation of prices of poultry to beef went from 1.4 to 0.7. Clearly, consumption of poultry responded significantly to relative price variations.

While per capita poultry consumption increased at an annual 7% in 1966-83, that of beef decreased at an annual 2.6%, and per capita pork consumption decreased at an annual 0.9%. Consequently, animal feed demand grew at 4.6% per year. Since internal production of maize and sorghum was stagnant, feed grain imports increased at an annual 3.7%.

A demand equation for per capita poultry consumption was estimated, showing significant elasticities for its own price, for the cross price elasticities, indicating substitution effects caused by the higher beef and pork prices, and for the income elasticity (Table 19).

Metropolitan Lima absorbs 47.5% of the national production of poultry meat and eggs. According to the Consumer Price Index Weights, these two products account for 6.3% of the total household expenditures (Peru: El Agro en Cifras; Malarin). An important segment of the market constitutes sales of live animals (over 75% according to APA) and this helps to explain the rapid growth of this type of meat among all segments of the population, especially in those which do not have access to refrigerators.

The rapid growth of the poultry and feed industry has not been accompanied by a more competitive structure. In 1979, Bunge, Nicolini, and Purina had 80% of the feed producing market (Lajo).

On top of this oligopolistic structure, grain imports account for over a third of grain requirements for feed, and maize imports are controlled by quotas assigned to private animal-feed mixing mills. ENCI is in charge of both domestic and foreign maize purchases. For stimulating production, maize has an attractive support price: by 1986 it was I3.30/kg (or US$240/ton), higher than that of rice at I3.20/kg.

Table 18. Production, trade, retail prices, and per capita consumption of Meats, Peru.

Year	Production			Beef imports	Popul. (millions)	Nominal retail prices in Lima			CPI general	Per capita consumptio[n]		
	Beef	Pork	Poultry			Beef	Pork	Poultry		Beef	Pork	Poult[ry]
	(t in thousands)									(kg/person/year)		
1962	66.7	40.5	22.3	3.7	10.73	16.2	17.3	37.4	5.3	6.6	3.8	2.1
1963	69.5	44.2	23.6	4.4	11.04	19.0	20.0	37.4	5.6	6.7	4.0	2.1
1964	81.2	46.9	25.5	4.9	11.36	20.6	21.8	38.5	6.1	7.6	4.1	2.2
1965	74.0	43.1	37.0	6.4	11.69	25.8	23.0	40.5	7.1	6.9	3.7	3.2
1966	75.1	41.7	39.4	6.9	12.03	27.62	26.0	41.3	7.8	6.8	3.5	3.3
1967	75.7	42.9	44.1	18.3	12.37	34.93	38.0	42.9	8.5	7.6	3.5	3.6
1968	77.5	42.8	46.5	21.3	12.72	35.5	41.7	43.4	10.1	7.8	3.4	3.7
1969	82.6	46.7	51.3	37.9	13.09	36.3	52.4	48.5	10.8	9.2	3.6	3.9
1970	84.9	46.5	57.7	38.3	13.46	38.8	61.9	54.5	11.3	9.2	3.5	4.3
1971	89.5	53.6	63.6	22.9	13.83	47.7	66.7	63.6	12.1	8.1	3.9	4.6
1972	85.3	53.6	92.6	18	14.20	40.8	68.8	68.7	13.0	7.3	3.8	6.5
1973	84.5	53.2	102.5	12.1	14.59	63.2	70.4	52.5	14.2	6.6	3.6	7.0
1974	85.3	54.6	127.6	8.4	14.98	87.4	76.5	60.7	16.6	6.3	3.6	8.5
1975	86.1	54.6	129.9	5.1	15.40	102.0	91.5	78.3	20.5	5.9	3.5	8.4
1976	86.7	54.9	140.0	8	15.82	136.1	129.0	95.6	27.4	6.0	3.5	8.9
1977	87.0	54.0	143.0	7.4	16.25	172.6	153.4	132.4	37.8	5.8	3.3	8.8
1978	89.0	53.0	118.6	1.2	16.69	257.4	248.9	223.8	59.6	5.4	3.2	7.1
1979	86.6	52.5	118.4	-0.5	17.15	410.4	491.1	386.7	100.0	5.0	3.1	6.9
1980	83.8	55.0	143.5	3.6	17.63	838.0	732.8	536.4	159.2	5.0	3.1	8.1
1981	90.1	59.2	182.6	11.5	18.12	1,516.0	1,014.9	781.8	279.2	5.6	3.3	10.1
1982	91.0	58.7	204.8	21.8	18.63	2,335.0	1,743.1	1,176.0	459.2	6.1	3.2	11.0
1983	110.7	57.6	206.3	10.5	19.16	4,272.0	3,240.0	2,282.0	969.5	6.3	3.0	10.8
1984	103.1	54.5	181.6	9.1	19.70	9,076.0	8,494.5	5,360.8	2,038.1	5.7	2.8	9.2

SOURCE: Ministerio de Agricultura; INIPA.

Table 19. Projected demand for cassava, 1985-2000, Peru.

Dried cassava chips

Multiple regression for poultry meat demand, Cobb-Douglas Functional Form.
Constant -1.03 -- real retail price of -- per capita

	Beef	Pork	Poultry	Income
X Coefficient	0.6605	0.523234	-1.1942	0.53756
X Value '83	6.0935048	5.9221385	5.5167243	5.0387561
Beta X83	4.0587589	3.0986642	-6.588072	2.7086337
X Value 2000	6.0935048	5.9221385	5.2749061	5.0387561
Beta X2000	4.0585789	3.0986642	-6.299292	2.7086337

Per capita poultry consumption	
Observed 1984	9.2
Estimated 2000	12.6

Yellow maize needs from projections:

Assumptions	
Rates of growth	
Human population	2.5%
Per capita real income	0.0%
Real retail price poultry	-1.5%
Production of yellow maize	2.0%
Conversion poultry/feed	2.8
Ratio of meat/total poultry	1.5
Percent poultry feed in total	80.0%
Maize in feed formulas	60.0%

Variable levels

Human population (millions)	
1984	19.6
2000	29.2
Total production poultry meat	
1984	181.1
2000	368.4
Implied total feed needs	
1984	633.7
2000	1,289.6

Projections:	1,000
Maize production (tons)	686.4
Demand nonfeed uses of maize (annual growth of 2.5%)	315.3
Implicit maize needs for feed	773.7
Deficit (imports) of maize	402.6
CIF price maize	115 (in US$)
Cost of annual importations	46,303 (in US$)
Percent dried cassava in feed	10.0%
Total dried cassava needs(tons)	129.0

Fresh to dried cassava conversion rate	2.5
Fresh cassava implicit needs (includes reductions in waste of 10% or 41,829 tons)	280,559 tons
Average national cassava yields	10.5 t/ha
Required hectares	26,720
Fresh cassava, labor/ha	60
Dried cassava, labor/ton	1
New jobs generated per year	6,929

(continued)

Table 19. (Continued.)

Projections for fresh cassava

Multiple Regression for Demand for Fresh Cassava, Cobb-Douglas Functional Form.
Constant 5.7873906

	Cassava	Potato	White rice	Bread	Income	Urbanization
X Coef. elasticity	-0.22069	0.04924	0.313505	0.131571	0.09462	-1.1294
X Value '83	-0.727142	-0.648509	-0.613942	-0.503851	1.617159	2.577144
Beta X83	0.1604730	-0.031932	-0.192474	-0.066292	0.153015	-2.91062
X Value 2000	-0.887947	-0.648509	-0.774748	-0.664657	1.617159	2.754229
Beta X2000	0.1959612	-0.031932	-0.242887	-0.087449	0.153015	-3.11062

Per capita cassava consumption	
Observed 1984	18.2
Estimated 2000	14.3
Assumptions	
Rates of growth	
Real retail price, cassava	-1.0%
Real retail price, white rice and bread	-1.0%
Per capita real income	0.0%
Human population	2.5%
Urban population	3.0%
Urbanization effect reduced by 1/3	
Reduction in waste with plastic bags	10.0%
Fresh cassava production (1000 tons)	
1984	356.8
2000	376.5
Additional fresh cassava required (1000 tons)	19.7
Additional hectares	1,872
New jobs generated	449

Summary of joint projections for fresh and dried cassava needs

Current cassava production, 1984	356,800 tons
Hectares 1984	33,981 ha
Total production projected for year 2000	657,020 tons
Additional hectares	28,592 ha
New permanent jobs generated annually	7,378 jobs
Total reduction in waste (20% of fresh)	75,292 tons
at I2.75/kg farm level	207.05 millions of Intis
Annual savings to the country	14.90 millions of US$

SOURCE: Compiled by author.

Maize is purchased throughout Peru by ENCI at the support price of I3.30/kg and is sold at that same price everywhere in the country, regardless of whether it is imported or domestically produced in coastal areas or in the Selva. This implies a subsidy for Selva maize of about I1.50/kg, which is the 1986 estimated transport cost from the Selva and for coastal maize of about I0.50/kg, which is the transport cost to Lima, the major user of hard yellow maize. On imported grain, the government makes about I1.20/kg (exchange rate is I13.90 to the U.S. dollar).

Maize import quotas are highly valued because the homogeneity in the quality of imported grain surpasses that of national maize. Therefore, commercial millers continually press for increased quotas (Orden et al.).

The coast produces 60% of the yellow maize in the country under 40% of the area while the Selva produces 40% under 60% of the area. Current yields are 2.8 tons/ha at the national level. In coastal areas, where technology is modern, yields are close to 4 tons/ha, while in the Selva, with a more labor-intensive technology, yields are around 2 tons/ha (Table 20).

Although the trend in production during the 1966-85 period shows stagnation with no increases in yield nor in area, output grew at an accelerated pace between 1966 and 1976, decreased rather sharply between 1977 and 1980 (by 40.2%) due to a marked crisis in the poultry sector, to rebound in 1980-85 with a total increase in production of 64.7% (Malarin). These changes were associated with the corresponding variations in area harvested.

The rapid modernization of the poultry industry, which started in the sixties, brought about a marked reduction in costs of production, a phenomenon that was accompanied by increased demand for poultry meat and eggs due to the lower relative and real prices of chicken and due to the lack of response in production of other sources of protein. Government support became stronger after 1970 (Malarin). However, with the deep recession of the late seventies the industry faced a crisis that resulted in a 17.2% reduction in output between 1977 and 1979. But the industry recovered to grow at an annual 9.7% in 1980-85.

In terms of value of production, poultry meat represented in 1970 only 11.3% of the livestock subsector and 2.6% of the agricultural sector, while by 1984 those percentages were 26.6% for the livestock component and 7.4% for agriculture (Malarin).

The geographic pattern of consumption of poultry meat is uneven. Metropolitan Lima, with 25% of the population, absorbs 47.5% of total poultry meat. In the rural areas, consumption is 62% below the national average.

After the recession, the industry came out with a more competitive framework since many small industries were forced to merge if they were to survive (82% of existing farms stayed in the market). The economies of scale allowed them to produce their own feed. The market shares of Nicolini and Purina Peru dropped from 30.8% and 22.3%, respectively, in 1976 to 13.7% and 7.2% in 1984.

Table 20. Production of hard yellow maize, Peru.

Year	Area (ha)			Production (t)			Yield (t/ha)		
	Coast	Selva	Total	Coast	Selva	Total	Coast	Selva	Total
1970	104150	49550	153700	309805	78252	388057	2.975	1.579	2.525
1971	109665	46765	156430	340698	73124	413822	3.107	1.564	2.645
1972	107340	46230	153570	338897	75378	414275	3.157	1.630	2.698
1973	91580	46510	138090	307351	73098	380449	3.356	1.572	2.755
1974	87840	47020	134860	306116	76204	382320	3.485	1.621	2.835
1975	103725	40060	143785	352759	67954	420713	3.401	1.696	2.926
1976	116960	46910	163870	405444	83300	488744	3.467	1.776	2.983
1977	113789	52852	166641	406640	96654	503294	3.574	1.829	3.020
1978	74474	61896	136370	268568	110575	379143	3.606	1.786	2.780
1979	78075	79191	157266	269538	138801	408339	3.452	1.753	2.596
1980	49709	71785	121494	173843	127013	300856	3.497	1.769	2.476
1981	61470	81364	142834	228011	161809	389820	3.709	1.989	2.729
1982	57559	97095	144654	227035	171940	398975	3.944	1.974	2.758
1983	60504	105128	165632	210769	200766	411535	3.484	1.910	2.485
1984	88902	109592	198494	349824	220730	570554	3.935	2.014	2.874
1985	69891	105183	175074	287571	207976	495547	4.115	1.977	2.831

SOURCE: Ministerio de Agricultura, Oficina Sectorial de Estadistica.

