3. CASSAVA PRODUCTION, MARKETING AND UTILIZATION

Cassava is the principal root crop in the food economies of tropical Latin America and a major calorie staple in the rural areas of the lowland tropics. Although it is indigenous to Latin America, and has a high yield potential even under marginal conditions, there have been few efforts to promote the crop. Growth in its production has been sluggish compared to many other commodities, and its role in the diet has perhaps marginally declined.

Cassava production increased at an annual rate of 1.9% 1961-78, while rice output was rising 3.3%, maize 2.8%, sorghum 12.5%, poultry 9.5%, and beef 2.4%. Similarly, the percent of total calories from cassava in national diets declined in many major cassava producing countries in the period 1964-66 to 1975-77, among them Brazil, Paraguay, Venezuela and Peru (8).

The analysis of production trends and the demand for foods in the proceeding two chapters forms a useful framework for considering both the crop's potential and for understanding why cassava has heretofore remained outside the rapid modernizing process that has been taking place in the agricultural sectors of Latin American economies. Even though grains may seem to be threatening to usurp many traditional cassava markets, it will become evident that the demand for new cassava technology should not be based on the crop's recent performance, but rather on its potential.

It was shown above in Chapter 1 that the major sources of output growth in Latin American agriculture 1950-70 were increased use of chemical fertilizers and mechanization. More recently it appears that technical change has become a key source of growth in agricultural output. Cassava is and has been a crop of small farmers, generally produced under adverse conditions (poor soils; without irrigation or chemical control of pests and diseases; often in regions inadequately served by infrastructure). Consequently, it has yet to be mechanized, though a few exceptions show that it could be. Moreover, it has not significantly benefited from the use of chemical fertilizers, nor has there yet been major technical change in its production.

Hence, cassava has not shared in the factors that have been the most important in propelling growth in Latin American agriculture over the last two decades. However, because cassava is a crop produced with labor intensive technology by small farmers, it could be of major importance for those countries which opt for a strategy which includes intensifying production in the small farm sector in an effort to maintain rural employment and incomes, in order to both alleviate poverty directly as well as relieve pressure on the urban sector by slowing down rural-urban migration.

Demand factors have also been inauspicious for the prospects of cassava. Cassava is often of relatively greatest importance in the diets of the poor who may not have obtained sufficiently increased incomes in the recent past to be able to provide a strong demand for cassava. The income elasticity of demand for cassava tends to be fairly low in the upper income quartile, so that income growth for this group does not provide strong incentives to cassava production.

Although the income elasticity of demand for traditional cassava products such as farinha de mandioca in Brazil is usually positive, it is often less than that for cereals and animal products. Consequently, cassava producers may not have faced the same vigorous demand as have producers of more dynamically growing commodities like poultry, feed grains, and beef. As discussed in Chapter 2, relatively weak demand for a commodity not only fails to offer producers compelling short term incentives, but it also may fail to induce the demand for research that can lead to cost reducing technological change.

Hence, cassava in the recent past has neither benefited from the forces that have permitted augmented production of agricultural commodities in Latin America, nor has it enjoyed a brisk demand that encourages both producers in the short run and technical change in the long run. This represents a dilemma for Latin American policy makers for two reasons. First,cassava could be a crucial factor in raising the nutritional status of the malnourished because in certain regions it is such an important part of the diet of the poor.

Second, it may also be a key part of any strategy aimed at the small farm sector because it is almost always a crop produced by small farmers.

There are some trends emerging that may facilitate a more positive role for cassava in the future. First, as will be discussed below, it is now clear that cassava has the potential to enter non-traditional markets - as a feed concentrate or as a wheat substitute - where it would doubtlessly face a more elastic demand than in traditional markets. This could provide ample incentive for small farm producers of cassava. Second, investment in agricultural research on cassava has been on the rise. If such investment leads to cost reducing technical change, then for the first time cassava would participate in one of the factors that have led to agricultural growth for so many other products.

This chapter briefly outlines what can reasonably be said about cassava production, marketing, and utilization in Latin America. It will be shown that in order to achieve an expanded role for cassava in Latin American agriculture, not only is it necessary to improve production technology, but also it is essential to carefully identify potential markets, as well as develop new marketing channels and processing technology for cassava. The need to attain success in this variety of undertakings naturally increases the complexity of technology generation and transfer as research must expand from a concentration on production to encompass utilization and end-market demand. Nonetheless, as the current status of the crop is discussed and the principal research issues identified, it will be seen that the crop does face some favorable prospects.

3.1. PRODUCTION AND MARKETING

Statistics on cassava are scarce and notoriously unreliable. The concentration of production on small farms, the dispersion of production, the long production cycle, the variable sowing and harvest period, the lack of any market storage capability, and the highly decentralized marketing system all work against any systematic means of collecting data on cassava production. Combine this with the lack of demand for reliable production data for cassava and the results are production statistics that are little more than educated guesses, aggregated to a national level.

An attempt was made to collect all primary data on cassava production and consumption and to develop consistent supply and utilization tables. The hard data consisted principally of agricultural censuses, food budget surveys, manufacturing censuses, and sample surveys [1/]. The results of this reconstruction are presented in Tables 3.1 to 3.3.

1/ Sources, consistency checks, and assumptions in the construction of the tables will be discussed in detail in a future expanded version of this chapter.

These data depart markedly from official production statistics as reported in the FAO Production Yearbook (see Appendix A.4). Brazil provides an obvious example of the disparity between agricultural census data and official estimates for cassava, but the much more exact estimates for grains (Table 3.4).

For Brazil a partial consistency check was provided by the 1975 national food budget survey and the data for cassava flour production which was also included in the agricultural census. Estimated cassava flour consumption from the food budget survey was 1,887 thousand tons, while the census production figure was 1,812 thousand tons, a difference of only 4%.

This reconstruction of the supply and utilization data suggests that official estimates of cassava production in Latin America are 100% overestimated, that is twice the level shown in Table 3.1. The FAO Food Balance Sheets implicitly compensate for this overestimation, in that two-thirds of the difference is accounted for in wastage and on-farm animal feeding, both usually calculated as an assumed residual. For example, in the Brazilian case 50% of production is put in these two categories. Most of the rest of the difference comes in an overestimation of fresh cassava consumption.

The revision of the data does not change the status of cassava. It is still a principal caloric staple in rural Latin America, especially in the lowland tropics. Around 70% of cassava for human consumption is eaten in the rural area. However, since both the production base and average yield levels are much lower than indicated by previous estimates, the potential impact of new technology will be proportionally greater both in terms of anticipated market impact and potential increases in farm production.

Cassava, although generally stereotyped as a subsistence crop, is in fact a commercial crop, with over 70% of cassava being marketed. The major portion of cassava retained on farms is,in turn, used as a feed source, principally for hogs. A prime example is Paraguay (see Table 3.5) where 22% of energy intake by hogs is derived from cassava. The use of on-farm sources of cassava for hog feeding occurs principally in the small-scale production units. As production units get larger there is a marked switch to feed concentrates.