The animal-feed industry, by 1970, represented, in terms of total value of production, 65% of the agricultural processing industries and 1.2% of the manufacturing sector, while by 1981 those values were 12.4% and 2.45% (Malarin).

By the mid-eighties, poultry feed represented 73% of the total, while it was 92% in 1977 (Table 21). Cattle and "others" have taken up the slack.

Economic feasibility of expanding cassava use. The use of dry cassava in animal-feed rations is common practice in Europe, where current use reaches 4.5 million tons per year, and Asia. It is starting to take place in Latin America, where dry cassava is still an infant industry. Colombia now produces about 5000 tons per year of cassava chips and since 1986 there have been commercial drying floors in Ecuador, Panama, and Mexico.

Economic analysis reveals that, in most Latin American countries, cassava is economically attractive, when compared with local grains, in terms of the various links in the chain of activities: the producer, the drier, and the animal-feed manufacturer.

The procedure of conserving fresh cassava in plastic bags treated with thiabendazole-based fungicide (mertect or tecto) has less commercial empirical evidence although, conceptually, it is obvious that a reduction in marketing costs will take place and that the market will become more competitive. A semicommercial project has been conducted in Bucaramanga, Colombia, with highly successful results, showing that it is possible to reduce marketing margins and offer a higher quality product to consumers at lower prices. Consumers have responded immediately to these changes. Field and transportation trials from Satipo into Lima have shown that the procedure is successful in reducing marketing losses and consequently costs.

The cost structure of fresh cassava in Peru (Table 15) shows a high marketing margin that could be reduced with this treatment. The assumption that fresh cassava consumption will respond to a change in its own price was tested in the demand equation calculated and was accepted (Own-price elasticity of -0.22) (Table 19). Will supply respond to a higher farm price? In a competitive framework, supply for agricultural products responds to changes in price both in the short and in the long term, with long-term changes being more marked. However, in a controlled pricing environment, like the one faced by Peruvian agriculture for the past two decades, the short-term response depends rather heavily on the prices, marketing environment, and stimulus not only for cassava but also for its close substitutes in supply and demand.

Given the current level of technology used in cassava production, it is expected that improvements in its commercialization will stimulate use of better management practices, making cassava a more highly competitive alternative.

Table 21. Industrial production of feed by destination (in tons), Peru.

Year	Poultry	Beef	Pork	Other	Total
1973	576453	29840	37978	33409	678180
1974	635800	32912	41888	37400	748000
1975	652823	33793	43010	38401	768027
1976	697431	36102	45949	41025	820507
1977	681371	19791	26714	8792	736668
1978	468044	12089	22823	13623	516579
1979	363354	19325	40496	30581	453756
1980	544727	49023	43992	49712	687454
1981	591597	39792	34446	50625	716460
1982	670308	50306	44454	49436	814504
1983	570366	43654	58780	53538	726338
1984	435104	32030	73211	54447	594792

SOURCE: Ministerio de Agricultura. Programa de Abastecimiento de Alimentos Balanceados, 1985. DGAC.

The potential of cassava resides in the Selva where conditions are more appropriate to its socioagronomic characteristics: an ability to adapt to marginal soils with low use of inputs, making it a useful low-cost alternative. In coastal areas, where agriculture is highly mechanized and intensive in the use of inputs (for example, irrigation, fertilizer, and herbicides), cassava plays a minor role as a diversification crop against the risk of water shortages. Costs of production are much higher than in the Selva (Tables 22 and 23). Given the high local demand for fresh cassava, few surpluses are generated.

Lambayeque, the most important cassava-producing department in coastal areas, is an importer of the root. It comes in undetermined but important quantities from Machala (Ecuador) whose cassava is preferred to local varieties and therefore carries a higher price. In 1986, cassava from Machala had a retail price of around I3.20 per kilo while the local varieties could be purchased at around I2.50 per kilo. Another curiosity is that prices of fresh cassava in Chiclayo, (the largest city in Lambayeque with 500,000 people) were similar to those in Lima despite the fact that transport costs are much lower than those for Lima.

While a farmer near Chiclayo gets about I2.00/kilo, one close to Satipo (central Selva near Lima) gets I1.20/kilo, in 1986. Transport costs are twice as much from Satipo at I1.00/kilo compared with I0.50/kilo from Chiclayo. Still, cassava from the Selva would be cheaper than that from the north coast when taken into Lima because of the lower costs of production. Besides, the north coast does not have the capacity to respond with important additional quantities of cassava (outcompeting crops such as rice, cotton, maize in the limited areas of the coast).

In the Selva, it is feasible to expect important increases in supply, given the wide availability of land and the low costs of production per unit faced by cassava growers, even under present crop management conditions, which are far from optimal.

The potential of the dried cassava industry in Peru has been analyzed by Malarin, who concludes that dried cassava is profitable to farmers, processors, and feed manufacturers and that it could compete with maize if it were granted the same transport subsidy.

Currently, dried cassava chips have a support price of I2.00 per kilo with ENCI buying them at its warehouses in Pucalpa, Satipo, and La Merced (Selva). The decree was approved in March, 1986. At the time maize from the Selva had a support price of I2.6 per kilo. Therefore, cassava chips were priced at 80% of the price of maize. By mid-1986 the price of maize went up to I3.30 per kilo but that of dried cassava chips was not changed. As a result, maize became a much more attractive alternative to the farmer.

The proposal being presented to the government by the private sector consists in pegging the support price of dried cassava chips to the price of maize at a fixed percentage, namely 75%. An adjustment in the price of maize would imply an automatic adjustment to cassava chips and would protect its profitability for farmers, driers, and feed manufacturers.

able 22. Production cost of a hectare of cassava in the Selva, Peru.

tems	Measure unit	Quantity	Unit price	Subtotal	Total
irect expenses					4,635.69
Soil preparation					396.00
Rozo, tumba, picacheo, quema, shunteo	man-day	22	18.00	396.00	
Seeding					372.92
Furadan 5% G	kg	2	51.46	102.92	
Seed (7000 sticks)	stick	7.000	0.01	70.00	
Seed transport	bag	10	2.00	20.00	
Seed and seeding disinfecting	man-day	10	18.00	180.00	
Weed control					540.00
First	man-day	07	18.00	126.00	
Second	man-day	07	18.00	126.00	
Third	man-day	07	18.00	126.00	
Fourth	man-day	09	18.00	162.00	
Manuring					776.50
Fertilizers (formula 46-30-60)					
Urea	kg	100	3.72	272.00	
Superphosphate Ca simple	kg	150	1.71	256.50	
KCl	kg	100	1.98	198.00	
Fertilizers' transport	kg	350	0.04	14.00	
Fertilizers mixing and application	man-day	02	18.00	36.00	
Phytosanitary control					423.56
Aldrin 2.5%	kg	22	15.98	351.56	
Aldrin application (2)	man-day	4	18.00	72.00	
Harvest					940.00
Container	bag	200	4.00	400.00	
Harvest and transport	man-day	30	18.00	540.00	
ther expenses					[illegible],186.71
Social laws 50.76%	I			965.97	
Unforeseen 5%				220.74	
ndirect expenses					1,334.61
Administrative expenses 8% of direct expenses				370.85	
Financial expenses				963.76	
otal cost of production/ha					5,970.30
ield (kg/ha)					15,000
nit price					0.40
rofit 30%					0.12
arm price					0.52

OURCE: Malarin, H. 1986. Thesis. Univ. Pacifico.

Table 23. Cassava production costs, Peru.

Technical level	: Medium
Seeding time	: December
Harvest time	: August
Agricultural campaign	: 1985-1986
Cost date	: May

Labor	Month	Unit	Units (no.)	Unit price	Total cost
Soil preparation					
	Nov.	Man-day	4	25	100
	Nov.	Man-day	3	25	75
	Nov.	Man-day	2	25	50
	Nov.	Man-day	2	25	50
Seeding					
Selection	Dec.	Man-day	1	25	25
(indirect) seeding	Dec.	Man-day	9	25	225
Cultural labors					
Irrigation	Jan.-July	Man-day	5	25	125
Weed control	Jan.-July	Man-day	7	25	175
Manuring	Jan.-Mar.	Man-day	3	25	75
Aporque	February	Man-day	3	25	75
Phytosanitary control	Jan.-July	Man-day	5	25	125
Harvest					
Manual harvest	August	Man-day	15	25	375
Cargadores	Aug.-Sept.	Man-day	4	25	100
Selection and cleaning	Aug.-Sept.	Man-day	2	25	50
Guardiania	Aug.-Sept.	Man-day	2	25	50
Subtotal of labor					1675
Social laws (46.2%)					773.85
Total labor work					2448.85

Machinery and equipment operation	Month	Type of machinery	Hrs/days (no.)	Unit price	Total cost
Aradura	Nov.	Trac.Rue	2	150	300
Cruzadura	Nov.	Trac.Rue	1	150	150
Surcadura	Dec.	Yunta	1	70	70
Mochila	Jan.-July	Bomba	3	10	30
Total machinery and equipment					550

Inputs	Month	Unit	Units (no.)	Unit price	Total cost
Seed (sticks)	Dec.	kg	760	0.15	114
Fertilizers:					
Urea (46% U.N.)	Jan.-March	kg	90	5.02	451.8
Pesticides:					
Aldrin	Jan.	kg	22	9.9	217.8
Sevin 80% P.M.	Jan.-March	kg	1	211.41	211.41
Azodrin 400	Jan.-March	L	1	193.75	193.75
Water		mil m3	6	5.6	33.6
Total inputs					1222.36

Transportation					
Seeds	Dec.	kg	760	0.05	38
Fertilizers	Jan.-March	kg	196	0.1	19.6
Pesticides	Jan.-March	kg/L	24	0.1	2.4
Product	Aug.-Sept.	kg	12000	0.05	600
Total transport					660

Consolidated direct costs	(DC)		4881.21
Labor cost		2448.85	
Machinery and equipment		550	
Inputs		1222.36	
Transport		660	
Indirect costs	(IC)		1783.6755
Administrative (8% of DC)		390.4968	
Unforeseen (5% of DC)		244.0605	
Financial		1149.1182	
Total cost			6664.8855

SOURCE: CIPA II. May 1986. Chiclayo, Peru.

In Table 24, the gross margins of dried cassava chips versus those of maize in the coast and in the Selva can be observed. Cassava competes with both of them, constituting a viable alternative to farmers.

At 75% of the price of maize at I3.30 per kilo, dried cassava enters in the least-cost ration. It is a cost-reducing alternative, even when cassava chips cost I3.20/kilo or 95% of the price of maize. This is so, because protein in the form of fish flour is cheap and abundant in Peru (Table 25).

Projected demand for cassava

Current trends in food production in Peru point toward an increasing dependence on food imports, decreasing per capita production, narrowing of the alternatives available to consumers, high levels of market power concentration in the food-processing industries, and a continuing deterioration of the participation of agriculture in GDP. This scenario is not only undesirable as a goal but it is probably unrealistic for a country with strong constraints in its availability of foreign exchange.

Basic assumptions. Using a model for the demand of cassava and of poultry meat, estimated from time series data, we can project cassava consumption needs (in both fresh and dried forms) into the future. From the basic model:

Per capita consumption = function (Prices, Income, Urbanization)

one can assume changes in the independent variables, and calculate the new levels implicit in the dependent variable.

For the case of fresh cassava demand, three prices were assumed to exhibit price decreases in real terms, that affect this variable. They are the retail prices of cassava, rice, and wheat products. Also, while total population grows at 2.5% per year, urban population (a "proxy" for urbanization) grows at an annual 3.0%. Per capita real income remains constant, that is, real income grows at 2.5% per year.

With respect to the demand for poultry, assumptions for population and income growth are the same as above and the real retail price of poultry decreases at an annual 1.0% while those of beef and pork remain constant (Table 19). The derived demand for cassava is based on the assumptions that feed use by the poultry industry will keep its present ratio of broilers and layers, and that feed for poultry will represent a constant 80% of total feed use in the country. Coarse grains (yellow maize and sorghum) represent 45% of feed formulas (Table 25). Internal production of yellow maize will grow at an annual 2.0% (compared with 0.4% over the 1966-83 period).

Fresh cassava. Prospects for carbohydrate output destined for human consumption are alarming. The strong performer of the past 15 years, rice, reached a peak in 1984 with over one million tons of production, decreased in 1985 and again in 1986 when about 350,000 tons of this cereal were imported. Potatoes, a major staple, exhibits important reductions in per capita consumption, from about 130 kilos in ble 24. Separation of direct cost of production for maize (coastal and Selva) and for dried cassava chips (Selva), 1986. Peru.

st in Intis

rop	Technology	Land	Labor	Capital	Transport	Total	Price	Margin
ize	Coast	150.00	590.88	1786.58		2377.46	3300	922.54
	Selva	30.00	1083.28	727.21		1810.49	3300	1489.51
esh cassava	Selva	11.43	492.23	306.88	0.00	799.11		
ied Cassava	Selva	0.20	110.24	26.90	150.00	137.34		
tal dried cassava						936.45	2000	1063.55
			at 75% price of maize				2475	1675.89

nd rent in coast: I0.1200/ha per year or I0.600/ha per semester
nd rent in Selva: I0.120/ha per year

st in US$(I13.9 = US$1)

rop	Technology	Land	Labor	Capital	Transport	Total	Price	Margin
ize	Coast	10.79	42.51	128.53		181.83	237.41	55.58
	Selva	2.16	77.93	52.32		132.41	237.41	105.00
esh cassava	Selva	0.82	35.41	22.08	0.00	58.31		
ied cassava	Selva	0.01	7.93	1.93	10.79	20.67		
tal dried cassava		0.84	43.34	24.01	10.79	78.98	143.88	64.90
				at 75% price of maize			178.06	99.07

etail of cost structure for dried cassava chips in the Peruvian Selva (H. Malarin, 1986)

oductive unit	Farmer, 1 chipper
nths of operation	9 months
w material	345.6 tons of fresh cassava
st of raw material	0.52 Intis/kg, 25% above production cost
ount cassava chips for conversion from fresh to dried	138.24 tons at 15% humidity

erall costs (in Intis)	
anufacturing costs	
Raw material (fresh cassava)	179,712
Labor (2 workers for 216 days at I35.3 per day	15,240
Depreciation (10% of 5000)	500
dministrative and financial costs	
Transport to feed plant (I0.150/ton)	20,736
Interest and principal on equipment	3,718
tal cost	219,906
Unit cost per ton of chips	1,591
Unit price with 25% overhead margin	1,988
Current support price I/ton (June 1986)	2,000

URCE: Malarin, H. 1986. Thesis.

Table 25. Least cost formulations (percent of ingredient in total rations), including use of dried cassava chips, Peru.

Price of maize (Intis/ton)	3300	3300	3300
Price of cassava chips (Intis/ton)	2600	3000	3200
Maize	6.82%	17.89%	45.82%
Cassava chips	45.92%	32.18%	0
Cotton cake	10.00%	10.00%	10.00%
Fish meal	15.00%	15.00%	12.78%
Calcium carbonate	0.65%	0.69%	1.01%
Vegetable oils	1.50%	1.50%	1.50%
Feather meal	19.65%	22.34%	28.49%
Lysine	0.05%		
Methionine	0.02%		

SOURCE: Compiled by author from prices listed by H. Malarin, and physical requirements listed by NRC, Feedstuffs Ingredient Analysis Table: 1981 edition. (Prepared by Richard D. Allen).

the early seventies to near 70 kilos in the mid-eighties. Wheat, another staple in the diets of urban consumers is mostly imported, with domestic production representing less than 10% of total use and declining in absolute numbers.

Should current policies and marketing and production practices continue, these trends will prevail. But we can be optimistic about the adoption of the new cassava storage technology, based on survey data collected in Lima, and in Colombia and also in the pilot projects conducted in those two countries.

The immediate future for adoption of the new technologies lies in the Selva, where cassava is already an important staple. The new technology of storing cassava in plastic bags and treating it with mertect can be implemented in this area where 75% of the cassava is produced. The target population initially will be the 3.5 million people living in Loreto, Ucayali, San Martin, Cajamarca, Amazonas, Huanuco, Pasco, Junin, Cuzco, and Madre de Dios. A second stage of adoption could take place in the north coast for local consumption. The final stage would be the extension, from the coast, of adopting the method for coastal cities such as Lima.

The effects of adopting the new technology would be to increase market competition by reducing natural and artificial barriers of entry already present in the current market structure. The barriers result from the high perishability of cassava. Their removal would reduce marketing margins because of important reductions in waste (from about 35% to 15%), and therefore would carry the consequent savings to consumers (who would pay a lower price) and to farmers (who would receive a higher price), and to increase volumes being traded (Janssen and Wheatley).

The above-mentioned assumptions about prices, income, and population lead to an estimated per capita consumption of cassava of 14.3 kilos by the year 2000 (compared with 18.2 kilos in 1984). This is due to the substitution effect caused by wheat and rice but mainly due to the negative effect of urbanization on consumption--an effect that should lessen but not disappear with the implementation of the new storage technology. This is so because of the difficulty in reaching coastal populations (the majority of Peruvians live in the coast) from the Selva with a bulky commodity. Even so, there will be a need to expand production by 19,700 tons in that year to meet demand due to population growth. This figure would be larger if we do not incorporate a reduction in waste of 10% as being additional supply.

Savings associated with this level of waste reduction amount to about US$15 million annually by the year 2000. Although this increase is not impressive one has to bear in mind that it represents a reversal of the strong trend in reduction of cassava production over the past two decades.

Dried Cassava. The current interest of the government in providing a viable alternative to yellow maize in the manufacture of feed formulas is notorious. A decree in mid-1986, providing a support price for dried cassava chips and dictating the norms for quality, is certainly an encouraging sign. We have shown that dried cassava in Peru is:

Profitable at farm level under the present price and cost structure of the country for fresh cassava as well as for yellow maize. To compete with maize, the support price for cassava chips has to be pegged to that for maize (plans are to set it at 75% of the price of maize).

Profitable at the feed plant level. Dried cassava enters in the least-cost formulations at around 95% of the price of yellow maize (its main substitute).

Attractive to the end user, since quality remains virtually unchanged.

The farm price of fresh cassava, currently well above the support price of chips, fluctuates widely, depending on availability and transportation. In periods of high rainfall, in certain areas of the Selva when roads cannot be used, the producer price of fresh cassava drops substantially while at the other end of the chain consumers must pay high prices.

Production of cassava chips will create a floor price for the fresh root, stabilizing quantities produced as well as prices.

Identification of suitable areas for drying compatible with precipitation regime and land-use priorities remains to be done. However, semicommercial trials have been successful and no problems are expected in this respect (Malarin).

To estimate feed needs, pork and poultry meat production are projected to the year 2000, using time series data. Per capita pork consumption remains unchanged while for poultry the assumptions imply an increase in per capita consumption from 9.2 kilos in 1984 to 12.6 kilos in the year 2000.

In terms of feed requirements, total needs will go from 633,700 tons in 1984 to 1,289,600 tons in 2000, mostly due to poultry feed increases. With 10% of dried cassava in feed formulations, 128,960 tons of it are needed. The establishment of the industry allows a further decrease in waste of cassava for the fresh market of 10%.

By the year 2000, fresh cassava for the feed industry will amount to 280,559 tons per year which implies 26,720 ha of new plantings, keeping yields at the present level of 10.5 tons/ha. Crop losses will be reduced by 41,829 tons annually by that year.

In summary, if both markets (fresh and dried), are added up, annual requirements of cassava by the year 2000 will be 657,020 tons, which implies an additional production of about 301,020 tons per year in 28,592 ha and 7,378 new jobs will be generated.

Conclusions

Peru was radically transformed during the seventies from a social system characterized by liberal principles and policies to one with a very tightly controlled and distorted economy. Agriculture was hard-hit in the process. The once high-yielding crops by Latin American standards are now mere average performers (sugar, cotton, rice). The sector reduced its contribution to GDP by half in the past two decades and now represents 12% of the product.

Policy-induced distortions and state interventions eliminated not only foreign competition but domestic competitive forces as well. While the world economy was booming in the sixties and seventies, Peru lost a clear opportunity to continue the growth impetus of the fifties.

Valdes and Alvarez conclude that "the prevalence of implicit and explicit food subsidies on importables, particularly during the period 1970-75, could have induced a change in consumption patterns away from traditional foods produced in Peru, such as potatoes, and towards heavier dependence on imported foodstuffs, such as macaroni and bread. Policies aimed at protecting the urban consumer but ignoring the consequences of an increased fiscal burden would have resulted in the implicit taxation of several agricultural products" (p. 49).

Cassava is a major staple in the Selva, where it competes favorably with other crops, even under the present policy environment. For dry cassava chips, its potential demand will be materialized into effective use if the support price already established by the government is set as a fixed proportion of the price of yellow maize and if ENCI buys the chips, following the same guidelines applied to the commercialization of local yellow maize. In such a case, it has a bright future as an animal feed input in Peru.

The case of fresh cassava requires the implementation of the new conservation technology developed at the Centro Internacional de Agricultura Tropical (CIAT), Colombia. The method is being tested now in Satipo-La Merced. The method should be introduced first in the Selva, where a strong natural market already exists. Once the markets have assimilated the new technology and producers have responded by becoming more efficient in their production and marketing techniques, fresh cassava stored in plastic bags and treated with mertect will be ready to reach coastal consumers.

Under the existing set of policies that block the regulatory effects resulting from the presence of competitive forces, it is unlikely that an improvement in resource allocation and adoption of new technologies in neglected crops will take place, unless the crop is subject to similar treatment as the one presently received by grains and cereals. In addition to that, developments in infrastructure, for example, in roads such as the Carretera Marginal de la Selva and the road linking the northern Selva with the northern coast, are urgently needed if there is to be a more balanced regional and sectoral growth in the near future.

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VENEZUELA: POTENTIAL DEMAND FOR CASSAVA

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Macroeconomic Policy and Agriculture

To better understand the agricultural development of Venezuela, we will briefly review how the country's economy has evolved and the set of global policies that have shaped it, so that later we can concentrate on the set of specific policies that affect the agricultural sector.

Economic policy context

By 1985 Venezuela had a population of 17.4 million people, (81.3% urban) a per capita GDP of US$2,451 (in 1984 dollars), international reserves of US$12.5 billion, a total disbursed external debt of US$30 billion, exports of goods and services of US$14.3 billion, and imports for US$6.7 billion for a positive balance of US$7.6 billion in current accounts (Table 1).

Greatly increased oil revenues in the 1970s catapulted the country from the status of a developing country into the ranks of a middle-income nation. Oil constitutes the basis of the economy accounting for about 75% of government revenues and over 90% of export earnings.

Recent growth of the Venezuelan economy can be divided in three periods: 1958 to 1973, 1973 to 1978, and 1978 to present. The first period started with the installation of the democratic regime of Romulo Betancourt. The new policy of import substitution was formulated, following Prebish's theories on the subject. Real GDP grew annually at 5.5% during the 1958-73 period while agriculture had a similarly strong growth of 4.3%. The livestock sector was especially dynamic growing at 6.6% per year while crops grew 2.7% annually (Table 2).

In 1973, oil prices boomed and the economy's pace was accelerated with real GDP growing at 6.3% per year from 1973 to 1978. The livestock sector continued its remarkable expansion at 7.3% while crops grew at 5.0% (Table 2).

After 1978 the country entered a recession that was characterized by a sharp fall in oil export income, combined with an inability to continue borrowing abroad, an expanded foreign debt burden, an overvalued currency, and massive capital flight. A financial and foreign exchange crisis occurred in early 1983. Foreign reserves went from US$19 billion in 1981 to less than US$7 billion in 1983. Exchange controls, devaluation, and austerity measures brought the country's external accounts into balance.