Cassava is generally perceived as a small farmer crop. In Brazil about three-quarters of farmers growing cassava have farms of 20 hectares or less, accounting for about 60% of the area in cassava (see Table 3.6) 2/. In Ecuador the respective figures are two-thirds and 50%. Thus, while

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2/ Given that cassava is usually produced in more marginal agricultural zones, a farm size of 20 ha. is considered small when potential productivity is considered.

small farmers do dominate, cassava production on medium-size farms is far from negligible. The more striking factor concerning the structure of cassava production is that some 90% of cassava farmers in both countries grow 2 hectares of cassava or less. There is very little production of cassava in extensions larger than 5 hectares. In contrast, for the case of rice and maize in Brazil, well over 60% of production comes from extensions of 5 hectares or more. These data would have lent support to cassava's position as a subsistence crop, if it were not for the data on the high percentage commercialized.

Two factors appear to be important in limiting area planted to cassava by farm. First, there has been little move to mechanization of cassava production activities, apart from land preparation. Second, and probably more important, is access to market. While cassava does have a variable harvest period, once harvested its storage potential is minimal unless processed. Marketing is thus a critical factor in determining flows of cassava off the farm. Without storage, flows off the farm must be staggered, with an upper limit on these flows being set by the capacity of market channels or processing units. With lengths of storage in the ground being constrained by optimal timing of cropping activities and land availability, the farmer reduces area planted to that which be can reasonally expect to market during the harvest period.

Around 60% of marketed cassava is eventually processed. Given the demands made on the marketing system, the expectation might be that there would be a movement toward reducing assembly costs and assuring supply continuity by forming marketing linkages with large production units. The data would suggest that in general this has not occurred, although the fresh urban market in Colombia is a notable exception. Reasons for this may be the small scale of the processing units, the mechanization constraint, and the unacceptable levels of risk for the large farmers in relation to their other alternatives. If none of these factors are radically changed, there is no reason to suggest that the pattern of production would change as new end-markets are opened, and thus cassava may remain a small farmer crop.

Land does not appear to be a constraining factor in cassava farming systems, although studies are necessary to determine the extent to which labor is potentially constraining area planted. Access to markets thus appears to be a real constraint on farm-level production. Thus, production potential, while obviously related to resource constraints and the productivity of new technology, is in the final analysis a function of demand potential.

3.2. Cassava End Markets and Potential Demand

Cassava is an exceptionally versatile crop in its ability to enter diverse markets. It can be eaten as a fresh vegetable. It can be processed into a variety of forms for human consumption (flour, starch, casabe, farinha de mandioca). Cassava can also be used directly as an animal feed, or in the manufacture of feed concentrates. In Europe millions of tons of dried cassava are used annually in concentrates. Cassava starch has numerous industrial uses, for example, in textiles, glue and paper. Finally, cassava can serve as a feed stock in the production of alcohol, a fuel substitute for gasoline.

The demand for cassava in each of these markets is very largely independent of the others. Cassava, therefore, faces essentially five separate markets, each with a different capacity to absorb cassava; each with a different set of competing commodities; each presenting different prices at which it can enter the market. Hence, to obtain a broad understanding of the aggregate market potential for cassava, it is necessary to have information about the particular demand conditions in each of the separate markets for cassava.

Economic studies of the demand for cassava in these various end uses can contribute to the technology development process by providing information about the prices cassava faces and the quantities which can be moved in different markets. Knowledge of the prices at which cassava can be sold in each of these markets not only indicates which markets it is more likely to enter, but also gives an estimates of the level of productivity which new cassava production technology must attain in order for it to be competitive. Knowledge about the quantities of cassava which can be absorbed at various prices in the different markets can contribute to the determination of the relative importance of alternative markets for cassava. Since the characteristics of cassava and cassava production systems for these various markets may not be uniform, information about the relative importance of these markets can be an aid in setting the objectives for technology development.

Because the mandate of CIAT emphasizes increasing the availability of food supplies in Latin America, here primary focus will be placed on analyzing the markets for cassava where it contributes to food consumption in the region. There may be a great potential for growth in the use of cassava for industrial purposes, especially as a feedstock for alcohol; nevertheless, here only the market for cassava as a fresh vegetable, as processed food, and as animal feed will be considered.

3.2.1. Fresh Market

Fresh cassava provides a large proportion of total calories in average aggregate national diets only in Paraguay, where 10% of calories come from fresh cassava (Table 3.7). Elsewhere in Latin America at most 3% of calories come from fresh cassava.

Although fresh cassava does not appear to be a mainstay in average national diets, it is relatively more important among some groups. In particular, fresh cassava consumption is *much* greater in rural than urban areas (Table 3.3). This is probably in large part a consequence of the high perishability of cassava, which makes it more expensive to obtain in urban areas distant from centers of cassava production. Marketing costs form a high proportion of the costs of cassava to the final consumer. Because of this perishability constraint a highly efficient provision of marketing services (assembly, transportation, retailing) is necessary to get cassava into the hands of consumers before it begins to deteriorate. Such systems do exist, for example, in the urban Colombian fresh market. Clearly, though, the high standards of performance required of these systems are difficult to attain and entail substantial costs. These marketing costs are further increased due to the bulkiness of the crop and the resultant high transport costs.

Price, of course, is a critical factor in determining levels of consumption of alternative foods and the higher cost per calorie of fresh cassava compared to rice (Table 3.8), is doubtless a major reason for rice being on average a far more important source of calories than fresh cassava in urban Latin America. With few exceptions, though, cassava is cheaper on a per calorie basis than potatoes.

Cassava is consumed in smaller quantities than potatoes in a number of cities even though it is clearly cheaper (Table 3.22). Consumer preferences may play a role in this, but the greater perishability of cassava is probably also depressing its consumption. Urban consumers always face the risk that the cassava they buy may be already deteriorating at the time of purchase, or will before they are able to use it. Frequent consumption of cassava also requires the inconvenience of equally frequent shopping for it because it can not be stored. Thus, though the price may be lower than potatoes, there are additional implicit costs to the cassava consumer.

Hence, improved production technology which lowered the supply price of cassava would not necessarily alone lead to a dramatic increase in the consumption of cassava since it is already comparatively cheap in relation to other root crops. Furthermore, because of the high marketing margins, even substantial reductions in farm level prices will result in only a marginal decline in prices at the consumer level. Improved storage technology may thus be equally or more important for permitting greater consumption of fresh cassava, especially in the urban market.

Nevertheless, although high perishability may be a significant constraint on fresh cassava consumption, preliminary evidence does suggest that the demand for cassava is responsive to price changes. Price elasticities of demand for fresh cassava estimated from a rather narrow data base (one year of data from Cali, Colombia), appear to be quite high, in the range of -2.2 to -3.2 (Table 3.9). This result holds for the Cali data whether retail or wholesale prices are utilized; for both monthly and weekly data; and for either OLS or two stage least squares estimation.