In 1978-85, real GDP decreased at an annual rate of -1.5% while agriculture as a whole grew annually at 1.7%. The crop value of production had no significant trend (0.3% annually) while livestock continued to outpace most of the activities at 3.1% per year (Table 2).

The policy environment

Agriculture in Venezuela has been affected by what is known as the "Dutch Disease." The large influx of foreign exchange resulting from a

Table 1. Statistical profile of Venezuela

Area (km^2)				898.805	
Population: total 1985 (81.3% urban)				17,335,000	
Annual growth rate 1970-85				2.9	
Birth rate (1984)				29.9	
Mortality per 1000 inhabitants (1984)				4.6	
Infant mortality per 1000 live births (1984)				27.3	
Life expectancy at birth (1984)				58.6	
Percentage of literacy (1984)				85.95	
Labor force by sector (1985)				(Percentages)	
Agriculture				14.5	
Mining				1.3	
Manufacturing				15.7	
Construction				8.6	
Others				59.9	
	1981	1982	1983	1984	1985[a]
Beef production			(Growth rates)		
Total GDP (market prices)	-03	0.7	-5.6	-1.4	-0.4
Agricultural sector	-1.9	3.6	0.4	0.8	7.0
Mining sector	-2.5	-10.2	-6.3	1.9	-4.8
Manufacturing sector	-2.5	4.1	-1.7	4.6	3.3
Construction sector	-2.1	-8.4	-13.3	-34.4	-17.4
Central government			(Percentages of GDP)		
Current revenues	32.5	26.9	24.7	28.5	28.6
Current expenditures	19.9	18.7	18.6	19.8	19.5
Current savings	12.6	8.1	8.1	8.7	9.1
Capital expenditures[b]	14.6	13.0	8.4	6.0	6.9
Capital or surplus	-2.0	-4.9	-2.3	2.7	2.3
Domestic financing	2.4	2.2	2.8	-1.4	-2.3
Money, prices and salaries			(Growth rates)		
Domestic credit	10.5	22.4	6.2	13.3	-7.8
Public sector	36.7	86.9	76.1	n.a.	n.a.
Private sector	9.1	12.7	5.5	16.7	8.1
Money supply (MI)	9.5	5.6	20.7	23.8	5.8
Consumer prices (annual average)	16.0	9.7	6.3	12.2	12.0
Real wages	-5.4	-0.1	-7.2	-5.2	n.a.
Exchange rate			(Annual average)		
Official rate (national currency units per dollar)	4.30	4.30	4.30	7.02	7.50
Real effective exhange rate (index 1980=100)	91.2	85.7	90.7	115.4	112.6
Terms of trade (Index 1980=100)	99.0	98.3	95.2	101.5	99.0
Balance of payments			(Millions of dollars)		
Current account balance	3.9999.7	-3.999.2	4.426.7	4,970.3	3,927.0
Merchandise balance	7.840.2	2.588.9	8.161.8	7.973.6	7.604.0
Merchandise exports (FOB)	19.963.2	15.386.2	14.570.5	15.850.8	14.197.0
Merchandise imports (FOB)	-12.122.9	-12.797.4	-6.408.7	-7.877.2	-6.593.0
Net services	-3.431.4	-5.985.8	-3.524.5	-2.824.9	-3.535.0
Transfers	-409.2	-602.2	-210.6	-178.4	-142.0
Capital account (net)	-1.881.9	-1.656.9	-4.098.5	-3.506.6	-2.577.0
Change in net reserves (- = increase)	20.0	7.692.6	-336.7	-1.567.2	-1.350.0
External public debt			(Millions of dollars)		
Disbursed debt	11.382.0	12.122.5	12.911.4	17.248.6	n.a.
Debt service actually paid	2.588.3	3.220.8	2.655.8	2.536.4	n.a.
Interest payments/export of goods and NFS	5.9	11.1	10.9	8.6	n.a.

a. Preliminary estimate
b. Capital revenue is taken into account in calculating the deficit.

Table 2. Annual growth rates (%) of real gross domestic product in agriculture and its subsectors.

Period	Total	Agriculture	Crops	Livestock
1958-73	5.5	4.3	2.7	6.6
1973-78	6.3	4.7	5.1	7.3
1978-85	- 1.5	1.9	0.3	3.1

spectacular rise in oil prices (from around US$5.00 per barrel in 1972 to near US$40 in 1979) brought about a spending effect which raised the demand for both tradeables and nontradeables and increased the prices of the latter with a consequent appreciation in the exchange rate (Valdes, p. 170). In addition, resources have been sucked into the booming sector, moving labor from agriculture to the services and government sectors. Urbanization has occurred at an accelerated pace since the 1930s (Table 3). At the same time a rising demand for food products emerged.

Under those circumstances, government actions to redirect resource allocation become crucial to stimulate growth in the non-oil sectors of the economy and particularly in agriculture, which is directly affected by the rural-urban migration.

The major policy tools devised by the government have to do with the administration of oil-related activities. Extractive industries have been nationalized. A special fund (Venezuelan Investment Fund) was created primarily for investment abroad in order to avoid internal fluctuations related with changing conditions in the oil market, and as a regulatory fund.

To compensate for the disequilibriums brought about by the oil sector, the government has operated a vast set of complementary tools ranging from exchange rate policy, to price controls, fiscal incentives, credit research and extension, and commercialization, all designed to stimulate industry and agriculture.

Exchange rate policy has been characterized by fixed rates with the U.S. dollar throughout most of the past three decades. Two exceptional cases occurred. In 1960, shortly after the democratic regime of Betancourt came to power, exchange rate controls were necessary to avoid capital outflows. By 1964 the controls were eliminated and the Bolivar had been devaluated from Bs3.35/US$1.00 to Bs4.50/US$1.00.

In 1983 the financial and economic crisis that followed the sharp reductions in oil incomes and the rise in international interest rates made government intervention in the exchange market imperative. A progressive devaluation of the bolivar (within a multiple-rate system) and sharp restrictions of imports through import and foreign exchange control were established.

Agriculture in Venezuela

The agricultural sector in Venezuela contributes 7.4% to the GDP, and occupies 18% of the labor force. By subsectors, livestock contributes 3.4%, crops 3.3%, fisheries 0.2% and the rest of the agricultural sector has a 0.3% share of GDP. In addition, 45% of the manufacturing sector is composed of the food industry; this implies an additional 9.4% contribution to the GDP by the food and fiber sector of the country.

Urbanization took place at a rapid pace going from 26% of the total population in 1920 to 81.3% in 1985. Traditionally, the country has been a food importer. In 1950 nearly 30% of the agricultural supply was imported while in 1985 this increased to 50%.

Table 3. Evolution of exports and population composition in Venezuela, 1920-1980.

	Percent of exports		Percent of population	
Year	Coffee-Cocoa	Oil	Rural	Urban
1920	92.0	2.0	74.0	26.0
1930	15.0	83.0	65.3	34.7
1940	4.0	94.0	60.6	39.4
1950	3.0	96.0	46.6	53.4
1960	2.0	90.0	32.6	67.4
1970	0.8	90.2	24.3	75.7
1978	-	82.5	24.3	75.7
1980	0.2	92.0	23.9	76.1

SOURCE: Dirección General de Estadísticas.

In the 1920s, Venezuela was heavily dependent upon agriculture (36% of GDP) and 95% of exports and 75% of the population lived in the rural sector. In the 1930s, the country's economy shifted to the mining sector, with special emphasis given to oil- and steel-based activities (Table 3).

In the 1950s, the country saw an important influx of immigrants. The military regime resettled about 400,000 Europeans and 40,000 Colombians in 1950-58 through IAN (Wright, 1982). These immigrants were responsible for a dynamic real growth of the sector during the period (annual rate of 6.0%) while total GDP grew at an annual rate of 8.4% also in real terms. One-half of the growth in agriculture was made up by the livestock sector (dairy, cattle, and poultry) (World Bank, 1961). By 1944, Protinal, the largest animal-feed firm had been founded. In a welcome environment, multinational firms established and expanded subsidiaries which had formerly had a market for their products as imports in Venezuela: milk, milling, feed, and processed food firms (Wright, 1982).

In 1958, under the democratic rule of Betancourt, the new policy of import substitution, Prebish-style, was formulated. The basic idea was that the new, reliable processing sector could enlarge the market for agricultural raw materials that could be produced internally. In turn, the agricultural sector provided food for a rapidly growing urban population, making income available for the agricultural sector to purchase the products of new industries and allowing savings to be transferred to the industrial sector.

Cordiplan, (an agency at the level of presidential secretary), was created to implement planning on a national basis. The Agrarian Reform Law of 1960 was implemented. About 74% of all land redistributed was publicly owned (5.6 million hectares) as compared with 1.9 million ha of private-property redistribution between 1960 and 1970. Therefore there was no change in the land tenancy structure. Policies benefited mostly farmers with holdings of 500 to 2,499 ha (Wright, 1982), through directed subsidized credit, extension, and insurance programs. The land title situation was unclear in about one-third of the cases, disallowing those farmers to obtain access to main policies of credit and extension.

The process of food industry integration and diversification was also accompanied by an increased market-power concentration in that sector. Throughout the past two decades, three firms have controlled 80% to 95% of the market for feed and another three firms 85% of the market for wheat flour. Inputs for these industries were based on crops grown in temperate climates. Little research was done concerning the substitution of other crops suitable for local conditions previous to 1968, and little use of available evidence has been made to incorporate cassava or rice into their technology (Wright, 1982).

Agricultural production responded well to the incentives. Its value grew in an accelerated fashion and was followed by a reduction in agricultural imports. The percentage of agricultural imports in total consumption in 1958 was 45%, in 1960 this decreased to 32.7%, and again in 1970 to 25.2%.

Tremendous growth took place in products used as inputs to the food processing industry (rice, sesame, cotton, sugar cane and tobacco) also, in those destined to urban consumption (livestock products and vegetables).

The seventies witnessed a reversal in food import trends. Real crop production declined in 1970-73 by 1.1% per year but the decline was partially compensated for by a 4.2% growth in the livestock subsector. Although food production was reactivated after 1974 in response to the extraordinary increases in investments coming from the booming oil prices, demand outpaced production and agricultural imports increased dramatically (Table 4).

This process was curtailed by the sharp reduction in oil prices and rapid growth in the cost of funds in international money markets initiated in 1979. The economic and financial crisis that followed led to a control on foreign exchange and the establishment of a multiple-exchange rate system.

The multiple rate system enforced had a free market rate for dollar transactions with the Banco Central de Venezuela and two preferential rates. The preferential rate for agricultural imports (both products and inputs) and debt payments was at Bs4.30 per U.S. dollar. For other imports, which were severely regulated by prohibitions, prior licensing, and quotas, a preferential rate of Bs6.00 per U.S. dollar was set.

To avoid inflation, and given the large import component in the diets, particularly by the least-favored sectors of the economy, a system of administered prices was imposed. Finally, external debt payments were restructured.

Signs of improvement have already been recorded. Imports, that reached US$13.6 million by 1982 were US$6.6 million in 1985. Agricultural production grew fast spurred by area that increased from 1.5 million ha in 1983 to 1.8 million ha in 1985. Inflation has remained low (6% for 1985), but unemployment is high at around 13% (up from 9.5% in 1982).

Specific agricultural policies

The main goals of agricultural policy still are to substitute imports and foster domestic food production, to expand the agricultural frontier, and improve productivity and profitability in the sector.

Specific instruments used, along with the exchange rate system described, are price controls and commercialization, credit policies, and research and extension.

Price controls. Given the importance that imported foods have on the diets of the Venezuelans and the high concentration they have in the processing industry, the government has felt the need to implement controlled consumer prices for several food items over the past three decades. Dairy, wheat, maize, rice, and livestock meats and their processed products have been the target items.

Table 4. Agricultural imports and production in Venezuela, 1970-78.

Year	Value of agricultural production (Millions of 1960 Bs)	Imports of processed and nonprocessed agricultural goods (Millions of 1960 Bs)
1970	4,137	1,471
1971	4,197	1,248
1972	4,141	1,393
1973	4,355	2,021
1974	4,663	2,912
1975	5,005	3,981
1976	4,922	3,650
1977	5,306	6,141
1978	5,634	6,450

SOURCE: BID, FCA Project. 1984.

Recent price controls have not stimulated consumption of locally produced foods (rice, beef, roots and tubers, etc.) in favor of the imported ones (mainly wheat and coarse grains) by shifting consumption to the latter group and contracting the demand for those produced locally (Tables 5 and 6).

A look at price evolution shows an increase for agricultural commodities with respect to other items in the rest of the economy. This shows the great effort given to promote food production by creating a profitable environment.

In the 1968-83 period the wholesale price index showed:

General index	258.8%
Agriculture	376.3%
Manufacturing	232.8%
Machinery and equipment	207.3%
Chemical products	144.0%

This list shows that agricultural inputs have lagged in price increases making agriculture more profitable. Also, given that 45% of the manufactured output comes from food processing, the subsidy structure seems to have neutralized the higher input costs to this industry, in favor of consumers.

Two cases are quite relevant. White rice (5% broken grains) had a consumer price increase of 55% in 1980-84 to reach Bs8.50/kg while wheat flour had a 20% increased to reach Bs3.50/kg, and pasta had no increase to remain at Bs7.00/kg.

White maize flour, with over 70% of local corn content increased by 85% in those four years to reach Bs6.50/kg while yellow corn flour, with 95% imported corn content increased by 27% to close at Bs3.50/kg.

Let us take a look at price discrepancies as of 1984 and 1985 for some imported items.

	1984 (Feb)		1985 (Dec)	
	Minimum farm price	Import price at Bs4.30/US$1.00	Minimum farm price	Import price at Bs7.50/US$1.00
White corn	1,800	Bs697 US$162.00	3,000	Bs1,125 US$150.00
Yellow corn	1,600	Bs654 US$152,00	2,800	Bs1,058 US$141.00
Wheat		Bs702 US$163.25		Bs1,268 US$169.00
Sorghum	1,400	Bs606 US$141.00	2,200	Bs1,013 US$135.00

Table 5. Food items[a] that increase in consumption at lower income strata in Venezuela.

	Region			
	Carabobo	Zulia	Yaracuy	Portuguesa
Products	Pasta (1)	Pasta (1)		Pasta (1)
	Pulses (1)	Pulses (1)	Pulses (1)	Pulses (1)
	Sugar (1)	Maize (1)	Maize (1)	Maize (1)
	Soft drinks (1)	Sugar (1)	Eggs (1)	Soft drinks (1)
	Poultry (1)	Vegetable oil (1)	Powdered milk (1)	Fish (3)
	Eggs (1)	Fish (3)		Eggs (1)
	Embutidos (2)	Powdered Milk (1)		
		Embutidos (2)		

a. 1 = high-import component; 2 = medium-import component; 3 = low-import component.

SOURCE: FUNDACREDESA.

Table 6. Percent distribution of calorie and protein contribution for the diet according to the most important products in Venezuela, 1982.

Product	Calorie distribution (%)			Protein distribution (%)		
	Total	Local	Imports	Total	Local	Imports
Rice	7.74	7.74	-	5.69	5.69	-
Maize	14.64	2.77	11.87	10.77	2.04	8.73
Wheat	15.88	0.12	15.76	21.22	0.17	21.05
Caraota	1.61	0.47	1.14	4.28	1.24	3.04
Beans	0.19	0.19	-	0.62	0.62	-
Vegetable oil	10.95	3.07	7.88	-	-	-
Ocumo	0.20	0.20	-	0.12	0.12	-
Potato	0.87	0.78	0.09	0.80	0.72	0.08
Cassava	1.35	1.35	-	0.37	0.37	-
Avocado	0.23	0.23	-	0.07	0.07	-
Cambur	2.78	2.78	-	1.64	1.64	-
Oranges	0.46	0.46	-	0.31	0.31	-
Pineapple	0.07	0.07	-	0.02	0.02	-
Plantain	1.93	1.93	-	0.69	0.69	-
Onion	0.15	0.15	-	0.18	0.18	-
Tomato	0.10	0.10	-	0.29	0.29	-
Sugar	15.91	4.79	11.12	-	-	-
Cacao	0.20	0.20	-	0.22	0.22	-
Coffee	0.06	0.06	-	0.28	0.28	-
Total percent	75.32	27.46	47.86	47.57	14.67	32.90
Vegetable sector percent	100	36.46	63.54	100	30.84	69.16

SOURCE: INN. CORDIPLAN.

A contradictory situation emerges when the government intends to stimulate local production through high prices and also wants to keep the price of food low to the urban consumer. The higher the national component in the processed foods, the higher the cost to the manufacturer. As a result, there will be inflationary pressures or direct subsidies will have to increase (Table 7).

In 1984, the preferential exchange rate system cost the government Bs3,000 million (US$230 million) (Hernandez).

Commercialization policies also changed drastically with the elimination in 1985 of the Corporación de Mercadeo Agrícola (CMA) which had been created in 1971 to ensure adequate supplies of food to consumers at affordable prices by importing food to cover domestic shortages; buy local production at minimum set prices and provide cleaning, drying, and storage. Three products were most-favored by this institution: maize, sorghum, and rice. In the seventies, CMA increased its market participation by buying up to 75% of rice, 70% of sorghum, and 65% of maize production.

From its creation CMA absorbed nearly US$8,500 million, which could be accounted for by direct subsidy transfers, red tape costs, and plain inefficiency.

The elimination of CMA implies that MAC handles import licenses and grains are imported directly by users. The Corporation directly handled imports until 1979 at which time the private sector took over, previous license approval from CMA.

A concerted price policy, to reduce the inflationary impact on the consumer while local production reacts favorably to the stimulus created, is in effect. A mixed body, including the ministers of agriculture, finance, and the treasury, along with processors and producers, tackle prices and problems making "changes without decrees" (Latin America Weekly Report, Sept. 1985).

Starting in 1983, the government decided to completely eliminate the direct price subsidies even for basic food items. The last one to go was the dairy subsidy, in mid-1984. Other subsidies eliminated were those protecting rice, maize flour, vegetable oils, and feed grains.

To compensate for this direct subsidy elimination, important reductions in input costs were established. Therefore, interest rates, the rediscount rate for agricultural loans, were reduced and a 50% subsidy on fertilizers was approved. Fertilizer subsidy had been eliminated in 1981 but after a tripling of its price, the subsidy was reinstated.

A package of special credit, extension, and crop insurance policies have been designed to cover priority items in an effort to reactivate their local production in the mid-term. The most relevant are cereals (rice, maize, sorghum), oilseeds, pulses, livestock products, and the traditional export crops (coffee, cocoa, and sugar cane).

Credit policies. Traditionally, this tool has concentrated its efforts in supplying cheap, abundant credit to large producers and food

Table 7. Internal to international price ratios in Venezuela, 1972-82.

Item	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Maize	-	1.00	1.22	1.22	1.65	1.56	1.56	1.85	2.46	2.64	3.21
Sorghum	1.00	0.79	0.71	0.97	1.22	1.54	1.41	1.15	1.16	1.47	1.93
Sugarcane	-	1.00	0.55	4.19	1.18	1.48	1.64	2.34	0.95	1.53	2.95
Beef	-	1.00	0.91	1.04	1.08	0.87	-	-	-	0.99	1.01
Dairy	-	-	-	1.00	1.37	1.45	1.36	1.28	1.80	1.41	1.41
Pork	-	-	-	-	1.00	1.16	0.72	1.08	0.85	0.99	1.01

SOURCES: 1982 Statistical Yearbook, IMF
MAC, Anuario Estadistico

processors, neglecting the small farmer (Wright, 1982). In 1975, Banco Agrícola y Pecuario (BAP) was redesigned in an effort to give better coverage to small and larger farmers. Two institutions took over its functions: ICAP, basically oriented to small and medium farmers and BANDAGRO, created in 1969, dedicated to larger producers and food processors.

In 1974, FCA (Fondo de Credito Agropecuario) was created to supply infrastructure and farm machinery credit for the agricultural sector under MAC. It does not grant direct credits; rather, they are channeled through other institutions.

Presently, commercial banks are obliged to place 22.5% of their portfolios in farm loans, 17% to growers, and 5.5% to the agroindustry.

In 1984, the government reformed the banking laws, lifting the repayment limit from 5 to 10 years, with 3 years grace. Interest rates for farmers were reduced from 11.7% to 8.5% at Bandagro. They have been at 3% for ICAP loans.

Credit recovery has always been a problem. With the new measures taken, repayment has improved substantially to about 90% for commercial growers and 75% for campesinos. Regional managers of ICAP offices are now evaluated, among other criteria, on the basis of credit recovery. This brought as a consequence a reduction of loans granted to risky crops (such as cassava) and in favor of secure ones (grains). For grains, loans can be recovered at sales time, given the nature of the commercialization process. For cassava, marketing is not centralized at storage points and there is no defined harvesting time. So, the practice of discounting the value of the loan is not viable. Therefore, lenders have absolutely no control over cassava sales.

Even the system to provide credit to small farmers constitutes a tool to divert Venezuelan agriculture away from its traditional crops and into the new (ecologically maladapted) food and feedstuffs.

The total amount of credit directed to agriculture reached its peak in 1977 to drop by almost Bs2,000 million per year thereafter (Table 8). At the same time, fiscal outlays for agriculture went from 8.7% of the total in 1974-78 to 6.0% in 1979-83, reflecting changes in priorities that coincided with austerity policies and monetary restraint.

In 1984, major revitalization actions for agriculture included: payment of government agricultural debt to producers; expanding the availability of preferential private and public bank credit; 50% subsidy on fertilizer prices; increased output prices for a selected set of agricultural items (cereals, pulses, livestock products); and an import-quota system to ensure purchases of domestic production by the food-and feed-processing industry.

Crop insurance is an added policy element designed to attract investment into agriculture. In 1980, Congress created AGROSEGURO with the shareholders being FCA and IAN. The insurance covers total or partial losses in rice, maize, sorghum, cotton, and peanuts, when they are due to

Table 8. Financing of public and private entities in the agricultural sector (millions of bolivars) in Venezuela, 1975-1982.

Year	Commercial bank	Public entities				Total financing (Bank + total)
		BANDAGRO	ICAP	FCA	Total	
1975	672	917	917	1,204	2,890	3,562
1976	3,242	691	951	329	1,971	5,213
1977	3,725	1,112	1,130	227	2,469	6,194
1978	1,425	1,305	1,319	295	2,919	4,344
1979	398	1,690	1,097	483	3,270	3,668
1980	1,411	1,895	1,322	264	3,481	4,892
1981	1,777	1,493	1,629	201	3,323	5,100
1982	1,280	1,389	1,188	272	2,849	4,129

SOURCE: Banco Central de Venezuela, Informe Económico de 1979, 1981, y 1982. Fondo de Crédito Agropecuario, Oficina de Planificación.

uncontrollable natural causes. Livestock deaths of the same nature are also covered.

Also, FCA covers losses of financial intermediaries when MAC declares proved disasters to qualify under the program. Maximum coverage limits have been defined for livestock, fisheries, coffee, cocoa, oilseeds, cereals, sugar cane, and fruits. Roots and tubers are not included in the list.

Government expenditures. government expenditures in agriculture per hectare by 1980 were the highest among 10 countries In North and South America surveyed by Elias, and government expenditures on agriculture per person employed in agriculture were second only after the US. Expenditures in research and extension increased rapidly in the fifties to stabilize thereafter until 1977, the last datum available, at about US$50 million (1960 dollars) per year. Irrigation expenditures also grew tremendously in the period of analysis presented by Elias (1950-80).

The research institution FONAIAP has 5 regional centers and is based in Maracay. In 1980, MAC established the Integrated Program for Agricultural Development (PRIDA) which gives technical assistance to campesino organizations.