In contrast to the meager past available evidence (25), these data indicate that consumers will significantly alter their consumption of fresh cassava in response to price changes 3/. Moreover, though the reliability of estimates based on such scanty data ought not to be exagerated, the finding of an elastic demand for cassava is more consistent with its apparent role as a vegetable that makes a fairly small contribution to the diet, than were the past findings of an inelastic demand which would be more characteristic of a food that formed a major part of the diet.

The demand for fresh cassava is affected by income as well as by price. Data from both Brazil and Colombia (Tables 3.10 and 3.11) show that expenditures on fresh cassava generally rise with income though there is some tendency for expenditure to level off in the highest income groups. Expenditure elasticities of demand for fresh cassava present a similar pattern (Table 3.12).

The expenditure elasticity of demand for fresh cassava is low but positive in the lowest income quartile in three Colombian cities. The elasticity tends to rise in the two

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3/ Estimated price elasticities refer to marginal changes. While a 1% drop in price could be expected to be associated with a 2.5% change in consumption, it would be inappropriate to infer from this that a large price decline, say of 50%, would lead to a proportional increase in consumption of 125%.

middle income quartiles, and is zero or negative in the highest income group. These findings suggest that among the lowest income families, fresh cassava consumption does not rise rapidly with income increases.

The difficulties of managing perishability may be greater among low income households where refrigerators are less common and where housewives have greater work responsibilities that limit their capacity to cope with the time consuming chore of frequent purchase of fresh cassava. Also, since cassava is not the cheapest source of calories, these families may find it a better strategy to increase purchases of commodities that give a higher return in nutrients per unit of expenditure.

However, once a certain income threshold is reached, the propensity to purchase cassava as incomes rise is quite strong. In the lower-middle income groups the demand for fresh cassava is income elastic. In common with most foods at higher income levels, consumption ceases to grow with income.

Annual growth rates in demand projected for fresh cassava, assuming constant prices, are presented in Table 3.13. These growth rates take into account distinct rates of population and income growth for urban and rural areas as well as different levels of current consumption and different income elasticities. Unless the income elasticity of demand for fresh cassava in rural areas was elastic, demand growth for fresh cassava would be constrained to modest levels, below three per cent. This is anticipated to occur as population moves out of high cassava consuming rural areas (the rural population is expected to continue declining) into urban centers where fresh cassava consumption is much less.

In summary, then, fresh cassava in not a dietary staple in Latin America, with the exception of Paraguay. Perishability of cassava appears to be an important constraint on its consumption, leading to lower levels being consumed in urban than rural settings and contributing to a lower consumption of cassava than potatoes in cities, even though cassava is generally cheaper than potatoes. The demand for fresh cassava may be more price elastic than has been heretofore believed. Finally, fresh cassava consumption rises with income except among the highest income groups. The demand for fresh cassava in urban Colombia is income elastic among middle income and inelastic but positive among the lowest income households.

3.2.2. Flour Market

In many parts of the world cassava is processed into some form so that it is more storable than when fresh, thus circumventing the limits on the consumption of cassava imposed by its perishability and, for some varieties, a high HCN content. There are many traditional ways of processing cassava: in Brazil, the flour-like farinha da mandioca is produced; in Venezuela and the Caribbean the bread-like casabe is produced; in West Africa, gari, a fermented, roasted product is a staple for many.

Cassava flour (farinha da mandioca) is the principal form in which cassava is consumed in Latin America (Table 3.2), but only because of the dominance of Brazil in the aggregate. While cassava flour contributes only about 7% of total calorie intake in Brazil, its importance varies substantially by region (Table 3.14). In the Brazilian Northeast, cassava flour is the principal (and cheapest) calorie source, accounting for almost a quarter of total calorie consumption (Table 3.15). Moreover, cassava flour is principally a staple among the poor (Table 3.16), with consumption declining in the higher income stratas.

Indications are that cassava flour consumption has been declining in Brazil. This is partly due to an apparent negative income elasticity. However, prices have been rising rapidly since 1975, due to apparent declines in cassava production. Moreover, with the maintenance of price subsidies on wheat flour consumption (which were just recently removed), wheat flour prices were maintained at as much as one-half the price of cassava flour in the later part of the seventies. While upward price pressure has occurred for a basic calorie staple of the poor (farinha), the removal of the wheat flour subsidy will put further pressure on their food budgets and will probably halt the substitution process. Thus, improved cassava production technology for the Brazilian Northeast would probably have an immediate impact on nutritional levels, bringing down farinha prices and reversing the substitution process.

While traditional systems of cassava processing have been successful in creating less perishable products, their use tends to be restricted to their regions of origin, due apparently to differences in consumer tastes. Thus, there is a need for identification of some way of processing cassava that will lead to a product that will be widely accepted by consumers.

Since cassava flour can be incorporated into bread at levels of 10-15% with little to no noticeable effect on quality, the use of cassava flour in bread making appears to be one attractive prospect. This is particularly true in Latin America where wheat forms an important part of the diet in many countries.

Per capita consumption of wheat has risen in Latin America from about 30 kgs/capita/year in 1961-63 to nearly 50 kgs/capita/year 1976-78 (Table 3.17). Today wheat is one of the leading sources of both calories and proteins in the diet of most Latin America coutnries, generally providing more than 10% of both calories and proteins.

At the same time that wheat occupies an important role in the Latin American diet and that its consumption has been rising, imports of wheat into the region have more than tripled to over 9 millions/tons a year (Table 3.18). Not only have imports of wheat been growing, but imports have been increasing faster than domestic production, so that whereas in 1961-63 about half of the wheat consumed in Latin America was domestically produced, this figure has fallen to about 40% (Table 3.18).

Hence, the use of cassava to partially substitute for wheat flour in breads and pastas could promote some key economic objectives in the reduction of the ever growing burden of wheat imports and the farm income and employment effects of increased cassava production. Despite these positive prospects, there are some factors that impede the use of cassava as a wheat flour substitute.

Maintainence of end product quality is an important consideration, especially in leavened products. This necessitates the use of fairly low proportions of cassava in the flour mixture and also requires that the cassava flour be of very high quality. To obtain high quality cassava flour free of impurities may be difficult, particularly if the cassava is sun dried at a village level prior to milling.

The use of small amounts of cassava flour in the flour mixture, while preserving product quality, reduces the potential cost reductions to be achieved by utilizing cassava flour. For example, if cassava were 10% cheaper than wheat flour, substitution of 10% cassava in wheat flour would reduce total costs only 1%, perhaps barely sufficient to cover the costs of mixing and handling. Due to the low proportion of cassava that can be incorporated into wheat flour, the price differential between cassava and wheat must be quite substantial before any significant cost reduction in end product costs well be observed. Thus, in terms of motivating cassava flour substitution merely through the profit incentive, price differentials would have to be substantial. However, the social benefits of such a program might be achieved with a much more limited price spread by administrative order, given that private costs are covered.