Concluding comments

The political and economic forces behind the present import substitution strategy are quite complex. Food processors, which are, for the most, direct importers of their own raw material, exhibit a good deal of market power concentration. They exert effective pressures on policy makers to protect their own interests. This has probably been the reason behind an increasing specialization, both in terms of production and consumption, of a few imported items that are used as inputs for the local processing firms. Jaffe and Rothman (1977) concluded the following:

"In general, the terms of interchange are heavily biased in favour of industry, creating a distorted economic structure with an increasing economic and technological dependence upon industrialized countries. The changes in food consumption pattern are clearly part of this complex and, therefore, part of the distorted economic structure, which in the final analysis is the basis of underdevelopment.

Some of the elements defining this implicit food policy, which emerge from our analysis, are:

The change towards high-import content and ecologically maladapted foods.

The tendency towards manufactured foods incorporating a high degree of industrial processing, e.g., the change from husked maize to pre-cooked maize flour.

The trend towards high-cost nutrients, as shown by the increase in meat consumption and the growth of the animal feeds industry, amongst others" (Jaffe, Rothman).

Status Quo of Cassava in Venezuela

Cassava production has stagnated in the country at about 330,000 tons per year since 1960 and with yields of 8 t/ha in 40,000 hectares (Table 9).

Present status

Production is highest in the eastern part of the country (Table 10), and its share has grown within the 1960-85 period due to gains in production in the state of Bolivar and stable production in the other states (BCV, 1974), Consumption of "casabe" (a kind of bread made from cassava flour) is quite important in this region.

Our survey of 50 producers conducted in Monagas in May 1986 revealed that about one-half of the farmers surveyed did not use machinery, one-half of them used intercropping with maize, and fertilizer use was mostly associated with the presence of maize as well as use of other chemicals (Table 11). Among the 50 farmers surveyed, the average farm was 23.5 hectares and 2.2 hectares were under cassava. Yields fluctuate widely from around 5 t/ha to over 20 t/ha depending on technology and crop management. Analysis of the survey is under way now.

Except for the highly mechanized farmers, use of purchased inputs in cassava is quite limited. Most farmers plant bitter varieties for sale to "casaberas" or to process their own casabe, and they also plant a parcel (up to one-half a hectare) of sweet varieties for home consumption and occasional sales.

The state that produces the most cassava is Zulia, in the west, with 15% of total production. This area, as well as the rest of the country, produces sweet varieties as opposed to the eastern section of the country where bitter varieties are predominant.

The Andean states are also important producers of the root accounting for 31% of the total. However, per capita production here is lower due to larger population concentration.

With respect to consumption, there are no recent estimates of cassava use in the country. A 1974 study conducted by BCV revealed that about 38% of all cassava is destined to animal feed, 40% is consumed in fresh form by humans, 12% is consumed in the form of casabe, and the rest, 9%, goes to starch production (Table 12).

In the 1965-84 period analyzed, per capita consumption of cassava decreased at an annual rate of 3.1%--the sharpest fall among carbohydrate foods. This reduction was accompanied by a 3.8% annual increase in its real retail price--the highest price increase among carbohydrates (Tables 13 and 14). For Caracas, the INN 1981 nutrition survey, revealed that cassava is mostly consumed by lower income groups (IV and V), with an annual per capita consumption of 8.1 kg for the lowest income group (V), 6.2 kg for the middle-low (IV) group and only 3.6 kg for the upper-income groups.

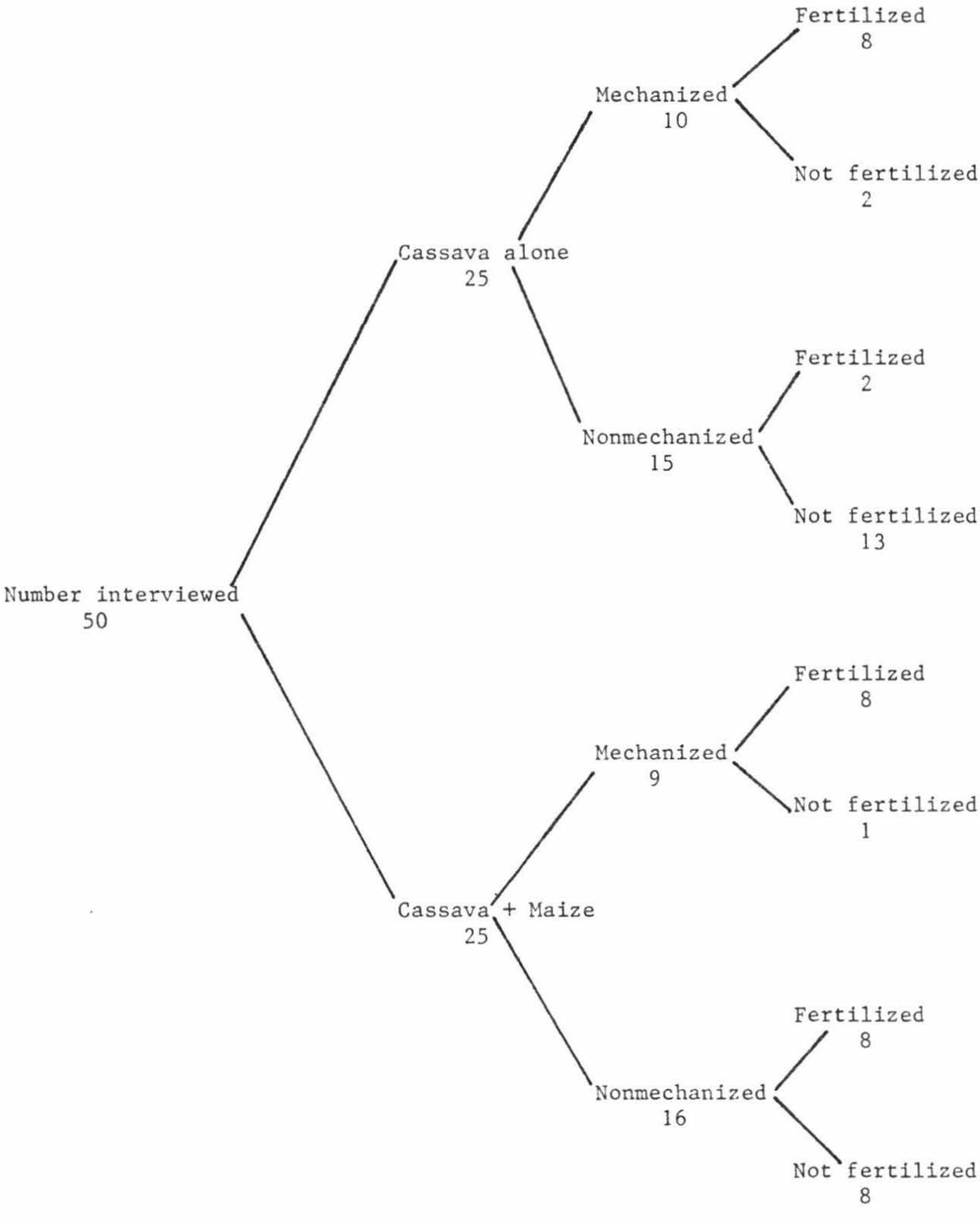
Table 9. Production (metric tons) of major carbohydrates in Venezuela, 1960-85.

Year	Cassava	Potato	Rice	Maize	Wheat	Plantain
1960	340	134	72	439	1	296
1961	300	74	81	420	1	301
1962	323	121	103	540	1	275
1963	342	111	131	430	1	276
1964	312	124	165	475	1	287
1965	301	136	199	521	1	283
1966	320	126	194	557	1	279
1967	316	133	223	633	2	259
1968	341	143	244	661	1	293
1969	310	124	244	670	1	342
1970	317	125	226	710	1	370
1971	323	115	153	713	1	377
1972	318	109	164	506	1	372
1973	272	124	302	454	1	369
1974	293	152	297	554	1	382
1975	317	152	363	653	1	370
1976	295	132	206	417	1	363
1977	304	179	496	774	1	406
1978	304	171	502	591	1	445
1979	315	191	614	612	0	437
1980	312	199	619	575	0	418
1981	327	171	681	452	0	426
1982	301	217	609	501	0	413
1983	325	225	449	488	0	420
1984	331	226	409	609	1	438
1985	310	191	472	900	1	445

Table 10. Cassava production by state in Venezuela, 1983.

Region and state	Hectares	Production	Per capita production
Eastern			
Bolivar	5,482	52,740	72.4
Sucre	2,016	21,402	34.5
Monagas	3,987	42,313	99.3
Anzoategui	4,270	30,960	41.1
Central and central west			
Carabobo	2,409	10,104	9.1
Cojedes	2,801	21,317	143.9
Guarico	853	7,536	18.6
Falcon	144	546	1.0
Lara	278	2,100	1.8
Portuguesa	566	2,611	5.5
Apure	1,148	7,475	34.8
Miranda	2,012	24,408	16.2
Andes and west			
Barinas	1,600	12,800	36.8
Merida	1,976	14,812	29.2
Trujillo	917	4,680	8.5
Tachira	2,128	14,943	20.1
Zulia	7,825	52,977	28.8
Total of regions	40,412	323,724	26.8
Totals for the country	40,526	324,733	20.4
Summary of production			
Eastern		147,415	45.5%
Central and central west		76,097	23.5%
Andes and west		100,212	31.0%

Table 11. Characterization of the sample of cassava producers in Monagas, Venezuela, 1986



Average cassava lot : 3.5 ha
Average farm lot : 14.8 ha

Table 12. Cassava, supply and demand (tons) in Venezuela, 1960-72.

Year	Local production supply	Demand				
		Intermediate (starch)	Animal food	Casabe production	Direct consumption	Total demand
1960	340,248	6,450	131,988	40,518	161,292	340,248
1961	339,223	14,310	131,855	40,131	152,927	339,223
1962	322,805	22,434	123,921	39,741	136,709	322,805
1963	342,388	21,558	134,237	39,354	147,239	342,388
1964	311,697	16,439	119,066	38,964	137,228	311,697
1965	301,423	29,040	114,244	38,557	119,582	301,423
1966	320,000	24,912	124,053	38,187	132,848	320,000
1967	315,563	23,070	122,190	37,800	132,503	315,563
1968	340,882	40,818	132,027	40,800	127,237	340,882
1969	309,847	41,550	119,892	37,200	111,205	309,847
1970	317,197	39,558	122,719	38,100	116,820	317,197
1971	322,724	46,158	124,621	39,000	112,945	322,724
1972	318,170	46,110	122,468	38,100	111,492	318,170
Average	323,244	28,647	124,868	38,959	130,771	324,013

SOURCE: Taken from Table 14.

Table 13. Summary of annual growth rates (%) in agricultural parameters in Venezuela, 1965-84.

Per capita consumption		Per capita consumption		
Beef	1.3%	Cassava	-3.1%	
Pork	2.3%	Potato	-0.0%	
Poultry	5.9%	Rice	2.2%	3.1%[a]
		Wheat	0.7%	
Poultry total production	8.9%	Maize	-0.6%	
		Plantain	-0.8%	
Real retail prices				
Beef	2.2%	Total production of cassava	0.0%	
Pork	0.7%			
Poultry	-2.4%			
		Real retail prices		
		Cassava	3.8%	
Relative price beef/poultry	4.6%	Potato	2.6%	
		Rice	-0.5%	-2.9%[a]
Animal	10.4%	Wheat	3.0%	
Maize/sorghum	23.3%	Maize	3.3%	
Urban population	4.2%	Plantain	1.6%	
Total population	3.3%			
		Relative price cassava/wheat	0.8%	
		Real income PC	1.8%	
		Sorghum production	5.1%	

a. For period 1965-1980.

Table 14. Real retail prices (in 1968 bolivars) of carbohydrates, and per capita real income in Venezuela, 1965-85.