Because cassava is low in protein, inclusion of cassava flour in wheat-products will lower nutritional quality somewhat. With wheat one of the top three protein sources in the diets of most Latin American countries, groups that were both nutritionally at risk and heavily dependent upon wheat as a source of protein might suffer a deterioration in nutritional status due to the use of cassava flour as a partial substitute for wheat flour. Food consumption studies could establish whether this was indeed a serious threat although use of small amounts of cassava in wheat products seems unlikely to create grave nutritional deficiencies (see Chapter 2). Nevertheless, if it did appear to be a significant problem, then it is possible to use a high protein flour, such as soy flour, as a supplement along with cassava flour.

However, this will further narrow profitability margins.

3.2.3. Animal Feed Market

The third food related market in which cassava may have a large unrealized potential in Latin America is the animal feed market. The animal feed concentrates industry has been growing very rapidly in the region in the decade of the seventies, with many countries attaining annual growth rates of more than 10% (Table 3.19). The main impetus for this growth has come from the poultry industry which absorbs the bulk of concentrates production in Latin America (Table 3.19).

The expansion of poultry production has exceeded that of other meats, and has fueled a strong growth indemand for concentrate feeds. This rapid growth in poultry production has been propelled by both supply and demand factors. The ease of transfer of modern poultry production technology from Europe and North America has transformed poultry from a traditional enterprise to large scale specialized operations utilizing modern capital intensive technology, with most feed being purchased in concentrate form.

This increased poultry production has found a ready market. The income elasticity of demand for poultry is higher than that for other meats in Latin America, so that economic growth in urban centers has provided a powerful stimulus to the demand for poultry (see Chapter 2). Moreover, the price of poultry has been declining relative to that of other meats in some countries (Figures 3.1 and 3.2).

The vigorous demand for poultry has led to an associated demand for feeds. Sorghum, which is used almost exclusively as an animal feed in Latin America, has been of critical importance in meeting the buoyant demand for feed. It has displayed a higher rate of growth than all other crops in most Latin America countries. It alone has accounted for half of the increased output of all crops in Mexico, one quarter in Colombia, and one tenth of the rise in total staple food production in Latin America between 1961-65 and 1974-76 (2).

This large increase in sorghum production has not, however, been sufficient to match the burgeoning demand for feed grains. Latin America (excluding the southern cone) is a substantial importer of sorghum and also maize, which in some countries is used as a feed grain (Table 3.20). In absolute terms Mexico is the largest importer, purchasing over half a million tons of sorghum annually as well as 1.3 million tons of maize, the latter amount being roughly equivalent to the quantity of maize used as animal feed in Mexico in 1972-74. Imports of grains and oilseeds in 1980 are estimated to be 10.3 million tons. Venezuela is proportionally the greatest importer, buying on the world market 62% and 44% respectively of apparent domestic consumption of sorghum and maize.

Moreover, it may be increasingly difficult to sustain the historic rates of output growth in feed grains, which have so far been unable to fill the rising demand. Much of output growth that has been attained has been through area expansion. Maize production in Latin America grew over 50% during the 1960's, with increased area accounting for the majority of the growth. In the 1970's, as area expansion in maize ceased, production grew a total of only 7% in the entire decade. Similarly over two-thirds of production gains in sorghum have been due to increased area under cultivation. With a rising marginal cost of increasing area to sorghum, it will be more difficult to achieve future gains in feed grain production than it has been in the past.

It is clear that despite large gains in domestic production of feed grains, demand has continued to grow faster than production with levels of imports climbing as a result. Based on these trends FAO projects that total coarse grain imports into Latin America will increase by 1985 to between 40% and 100% above the 1974-76 figures.

The widening gap between projected consumption of feed and domestic production creates a number of problems for the Latin American policy maker. These difficulties are intensified by the multi-objective framework within which policy is typically made, with a variety of different, sometimes conflicting, goals competing for attention. Among these, ample food supplies is a major concern, especially to maintain urban food prices. Even though cheap imports may be able to satisfy this objective, such an approach will tend to exacerbate already chronic trade deficits in many Latin American countries.

The inability of increased production of conventional feed grains to meet the growing demand at prevailing prices, as well as the disposition to attempt to increase domestic availability rather than rely on foreign sources of cheap carbohydrates as an animal feed, induces a search for new sources of animal feed, the most promising of which is cassava.

Large quantities of imported Asian cassava are already being used in the European feed concentrate industry. The European experience demonstrates that cassava can be a suitable source of carbohydrates in animal feeds even though it is very low in protein. Currently cassava is not a major constituent of feed concentrates in Latin America although the crop is widely cultivated in the tropical lowlands of the region.

Cassava may be a particularly attractive alternative to sorghum and other coarse grains for a variety of reason. First, it is well adapted to the acid infertile soils where feed grains cannot be produced at low cost. There are immense uncultivated areas of these soil types in South America which could be converted to cassava production. Second, cassava has a very high yield potential, with production of up to 5 tons of dry matter per hectare per year feasible under marginal conditions.

Third, while sorghum is generally produced in large farms with mechanized technology in Latin America, cassava remains a relatively labor intensive crop produced mainly by small farmers. Hence, there exists the possibility that increased production of cassava for the animal feed market could have a positive effect on the small farm sector while creating substantial rural employment.

Price is the crucial determinent of whether cassava can in fact tap the fast growing market for feeds. A linear programming least cost feed mix model has been constructed for poultry broilers in Colombia in order to ascertain the prices at which cassava would be competitive in this market. While at current market prices cassava is not included in least cost diets, at a price of 3.3 pesos/kg. cassava would enter the optimum ration, given the price regime of March 1980.

One can use estimates of current costs of production along with estimated costs of chipping and drying to project the per hectare yields that would have to be attained with the present cost structure in order to produce cassava cheaply enough that it would be incorporated in feed concentrates. Such an exercise indicates that with yields of roughly 15 tons per hectare, costs of production would fall sufficiently so that cassava would be competitive in the Colombian feed market.

With new production technology, such yields may be possible in the low cost production zones, such as the north coast of Colombia. Here cassava faces considerable moisture stress and is cultivated on poor soils. With current yields in Colombia averaging between 6 to 9 tons per hectare, achievement of 15 ton yields in the north coast appears to be a challenging though emminently feasible target.

Such a new high yielding cassava production technology could result in a number of favorable consequences. This cheaper cassava would reduce the cost of animal feed, hence the cost of production of poultry, leading to a consumer savings in Colombia estimated at $1,320,000 per year. Moreover, this increased cassava production would lead to the creation of new employment for the equivalent of 15,600 workers. Finally, it could potentially eliminate Colombia's present dependence on imported sorghum for feed, thus realizing a foreign exchange savings of $12.7 million, based on 1976-79 average imports and 1979 sorghum prices.

In summary, feed grain production has not been able to keep up with the demand for feed, spurred in large part by strong consumer demand for poultry and cost reducing innovation in the poultry industry. Consequently, there has been upward pressure on feed prices and imports of feed have been rising in many Latin American countries despite very high achieved growth rates in sorghum output. Use of cassava in feed concentrates is an appealing solution to the widening gap between the demand for feed and domestic supply. Cassava is especially promising because it has a relatively high yield potential under the marginal conditions that characterize extensive areas of under utilized land in Latin America and also because it is produced primarily by small farmers with labor intensive technology.

A case study of the Colombian feed market has suggested that new cost reducing production technology is essential for cassava to be able to enter the feed market in Colombia. Cassava may face similarly positive prospects in other feed deficit nations, such as Mexico, Peru and Venezuela. However, the prices of feed grains in Colombia are well above world market prices. Were cassava to face would market competition with low cost coarse grains, then entry into the feed market would be rather more difficult than has been indicated from the Colombian case study and the requirements for new technology would likewise be more rigorous.

3.2.4. MARKET GROWTH POTENTIAL

The potential growth prospects for cassava in the fresh, flour and feed markets for Colombia are presented in Table 3.21. Colombia is not an ideally typical case, and thus caution needs to be exercised in generalizing from the conditions in markets in one country to that of all Latin America.

Colombia is in one sense representative of the rest of

Latin America, except for Brazil, in that today the fresh market for cassava is the most important. Projected growth of demand in this market is clearly non-zero, but it does not seem to have the same potential for further expansion as do the flour and feed markets. While improved storage techniques for fresh cassava might reveal a strong latent demand for the fresh product, the impact of such a new technology is highly speculative at this time.

The flour market may be slightly less promising than the feed market in Colombia, both in that it appears to be a smaller market, and also because the quality standards required of cassava in this market are likely to be more rigorous. Nonetheless, cheap high quality cassava flour could find a not insubstantial market as a wheat substitute both in Colombia and elsewhere in Latin America.

The feed market may offer the best promise both in that it is the largest potential growth market facing cassava (ignoring non-food markets), and also because the quality standards needed in this market are relaxed compared to the fresh and flour markets. Nevertheless, cassava is most unlikely to be able to enter this market, at least in Colombia, without a cost-reducing, yield-increasing, improved technology. Moreover, even in this market cassava could face tough international competition from low cost producers of feed grains. Cassava probably has good prospects in this market in the policy context of a continued political commitment to import substitution and high utilization of domestic resources, but it would have difficulty in competing in a free trade regime, unless either the impact of new technology were somewhat greater than has been assumed to be the case here or there were a tendency for world feedgrain prices to increase.

3.3. Research Implications

As was true of soybeans and sorghum in 1960, the importance of cassava in Latin America lies not so much in current production and utilization - although it is regionally important in Paraguay and the Brazilian Northeast - but in its potential. As was shown for the case of Colombia, for traditional markets commercial production could increase by no more than 2.7% per year in the next decade. Were the composite flour and feed concentrate markets to be fully exploited, the potential production growth rate could be as high as 10% per annum. The potential impact on farmer incomes and labor utilization is obvious. Moreover, to enter these markets prices would have to be substantially reduced, providing a price floor to farmers and, given the high price elasticity of demand for fresh cassava, resulting in a potential marked increase in urban fresh consumption, due to the resultant price decline.

The principal conclusion to be reached, then, is that new production technology is absolutely necessary to realize this potential but that the extension of new production technology without the associated development of these alternative markets will, outside the Brazilian Northeast, either face farmer resistance or result in a retrogressive impact on farmer incomes, since area reduction within the current production structure would result in many farmers moving out of production. The mere existence of improved production technology, moreover, does not guarantee the development of these alternative markets. Processing technology is required, market linkages need to be made, and profitability margins need to be apparent, which may not be the case when based solely on urban fresh market prices (a dual price structure is usually found where an industrial and fresh urban food market compete 4/). Cassava technology generation and transfer must thus take place within a systems framework integrating both production and utilization.

Within this systems framework, the principal economic research issues are defined in a hierarchical manner, as follows:

a) Evaluation of the agronomic potential of the crop.

b) Cassava farming systems evaluation.

c) Analysis of utilization and marketing systems.

d) Analysis of aggregate demand and production potential.

4/ For example, in the state of Sao Paulo in Brazil in 1980, farm level prices for fresh cassava for the urban market was 2 to 4 times higher than the price of cassava for industrial use. In some cases there are quality differences in the cassava; in other cases it is the same cassava. Similar cases have been observed in Colombia and Ecuador.

Cassava research must necessarily exceed the scope of most traditional crop research programs. While increasing the complexity of the task, the framework insures a comprehensive evaluation of research priorities and of potential constraints on technology adoption at each systems level. The preceding analysis and the potential productivity of the crop established by the cassava program would strongly argue that the potential of cassava be pursued.

TABLE 3.1 : CASSAVA : STATISTICS ON AREA, PRODUCTION, AND MARKETING, 1971-76

REGION AND COUNTRY	AREA HECTARES	YIELD TONS/HA	PRODUCTION TONS	ON-FARM CONSUMPTION TONS	MARKETED TONS	PROCESSED TONS
TROPICAL LATIN AMERICA						
BRAZIL (75) 2/	1,307,251	8.9	11,672,739	2,687,923	8,984,817	6,178,394
PARAGUAY (76)	56,550	14.8	836,940	719,768	117,172	175,498
VENEZUELA (75)	37,417	8.5	317,393	77,131	240,262	66,670
ANDEAN						
BOLIVIA (72)	26,426	7.3	193.128	N.A	N.A.	1,000
COLOMBIA (73)	117,540	6.5	764,015	N.A.	N.A.	3,179
ECUADOR (74)	23,536	5.8	136,754	14,788	122,006	2.000
PERU (76)	36,055	8.3	299,128	N.A.	N.A.	1.500
CENTRAL AMERICA						
COSTA RICA (73)	2,077	6.6	13,811	1,275	12,536	925
EL SALVADOR (71)	1,166	14.1	16,470	N.A.	N.A.	-
GUATEMALA (72-74)	2,333	3.0	7,000	N.A.	N.A.	2,512
HONDURAS (74)	3,644	2.7	9,743	N.A.	N.A.	-
NICARAGUA (74)	5,112	4.8	24,608	N.A.	N.A.	-
PANAMA (72-74)	4,555	8.6	39.174	N.A.	N.A.	3,933
CARIBBEAN						
CUBA (76)	19,338	8.0	154.704	70,368	84,336	-
DOMINICAN REP. (75)	22,300	8.1	179.750	87,150	90.800	N.A.
HAITI (72-74)	31,556	4.5	142,000	N.A.	N.A.	138,000
JAMAICA (72-74)	3,405	5.0	17,025	N.A.	N.A.	2,554
TOTAL LATIN AMERICA	1,700,291	8.7	14,824,422	4,075,000 1/	10,749,500	6,576,165