Year	Cassava	Potato	Rice	Maize	Wheat	Plantain	Per Capita income
1965	$0.71	$0.87	$1.21	$0.73	$0.64	$0.59	$3.38
1966	$0.59	$1.10	$1.63	$0.69	$0.63	$0.58	$3.34
1967	$0.61	$0.97	$1.62	$0.71	$0.63	$0.58	$3.37
1968	$0.70	$0.90	$1.61	$0.70	$0.62	$0.60	$3.30
1969	$0.63	$1.01	$1.54	$0.66	$0.61	$0.59	$3.42
1970	$0.60	$0.90	$1.44	$0.66	$0.67	$0.49	$3.62
1971	$0,64	$0.84	$1.42	$0.63	$0.65	$0.50	$3.58
1972	$0.65	$0.95	$1.36	$0.63	$0.63	$0.54	$3.59
1973	$0.63	$1.04	$1.34	$0.76	$0.61	$0.54	$3.69
1974	$0.58	$0.93	$1.30	$0.79	$0.56	$0.52	$3.61
1975	$0.73	$0.89	$1.32	$0.80	$0.51	$0.60	$4.03
1976	$0.79	$0.87	$1.17	$0.89	$0.63	$0.65	$4.55
1977	$0.89	$0.79	$1.06	$0.79	$0.82	$0.62	$4.68
1978	$0.85	$0.78	$1.03	$0.78	$1.16	$0.62	$4.65
1979	$0.94	$0.89	$1.02	$0.90	$1.29	$0.61	$4.97
1980	$1.00	$1.36	$1.05	$1.01	$1.15	$0.60	$4.80
1981	$0.98	$1.55	$1.80	$1.13	$1.09	$0.65	$4.78
1982	$0.91	$1.12	$1.50	$1.02	$0.91	$0.64	$4.65
1983	$1.11	$1.46	$1.43	$1.03	$0.86	$0.64	$4.36
1984	$1.27	$1.46	$1.54	$1.22	$0.90	$0.77	$4.11
1985	$1.44	$1.67	$1.45	$1.45	$0.85	$0.85	$3.97

A miscalculated effort was made in the late seventies to incorporate cassava into the main stream of agroindustry in Venezuela. The amount of research done with the crop is quite impressive, both at the agronomic level (FONAIAP, UEV, UDO, LUZ, UNELLEZ FUNDATEC, etc.), and at the utilization end (UEV, UDO, Protinal, etc.).

In the late seventies cassava was seen as an important alternative in the government import substitution policies. Eleven drying plants were created throughout the country in 1975-80 at a cost of about US$25 million. They were closed as of 1986. Most of them never got off the ground. Careful analysis revealed that soft credit lines were formulated by the same institutions that sold the machinery, without considering the economic feasibility of success of those plants in terms of location, market expansion, social impact, labor needs, etc. Total installed capacity for these cassava plants was 250,000 tons or 75% of actual production.

Econometric analysis of the demand for fresh cassava. Data from the INN only refers to quantities of products consumed. There is no expenditure information. Therefore, only time-series data were used to calculate the effects of changes in incomes, prices, and urbanization trends on per capita consumption of cassava. The period of analysis chosen covers the years 1965-84.

Urban population grew faster than total population at 4.2% per year. Urbanization has a negative implication on cassava demand that goes beyond the effect of causing higher consumer prices due to the obvious increase in marketing costs. Because the root is highly perishable, urbanization presents special difficulties in market access. Effective barriers of entry emerge with the subsequent reduction in competitiveness in the market place. The lower degree of competition converge lower volumes of trade than would have taken place under a more competitive environment.

The model proposed to estimate per capita demand for cassava includes its own real retail price, real retail prices of other carbohydrates, per capita real incomes and total urban population as independent variables.

Parameter estimates show that urbanization has had a marked negative impact on consumption of fresh cassava in the country. Income did not have a significant effect on its consumption at the aggregate level most likely because it is a significant variable at lower income levels (as is the case in Colombia, Indonesia and Brazil, for example) and not significant or even negative at high income levels. So, in the aggregate the income elasticity is very low, 0.08 (and not significantly different from zero, Tables 15 and 16).

Per capita consumption of cassava is also quite responsive to prices. The marked growth in its own price (at 3.8% per year) had a contractionary effect on its demand of 0.38% per year (own price elasticity of 0.10). Substitution away from cassava consumption was also caused by wheat and rice prices (cross price elasticities of 0.13 and 0.18).

These results confirm that cassava has been discriminated against not only at the supply level, where policies encourage production of imported food items, but also at the demand level with discriminatory consumer price

Table 15. Elasticities of time series for several countries and per capita consumption of fresh cassava in Venezuela, 1965-84.

	Colombia	Ecuador	Paraguay	Peru	Venezuela
Own price	-0.43 (3.09)[a]	-2.08 (3.59)	-0.10 (4.62)	-0.21 (3.08)	-0.10 (3.53)
Income	2.51 (1.73)	1.38 (1.89)	-0.13 (7.03)	0.03 (0.13)	0.08 (0.44)
Urbanization	-1.55 (3.14)	-0.99 (2.85)	-0.13 (5.52)	-1.03 (9.17)	-0.77 (6.90)
Wheat rice	NO	0.45 (3.01)	0.07 (5.38)	0.11 (1.84)	0.13 (2.60)
Rice price	0.09 (2.16)	2.42 (2.78)	NO	0.64 (12.24)	0.18 (2.00)

a. Figures in parentheses are t-statistics.

Table 16. Elasticities of time series for several countries and per capita consumption of poultry meat.

	Colombia	Ecuador	Paraguay	Peru	Venezuela
Own price	-0.46 (10.45)[a]	-0.19 (1.73)	-0.33 (6.39)	-1.19 (6.26)	-0.92 (10.39)
Income	0.88 (10.86)	0.57 (8.14)	0.59 (10.73)	0.54 (1.54)	1.09 (14.03)
Beef price	0.61 -2.54	0.80 (8.88)	-0.15 (3.10)	0.66 (3.75)	0.44 (1.76)
Pork price	-1.14 (5.60)	0.39 (1.86)	0.53 (6.49)	0.52 (2.36)	-0.70 (2.12)

a. Figures in parentheses are t-statistics.

policies that have affected consumption of this root in favor of an imported cereal such as wheat.

Potential demand for cassava

As we have seen, cassava has been left out of the main stream of import substitution and agroindustrial policies that have characterized the past three decades of Venezuelan agricultural development. But cassava's excellent agroecological adaptation to the different environments of the country make the root an obvious candidate in the long term to substitute for imported, food energy sources in both the food- and the feed-processing industries.

The obvious impediment at present is the complex set of political economic forces that propitiated and maintain the actual state of things. The oligopolies existing in wheat milling and feed manufacturing are also heavily involved in the grain import business. These interest groups play a vital role in the price and production policy decision-making process.

There are encouraging signs in both industries with respect to utilization of local food items in their processing technologies. The wheat millers have experimented with cassava and rice flour. They will have to use, by law, 15% to 20% of rice flour in production of pasta.

With respect to feed, Protinal, the largest feed and poultry producer in the country (with 30% of the feed market) has been actively involved in dried cassava research for animal feed. For the last four years, they have been operating a 100 ha plantation in Monagas (eastern part of the country) where experiments with mechanized planting and harvesting are progressing satisfactorily. A 250-m^2 drying floor and a Thailand-type chipper, following CIAT's specifications, were built to keep abreast of the possibilities in this area. The same firm has conducted experiments in a "Central Yuquero" in the eastern part of the country, where artificial drying experiments are being conducted.

Protinal thinks that the drying floors have a bright future in that region of Venezuela where abundant marginal but mechanizable land exists, drying conditions are excellent (four months of dry season), and there is a cassava tradition that goes back several decades. Casabe prices have increased relative to wheat products; it is now more expensive than pasta and bread at around Bs10/kg and its consumption has declined. Drying cassava offers an alternative market for farmers in that region.

Purina, the second largest feed manufacturer has also shown interest in dried cassava, following the example of its sister company in Colombia which has been a major user of dried cassava chips produced on the Atlantic Coast of that neighbor country.

Fresh cassava offers also new possibilities to reduce the negative impact associated with the high perishability of the root in a rapidly urbanizing society. The new technology to store fresh cassava in plastic bags and treat it with thiabendazol could have a tremendous impact on reducing retail prices and expanding volumes sent into major urban zones.

By 1986, farmers' prices of fresh cassava were around Bs0.75/kg to Bs1.10/kg while its retail price in Caracas was Bs5.95/kg.

The marketing margin seems excessive in a city with excellent roads and with an appropriate wholesale market (Los Coches). Reducing perishability will enable farmers from more distant places to enter the market. Retailers will see their losses cut and they will also be able to negotiate larger volumes at wholesale outlets.

Increased market access and lower commercialization losses due to use of the plastic-bag technology should result in sharp reductions in retail prices and markedly higher volumes of cassava being traded in the cities. In a country of high incomes, where food marketing usually conveys a high value-added to the final product, this type of technological innovation has a high chance for success.

We turn now to analyze the prospects for cassava demand both as a food item that competes with other carbohydrates and as a feed source.

Carbohydrate foods. Venezuela continues to be dependent on imports for over 50% of basic agricultural commodities (and perhaps 30% of total food consumption). Food imports (mostly cereals, oilseeds, dairy and their products) boomed after 1973, following the rapid oil price increase (Table 4). In the 1965-84 period of analysis, the highest gains in per capita consumption went to rice at 2.2% per year. Actually, per capita consumption of rice in the 1965-80 period grew at an annual 3.1% accompanied by an equally impressive retail price reduction (in real terms) of 2.1% per year. In the eighties, white rice prices increased rapidly in real terms from Bs1.05/kg to Bs1.45/kg in 1985 (5% broken grains). Accordingly, per capita consumption of rice (paddy equivalent) went from 40.0 kg in 1980 to 25.7 kg in 1985.

Per capita consumption of all major carbohydrates decreased during the period of recession, 1978-85, except that of wheat, for which a favorable price policy for bread and pasta meant a rapid real retail-price reduction. (Tables 14 and 17).

Reductions in the price of rice during the 1965-84 period are the result of the rapid adoption of improved, high-yielding varieties, (HYRV), a process that started in 1959. By 1982 it was estimated that out of 227,000 hectares cultivated with rice, about 200,000 used HYRV (mainly Araure 1) of which 30% was irrigated (M.J. Rosero in Dalrymple). By 1985 area harvested was 148,000 hectares of which 40,000 were irrigated. government credit for nonirrigated rice has been declining. Yields have been increasing in the eighties due to a higher proportion of irrigated rice. They were of 3.2 t/ha in 1985 (USDA Grain and Feed Annual Report).

Venezuela has been self-sufficient in rice since the early sixties and some exports have been registered of small amounts. Mechanized upland and a more intensive irrigated system are the predominant methods of cultivation.

Industrialization is predominant for milling. Of the 35% resulting from milling, 23% goes to nonfeeding uses at poultry farms, and 12% goes

Table 17. Per capita consumption for major carbohydrates in Venezuela, 1960-85.

Year	Cassava	Potato	Rice paddy	Maize	Wheat	Plantain
1960	42.3	16.7	7.5	32.3	36.9	36.8
1961	35.9	8.9	9.0	33.5	37.2	36.0
1962	37.2	13.9	11.4	39.9	30.5	31.7
1963	37.9	12.3	14.5	31.6	34.0	30.6
1964	33.3	13.2	17.6	48.3	45.4	30.6
1965	30.9	13.9	22.5	39.9	43.2	29.0
1966	31.6	12.5	24.1	38.4	42.2	27.6
1967	30.1	12.7	27.2	41.8	52.6	24.7
1968	31.3	13.1	25.4	57.6	54.8	26.9
1969	27.5	11.0	22.4	45.0	50.7	30.3
1970	27.2	10.7	24.4	48.5	48.9	31.7
1971	26.8	9.5	12.7	51.6	46.2	31.3
1972	25.6	8.8	13.2	45.5	48.3	29.9
1973	21.2	9.7	23.7	51.4	42.6	28.8
1974	22.2	11.5	27.5	53.3	40.9	28.9
1975	23.3	11.2	29.1	51.5	46.4	27.1
1976	21.0	9.4	14.7	37.0	50.8	25.8
1977	21.0	12.3	34.2	53.4	48.7	28.0
1978	20.3	11.4	33.6	45.3	54.0	29.8
1979	20.4	12.4	40.4	42.2	45.9	28.3
1980	19.6	12.5	40.0	50.5	48.7	26.3
1981	19.9	10.4	41.5	56.2	53.9	25.9
1982	18.0	13.0	36.5	50.6	46.3	24.7
1983	18.8	13.0	26.0	41.0	48.3	24.3
1984	18.6	12.7	22.9	35.9	60.9	24.6
1985	16.9	10.4	25.7	29.4	56.8	24.2

into animal feed. Between 2% and 4% of white rice goes into brewing and more elaborate foods.