1/ ESTIMATE

2/ NUMBER INDICATES THE YEAR IN WHICH DATA WAS OBTAINED

TABLE 3.2 . CASSAVA : UTILIZATION IN LATIN AMERICA, 1971-76

REGION AND COUNTRY	HUMAN CONSUMPTION FRESH	HUMAN CONSUMPTION PROCESSED	STARCH	ANIMAL FEED	TOTAL CONSUMPTION
	----------- METRIC		TONS -----------		
TROPICAL LATIN AMERICA					
BRAZIL	687,730	5,898,394	280,000	4,806,615	11,672,739
PARAGUAY	299,825	136,998	38,500	361,617	836,940
VENEZUELA	119,917	42,606	24,064	130,806	317,392
ANDEAN					
BOLIVIA	68,923	-	1,000	123,205	193,128
COLOMBIA	466,042	-	3,179	294,794	764,015
ECUADOR	124,109	-	2,000	10,685	136,794
PERU	172,420	-	1,500	125,208	299,128
CENTRAL AMERICA					
COSTA RICA	12,886	-	925	-	13,811
EL SALVADOR	16,470	-	-	-	16,470
GUATEMALA	4,488	-	2,512	-	7,000
HONDURAS	9,743	-	-	-	9,743
NICARAGUA	24,608	-	-	-	24,608
PANAMA	29,341	300	3,633	5,900	39,174
CARIBBEAN					
CUBA	154,704	-	-	-	154,704
DOMINICAN REP.	175,700	?	-	4,050	179,750
HAITI	-	138,000	-	4,000	142,000
JAMAICA	14,471	-	2,554	-	17,025
TOTAL LATIN AMERICA	2,381,377	6,216,298	359,867	5,866,880	14,824,422

TABLE 3.3. CASSAVA : ESTIMATES OF RURAL AND URBAN CONSUMPTION OF FRESH CASSAVA IN LATIN AMERICA

COUNTRY	RURAL CONSUMPTION		URBAN CONSUMPTION		TOTAL CONSUMPTION	
	PER CAPITA	TOTAL	PER CAPITA	TOTAL	PER CAPITA	TOTAL
	KG	TONS	KG	TONS	KG	TONS
TROPICAL LATIN AMERICA						
BRAZIL (75)	11.2	515,805	2.7	171,925	6.3	687,730
PARAGUAY (76)	180.0	252,540	35.0	47,285	110.1	299,825
VENEZUELA (75)	27.4	72,062	5.0	47,915	9.8	119,917
ANDEAN						
BOLIVIA (72)	17.0	60,017	5.4	8,906	15.3	68,923
COLOMBIA (73)	35.0	298,291	16.5	207,751	20.4	446,042
ECUADOR (74)	31.0	102.127	6.0	21,282	19.0	124,109
PERU (76)	17.3	116,273	6.2	56.147	10.9	172.420
CENTRAL AMERICA						
COSTA RICA (73)	N.A.	N.A.	N.A.	N.A.	6.9	12,886
EL SALVADOR (71)	N.A.	N.A.	N.A.	N.A.	4.5	16,470
GUATEMALA (72-74)	N.A.	N.A.	N.A.	N.A.	0.8	4,488
HONDURAS (74)	3.5	6,295	3.5	3,448	3.5	9,743
NICARAGUA (74)	N.A.	N.A.	N.A.	N.A.	11.0	24,608
PANAMA (72-74)	N.A.	N.A.	N.A.	N.A.	18.5	29,341
CARIBBEAN						
CUBA (76)	20.3	70,368	12.4	75,674	16.0	154,704
DOMINICAN REP(75)	N.A.	N.A.	N.A.	N.A.	34.3	175,700
HAITI (72-74)	N.A.	N.A.	N.A.	N.A.	-	-
JAMAICA (72-74)	N.A.	N.A.	N.A.	N.A.	7.3	14,471
TOTAL LATIN AMERICA 1/	19.0	1,683,531	5.6	697,846	11.1	2,381,377

1/ ESTIMATED FOR ONLY TROPICAL LATIN AMERICA, EXCLUDING MEXICO.

TABLE 3.4. : BRAZIL : PRODUCTION ESTIMATES BY SOURCE, 1975

	Production TONS	Area HA	Yield TON/HA
Cassava			
Census	11,672,739	1,307,251	8,929
Official	26,117,614	2,041,416	12,793
Rice			
Census	7,548,930	5,662,875	1,333
Official	7,781,538	5,306,270	1,504
Soybean			
Census	8,721,274	5,656,928	1,541
Official	9,893,008	5,824,492	1,698

Sources : Census : <u>Censo Agropecuario</u>, <u>Brazil</u>, Fundacao Instituto Brasilereiro do Geografia Estadistica, Rio de Janeiro, 1979.
Official : <u>Anuario Estadistico do Brazil</u>, Fundacao Instituto Brasilereiro do Geografia e Estadistica, Rio de Janeiro, 1977.

TABLE 3.5. : PARAGUAY : ON-FARM FEEDING OF CASSAVA TO HOGS

PRODUCTION UNIT	HOG POPULATION DISTRIBUTION	CASSAVA'S CONTRIBUTION TO ENERGY INTAKE	CASSAVA CONSUMPTION
	%	%	TONS
FARROWING			
1-4 SOWS	71.4	22.6	255.074
5-19 SOWS	6.5	21.6	36.018
20 OR MORE	4.5	0	0
FATTENING			
1-9 HEAD	15.9	34.9	68.336
10-49 HEAD	0.7	9.2	1.158
50 OR MORE	1.0	5.9	1.031
TOTAL	100.0	22.4	361.617

SOURCE : M. REGUROGA AND H. KUGLER, ''LA PRODUCCION PORCINA EN PARGUAY'', MIMEO, CIAT, 1979.

TABLE 3.6. CASSAVA: DISTRIBUCION OF NUMBER OF FARMERS, AREA, AND PRODUCTION BY FARM SIZE AND AREA HARVESTED, BRAZIL (1975) AND ECUADOR (1974).

AREA	BRAZIL			ECUADOR		
STRATIFICATION	FARMERS	AREA	PRODUCTION	FARMERS	AREA	PRODUCTION
HECTARES	----------	----------	---------- PERCENT	----------	----------	----------
FARM SIZE :						
LESS THAN 5	44.6	31.9	28.7	39.5	22.5	20.7
5 TO 10	13.6	12.8	13.2	14.6	13.0	11.8
10 TO 20	14.9	14.9	15.9	13.7	14.2	13.0
20 TO 50	16.0	20.6	22.1	18.0	21.6	21.2
50 TO 100	5.5	8.9	9.2	14.7	18.9	20.1
100 TO 500	4.7	8.7	8.7	3.8	7.9	10.1
500 TO 1000	0.5	1.2	1.2	0.2	1.2	1.5
GREATER THAN 100	0.3	1.0	1.0	0.1	0.6	1.5
AREA HARVESTED :						
LESS THAN 1	67.7	30.1	30.6	76.8	N.A.	N.A.
1 TO 2	21.1	28.3	28.4	16.8	N.A.	N.A.
2 TO 5	9.7	27.9	27.3	5.8	N.A.	
5 TO 10	1.1	7.4	7.1	0.4	N.A.	N.A.
10 TO 20	0.3	3.8	3.9	0.1	N.A.	N.A.
GREATER THAN 20	0.1	2.4	2.6	-	N.A.	N.A.
TOTAL	1,429,528	1,07,251	11,672,739	39,945	23,536	136,794

SOURCE : CENSO AGROPECUARIO, BRAZIL, FIBGE, RIO DE JANEIRO, 1979; II CENSO AGROPECUARIO 1974, INSTITUTO NACIONAL DE ESTADISTICA Y CENSOS, QUITO, 1979.

TABLE 3.7. DIETERY CONTRIBUTION OF FRESH CASSAVA AND POTATOES

COUNTRY	POTATOES	FRESH CASSAVA	ALL ROOTS AND TUBERS
	(PER CENT OF TOTAL CALORIES)		
BRAZIL	0.8	2.9	10.3
MEXICO	0.5	0.0	0.5
BOLIVIA	10.1	4.4	15.5
COLOMBIA	3.0	3.2	8.1
ECUADOR	5.4	2.8	8.5
PARAGUAY	0.1	11.3	17.0
PERU	8.3	2.8	13.0
VENEZUELA	0.8	1.7	3.8
CENTRAL AMERICA	0.3	0.7	1.2
CARIBBEAN	0.4	2.4	6.2
TOTAL [A]	1.9	2.8	8.8

[A] EXCLUDES MEXICO

SOURCE: FAO Food Balance Sheets, 1972-74

TABLE 3.8. RELATIVE PRICES PER CALORIE FOR FRESH CASSAVA AND OTHER FOODS (PRICE/CALORIE OTHER FOOD ÷ PRICE/CALORIE CASSAVA

COUNTRY	RICE	POTATO	BREAD
BRAZIL			
BELO HORIZONTE	0.40	1.52	-
PORTO ALEGRE	0.62	2.19	-
RECIFE	0.66	3.19	-
SAO PAULO	0.35	2.15	-
COLOMBIA			
BARRANQUILLA	0.65	1.51	-
BOGOTA	0.43	0.85	1.15
CALI	0.41	0.71	1.19
ECUADOR			
QUITO	0.69	0.88	1.61
PERU			
LIMA	0.66	1.41	0.82
VENEZUELA			
CARACAS	0.20	1.16	-
MARACAIBO	0.46	1.82	-
SAN SALVADOR			
EL SALVADOR	0.87	2.38	-
DOMINICAN REPUBLIC			
SANTO DOMINGO	0.55	1.67	-

SOURCES: ANUARIO ESTADÍSTICO DO BRAZIL, FUNDAÇAO INSTITUTO BRASILERO DE GEOGRAFÍA E ESTADÍSTICA, RÍO DE JANEIRO, 1978; ANUARIO ESTADÍSTICO AGROPECUARIO, MINISTERIO DE AGRICULTURA, CARACAS, VENEZUELA, 1979; BOLETÍN MENSUAL, DEPARTAMENTO ADMINISTRATIVO NACIONAL DE ESTADÍSTICA, BOGOTÁ, COLOMBIA, VARIOUS ISSUES; ANUARIO DE ESTADÍSTICAS AGROPECUARIAS, MINISTERIO DE AGRICULTURA, SAN SALVADOR, EL SALVADOR, 1979; BOLETÍN SEMESTRAL, SECRETARIA DE AGRICULTURA, REPÚBLICA DOMINICANA, MAYO 1977; AMERICA EN CIFRAS, O.A.S., WASHINGTON, D.C. 1974.

TABLE 3.9. DEMAND EQUATIONS FOR FRESH CASSAVA, CALI, COLOMBIA

	WHOLESALE PRICES			RETAIL PRICES
	WEEKLY (OLS)	MONTHLY (OLS)	MONTHLY (TSLS)	MONTHLY (TSLS)
INTERCEPT	2.94	4.06	4.43	4.48
SUPPLY OF CASSAVA	-0.315	-0.398	-0.448	-0.393
	(6.01)	(4.04)	(2.78)	(2.38)
PRICE OF PLANTAIN	0.253	0.148	0.108	0.180
	(1.96)	(0.72)	(0.47)	(0.85)
R^2	.49	.71	.60	.66
DW	1.85	2.44	2.69	2.02
OWN PRICE ELASTICITY	3.18	2.58	2.23	2.54

't' VALUES IN PARENTHESES

SOURCE: UNPUBLISHED DATA, CAVASA, CALI, COLOMBIA, 1979.

TABLE 3.10. PER CAPITA EXPENDITURES ON FRESH CASSAVA BY INCOME GROUP, BRAZIL, 1975

REGION	FAMILY INCOME LEVEL ($CRU/YEAR) 0-8499	9000-15799	15800-31599	31600+
URBAN				
BELO HORIZONTE	2.1	1.4	7.5	3.4
PORTO ALEGRE	8.7	7.5	9.2	5.8
RECIFE	2.5	2.9	3.0	3.7
SAO PAULO	0.3	1.5	2.1	2.6
RURAL				
NORTHEAST	4.7	6.0		
SOUTH	11.7	22.6	22.2	17.8
MINAS GERAIS	2.5	3.4	6.2	11.4

SOURCE: ESTUDO NACIONAL DA DESPESA FAMILIAR, FUNDAÇAO INSTITUTO BRASILERO DE GEOGRAFIA E ESTATICA, RÍO DE JANEIRO, 1978.

TABLE 3.11. PER CAPITA EXPENDITURES ON FRESCH CASSAVA BY INCOME CLASS, COLOMBIA, 1967-68, PESOS/YEAR.

CITY	INCOME QUARTILE			
	LOWEST	2	3	HIGHEST
BARRANQUILLA	30.0	37.6	36.4	40.4
BOGOTA	12.4	22.0	22.8	28.0
CALI	18.0	26.4	31.2	30.8

SOURCE: ECIEL, BROOKINGS INSTITUTE, WASH., D.C.

TABLE 3.12. EXPENDITURE ELASTICITIES OF DEMAND FOR FRESH CASSAVA

CITY	EXPENDITURE QUARTILE			
	LOWEST	2	3	HIGHEST
BARRANQUILLA	0.50	0.90	0.66	0.00
BOGOTA	0.44	1.06	1.16	-0.01
CALI	0.40	1.10	-0.23	-0.10

SOURCE: ECIEL DATA, BROOKINGS INSTITUTE, WASH., D.C.

TABLE 3.13.PROJECTED GROWTH RATES FOR DEMAND OF FRESH CASSAVA, COLOMBIA (%/YR)

TOTAL DEMAND GROWTH	RURAL DEMAND GROWTH	URBAN DEMAND GROWTH	RURAL INCOME ELASTICITY	URBAN INCOME ELASTICITY
1.96	-2.20	5.44	0	0.5
2.70	-0.59	5.44	0.5	0.5
3.96	1.03	6.40	1.0	1.0

TABLE 3.14. CASSAVA PER CAPITA CONSUMPTION IN BRAZIL IN FRESH AND FLOUR FORMS, 1960 AND 1975

COUNTRY	1960			1975		
	FRESH CASSAVA	CASSAVA FLOUR	TOTAL	FRESH CASSAVA	CASSAVA FLOUR	TOTAL
	KILOGRAMS					
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
SAO PAULO	5.7	3.7	16.8	2.4	1.1	5.7
URBAN	2.5	2.4	9.7	1.3	1.0	4.3
RURAL	11.1	5.8	20.5	4.3	1.7	9.4
SOUTH	44.6	12.1	80.9	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
NORTH AND WEST	-	-	-	5.0	23.6	75.8
URBAN	-	-	-	0.4	45.5	136.9
BRAZIL	14.9	26.3	93.8	6.1	17.6	58.9
URBAN	3.0	11.6	37.8	2.7	9.7	31.8
RURAL	24.7	38.3	139.8	11.2	29.4	99.4

SOURCE : GETULIO VARGAS FOUNDATION (15) AND IBGE (14).