Per capita consumption of white rice was at 17 kg by 1985 with total consumption increasing with income level.

Corn consumption is per capita terms showed no significant trend over the 1965-84 period, while the real retail price of maize flour increased at 3.3% per year.

About 75% of domestic availability goes to the flour-processing industry. The rest goes into feed manufacturing. Apparent per capita disappearance in 1985 was about 30 kg. Corn consumption increases as income level decreases (Hernandez, IESA). It is a basic staple at low income levels. The maize-processing industry has a high degree of market-power concentration.

Wheat is almost exclusively imported and constitutes a basic dietary source with 21% of the total protein need and 40% of vegetable needs being supplied by it (Hernandez Doc. #1.). Venezuela imports much, high-priced wheat mostly from the United States (UCV Economia).

About 90% of the wheat reaches a second milling phase. Of this, 59% goes into bread and pastry, 25% into pasta, 5.5% into cookies, and 10% into domestic use of wheat flour. Milling is highly concentrated while pasta and bread processing have lower degrees of market-power concentration.

Per capita availability of wheat was around 56 kg in 1985. Bread consumption increases with income level while pasta shows the opposite trend (Hernandez, IESA).

Per capita consumption of fresh carbohydrates shows no significant trend for potatoes and plantains and shows a decrease for cassava. Prices of these three items increased in real terms.

Should present trends continue, the diets of the Venezuelans will contain even more imported wheat, with rice and maize having a chance to maintain their shares, given the strong government support to producers. Potatoes, cassava, and plantains will continue to be replaced due to the consumer pricing policies favoring wheat.

Meats. The livestock sector has been very dynamic over the past two decades. Its contribution to GDP has increased, spurred by a fast-growing poultry industry although pork, beef, and dairy have made important gains.

Per capita consumption of poultry grew in 1965-84 at an annual 5.9%, pork at 23%, and beef at 1.3%. The faster growth for poultry was accompanied by a continued reduction in its real retail price at 2.4% per year, the result of the rapid adoption of modern technologies (Table 13).

In per capita terms, beef has been surpassed by poultry (16.7 kg versus 19.6 kg) and pork is a distant third with 6.2 kg.

A rather conservative scenario has been assumed. Per capita real incomes in 1985-2000 will increase at an annual 1.0%, population will grow at 2.8% per year, and the real retail price of cassava will decrease at an annual 1.0% while other real prices remain constant.

The price fall is based upon the assumption that plastic bags will be gradually adopted. With this technology, consumers will pay less, farmers will receive more (Janssen and Wheatley) because of a significant reduction in waste and marketing costs, and by the formation of stronger markets.

Therefore the assumption of a reduction in the cassava retail price rests initially on the implementation of the new storage technology. In such a case the rate of reduction in price could be much higher than the one proposed for this exercise. An additional assumption for projections is that with this technology, commercialization losses of cassava will be reduced from an estimated present level of 25% to 15% in the fresh market. If there is a parallel development in the drying industry, losses will be reduced to 5% since the additional 10% of cassava that is not suitable for the fresh market due to quality problems (small size or broken), and that is currently left on the field, could be utilized by this industry. Therefore, the final effect on additional production requirements will be 20% less due to better crop use.

Fresh cassava. The 1984 per capita consumption level of 18.6 kg will increase to 19.1 kg by the year 2000. The increase in per capita consumption is the result of the own-price decrease (Table 18).

Under those circumstances, implied cassava production will reach 541,000 tons (over the 331,000 tons produced in 1984). Again, a 10% waste-reduction equivalent (around US$4 million) is assumed to be associated with the new storage technology. Therefore increments in production for the year 2000 will amount to 156,800 tons, or 15,680 additional hectares of production assuming a yield of 10 t/ha (Table 18).

Dried cassava. Our estimates indicate the following:

Dry cassava competes with locally produced sorghum, but not with imported sorghum at the preferential exchange rate (Tables 19 and 20).

Against local sorghum, cassava drying is a profitable alternative for feed manufacturers, entering in the optimal least-cost solutions at 80% of the price of sorghum. Sorghum has a higher protein content and, for that reason, cassava must cost less.

Therefore, the viability of its production remains subject to policy decisions.

Whether cassava is incorporated into the main stream of import substitution and feed processing will be a political decision depending upon both industry and government willingness to stimulate this promising root.

Table 18. Projections for time-series model for the year 2000 in Venezuela.

Dried cassava		
Annual rates of growth		
Per capita real income	1.0	
Population	2.8%	
Real retail price poultry	-1.0%	
Sorghum production		
Variables levels	1984	2000
Population (millions)	17.8	28.3
Per capita consumption (kg) of:		
Beef	19.1	
Pork	6.4	7.9
Poultry	16.9	25.2
Pork meat production	114.5	223.0
Poultry meat production	290.2	784.9
Total feed production	2,955.5	5,736.6
Pork feed production	956.1	1,783.7
Poultry feed production	1,744.4	3,204.6
Maize/sorghum		
Implicit use	1,921.4	3,728.8
Imports	1,300.0	2,012.6
Dried cassava		
Percent in feed	10.0%	
Required production		573.7
Maize/sorghum imports		1,438.9
Foreign exchange earnings (millions of US$)		$57.4
Fresh/dried cassava conversion		2.5
Cassava yield/ha		10.0
Fresh cassava labor/ha		45.0
Dried cassava labor/t		3.0
Fresh cassava required (000 t)		1,380.0
Required hectares		137,996.0
New jobs generated		34,545.6
Fresh cassava		
Annual rates of growth		
Per capita real income	1.0%	
Population	2.8%	
Real retail price fresh cassava	-1.0%	
Variable levels	1984	2000
Population (millions)	17.8	28.3
Per capita consumption of fresh cassava (kg)	18.6	19.1
Fresh cassava production	331.0	541.8
Production increase (000 t)		156.8
Additional hectares for cassava		15,680.0
New jobs generated		3,763.0
Final balance for fresh and dried cassava		
Additional production for fresh cassava (000)		1,536.8
Required hectares		153,676.0
New jobs generated		34,545.0

Table 19. Profitability of a cassava drying floor, Monagas, Venezuela, 1986.

Drying floor (m^2)	1,000
Months of operation (months/year)	4
Drying load operation (kg/m^2)	12
Dried cassava sales Bs/t	$2,010
Labor cost (wage)	$50
Conversion of fresh to dried cassava	2.5
Fresh cassava yields/ha (kg)	12,500
Dried cassava, transport costs (Bs/t)	$100
Sorghum price at farm gate	$2,513
Internal rate of return	15.0%
Net present value (10%)	$93,391
Annual capacity, fresh cassava	576,000
Annual capacity, ha	46.1

Investments	Unit cost ($)	Units	1985 Bs
Cement floor	60	1000	60,000
Chipping area	100	32	3,200
Warehouse	160	336	260,000
Screen	15	240	45,000
			368,200
Equipment			
Chipper	10,000	1	10,000
Motor	15,000	1	15,000
Scale	1,500	1	1,500
			26,500
Tools			
Wheelbarrows	350	6	12,000
Shovels	28	12	3,000
Rakes	15	4	4,000
Collectors	50	4	4,000
Sacks	3.5	200	20,000
Plastic sheet	3	500	40,000
			83,000
Subtotal			477,700
Unforeseen, 5%			23,885
Working capital	30	1400	42,000
Total			543,585

Table 20. Distribution of direct costs for cassava (fresh and dried) and for sorghum, Monagas, Venezuela, 1986.

Variable	Total (Bs/ha)	Cost (Bs/t)		Cost (Bs/t)	Free exchange rate (Bs20=US$1.00) (US$/t)	Official (Bs7.5=US$1.00)
Land	$8.33	$0.04		$2.54	$0.13	$0.34
Labor	$47,466.67	$206.02		$592.27	$29.61	$78.97
Capital	$59,371.12	$257.69		$760.69	$38.03	$101.42
Total	106,846.12	$463.74		$1,355.49	$67.77	$180.73
Fresh cassava yielding			$12,500			
Farm gate price, 85% sorghum			$1,870			
Gross margin			$515			

Sorghum production costs, Monagas - 1986
Yielding: 2.5 tons/ha

	Total + 20%
Mechanization	1,228.464
Inputs	1,058.28
Labor	288

	Total	Cost (Bs/t)	Free exchange rate	Official exchange rate (Bs7.5=US$1.00)
Land	$20.83	$8.33	$0.42	$1.11
Labor	$288.00	$115.20	$5.76	$15.36
Capital	$2,286.74	$914.70	$45.73	$121.96
Total	$2,595.58	$1,038.23	$51.91	$138.43
Farm gate price	$2,200		$110.00	$293.33
Gross margin	$1,162		$58.09	$154.90

From our time-series demand estimation of pork and poultry in Venezuela (Sanint et al.) we translated those elasticities for projected consumption of those two types of meat for the year 2000 (Table 16).

It was assumed that the present ratio of feed going into broilers and layers remains constant (i.e., there will be an equally dynamic demand for eggs, which appears quite reasonable) and that pork and poultry feed will continue to represent 85% of that market (dairy and other uses will also show important growth; again, a proposition likely occur).

For the year 2000, the model predicted per capita consumption of poultry at 25.2 kg (up from 16.9 kg in 1984), that of pork at 7.9 kg (up from 6.4 kg in 1984) and feed use at 5.7 million tons (from 3 million in 1984) (Table 18).

Substituting only 10% of dry-cassava chips into feed formulas for the year 2000, 575,700 tons of dried cassava will be required (that will substitute about US$57 million of coarse grain imports). At a 2.5 conversion rate of dry to fresh cassava, 1.4 million tons of fresh cassava will be required to meet this requirement and 137,996 additional hectares will have to be cultivated (assuming yields of 10 t/ha, which is rather conservative). The exercise also assumes that 10% of what is produced for fresh cassava consumption can be incorporated into dried cassava, since that proportion is usually left in the ground at harvest time because it will not meet market standards. But those remainings ("colas") are perfectly acceptable for drying.

Total needs for additional cassava (in both the fresh and feed markets) by the year 2000 will reach 1.5 million tons, using 153,676 additional hectares, and with 34,546 new jobs generated in the process.

Concluding Comments

Venezuela has made considerable efforts to substitute food imports and reduce its level of dependence on foreign suppliers. The food-processing ability of the country has expanded very rapidly but the raw materials demanded contain a high proportion of imports. Wheat is almost one hundred percent imported, while 60% of coarse grains used in feed production are imported. This is in spite of the massive subsidies and price incentives given to farmers of those crops, and the rapid growth in corn and sorghum production.

In terms of potential, cassava has much to offer. It is the cheapest source of energy in the tropics. That undeniable evidence should be put to work. The crop's ability to grow under a very wide range of ecosystems and the present low yields, indicate that Venezuela could use many of its unproductive lands to cultivate cassava and achieve substantial productivity gains.

The present dilemma of substituting expensive local grains for cheap imported ones and at the same time provide cheap, abundant food to the urban consumer must be broken by means of productivity, rather than area expansion, in order to keep prices of local products low and competitive.

Increasing sorghum and maize yields far beyond their present levels (which are based on heavy use of subsidized fertilizers) is unlikely, but with cassava, it is a different story. Present average country yields of 8.0 t/ha are very low. Protinal, under field conditions, obtains 15-20 t/ha. At those levels, cassava becomes a much better alternative than coarse grains in Venezuela.

The case of fresh cassava also merits attention. With the introduction of cassava-bagging techniques impressive results can be achieved, as the Colombian experience (Bucaramanga pilot-project) demonstrates.

The political and economic forces behind the present import substitution stragety are quite complex. Food processors, which are, for the most, direct importers of their own raw material, exhibit a good deal of market-power concentrtion. They exert effective pressures on policy makers to protect their own interests. This has probably been the reason behind an increasing specialization, both in terms of production and consumption, on a few imported items that are used as inputs for the local processing firms.

As some of these firms (Protinal, Purina) turn their attention to cassava, the future of this root may be bright in Venezuela.

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