TABLE 3.15

Diet composition and nutrient cost to the consumer for calories in the Brazilian Northeast, 1975

Food Categories		Calories Per Adult Unit Per Day		Percentage of Calories (%)		Annual Cost to the Consumer of Maintaining Consumption of One Hundred Calories from Each Food[a] (Cruzeiros)	
Cereals and Derivatives		518		26.8		48	
	Rice		242		12.5		42
	Corn		108		5.6		35
	Wheat Products		161		8.3		65
	Others		7		0.4		114
Tubers		496		25.7		23	
	Potato		2		0.1		250
	Fresh Cassava		13		0.7		46
	Cassava Flour		454		23.5		20
	Others		27		1.4		52
Sugars		210		10.9		30	
Legumes		311		16.1		48	
	Field Beans and Cowpeas[b]		280		14.5		44
	Other Legumes		31		1.6		38
Vegetables		10		0.5		520	
Fruits		35		1.8		157	
Meat and Fish		179		9.3		246	
	Beef		74		3.8		273
	Pork		46		2.4		126
	Chicken		13		0.7		462
	Canned Meat		2		0.1		250
	Fish		23		1.2		296
	Others		21		1.1		224
Eggs		10		0.5		260	
Milk and Cheese		67		3.5		142	
Oils and Fats		84		4.4		74	
Beverages		10		0.5		900	
TOTAL		1.930		100		76	

a Calculated from the ENDEF data on annual expenditures per family by dividing these expentidures by an estimated 3.5 adult equivalents in the mean family of five and then dividing these expenditures by the number of calories per adult day. When multiplied by 100 these cost are the cruzeiro costs of obtaining 100 calories/day of each item during the entire year for one adult. Expenses on meals outside the house were not itemized; hence, they could not be categorized. However, they were only 5.7% of total food expenditures and *would probably be biased* towards the higher quality food and beverages hence, their omission would bias downward expenditure data on high quality foods and beverages but not substantially effect the comparisons of the low cost calorie staples. The calculation is made in the following manner:

$$\frac{\text{Expenses/Family-Year}}{\text{Adult Equivalent/Family}} \times \frac{1}{\frac{\text{Calories}}{\text{Adult Equivalent/Day}}} \times 100 = \frac{\text{Expenses/Year}}{\text{100 Calories/Day}}$$

b Cowpeas and field beans are given the same Portuquese word. Cowpeas predominate in Northeastern production but field beans are preferred by urban consumers. Consumption is probably about equally divided between the two in the Northeast.

Source: Calculated from Fundacao Instituto Brasileiro de Geografia e Estatistica (FIBGE), Estudo Nacional da Despesa Familiar, Despesas das Familias, *Regiao V, Rio de Janeiro*, 1978. p.82 and FIBGE, Estudo Nacional da Despesa Familiar, Consumo Alimentar Antropometria, Regiao V, Rio de Janeiro, 1978. p.21.

TABLE 3.16 : BRAZILIAN NORTHEAST : PER CAPITA COLORIE CONSUMPTION BY INCOME STRATA AND FOOD SOURCE, 1975

INCOME GROUP [a]	POPULATION WEIGHT	TOTAL	FOOD GROUP				
			CEREALS AND PRODUCTS	ROOTS AND TUBERS	SUGAR	OIL AND FATS	OTHER
		---------- CALORIES PER-DAY ----------					
LOW	.750	1813	449	546	188	44	586
MEDIUM	.155	2214	708	396	263	122	725
HIGH	.095	2390	752	262	303	201	872
AVERAGE	1.00	1931	518	496 [b]	211	71	635

[a] LOW = LESS THAN 2,260 CRUZEIROS ANNUAL TOTAL FAMILY EXPENDITURE
MEDIUM = FROM 2260 TO 4519 CRUZEIROS ANNUAL TOTAL FAMILY EXPENDITURE
HIGH = MORE THAN 4519

[b] CASSAVA FLOUR REPRESENTS 91.5% OF THE ROOT AND TUBER SUB-TOTAL

SOURCE : ANNUARIO ESTADISTICO DO BRAZIL, FUNDACAO INSITUTO BRASILERO DE GEOGRAFIA E ESTADISTICA, RIO DE JANEIRO, 1979

TABLE 3.17. WHEAT CONSUMPTION IN LATIN AMERICA

COUNTRY	PER CAPITA APPARENT CONSUMPTION (1961-63)	PER CAPITA APPARENT CONSUMPTION (1976-78)	%TOTAL CALORIES FROM WHEAT (1972-74)	%TOTAL PROTEIN FROM WHEAT (1972-74)
BRAZIL	36.7	56.0	10.7	11.4
MEXICO	41.5	50.0	11.4	12.7
BOLIVIA	15.8	52.5	19.4	21.7
COLOMBIA	15.7	19.1	5.7	7.0
ECUADOR	23.9	40.3	8.8	10.6
PARAGUAY	49.4	29.5	10.5	10.1
PERU	53.6	52.3	18.1	22.4
VENEZUELA	43.5	54.8	15.1	19.0
CENTRAL AMERICA	8.3	26.4	7.0	7.5
CARIBBEAN	-	68.6	16.0	18.5
TOTAL	31.3	49.4	11.3	12.7

SOURCE: FAO <u>PRODUCTION YEARBOOK</u>, VARIOUS ISSUES

FAO <u>FOOD BALANCE SHEETS</u>, 1972-74.

TABLE 3.18. WHEAT IMPORTS IN LATIN AMERICA, (1,000 TONS/YEAR).

COUNTRY	IMPORTS (1961-63)	IMPORTS (1976-78)	IMPORTS AS PER CENT OF CONSUMPTION (1961-63)	(1976-78)
BRAZIL	2083	3509	79.2	56.9
MEXICO	-	309	0.0	10.0
BOLIVIA	15	242	25.9	80.9
COLOMBIA	118	422	47.4	91.9
ECUADOR	38	236	36.7	85.1
PARAGUAY	79	50	91.2	62.0
PERU	391	730	71.9	86.7
VENEZUELA	-	676	-	99.9
CENTRAL AMERICA	69	447	68.3	89.2
CARIBBEAN	-	1464	-	100.0
TOTAL	2916	9081	49.8	58.3

SOURCE : FAO TRADE YEARBOOK, VARIOUS ISSUES
FAO PRODUCTION YEARBOOK, VARIOUS ISSUES

TABLE 3.19. FEED CONCENTRATES IN SELECTED LATIN AMERICAN COUNTRIES

	ANNUAL GROWTH RATE CONCENTRATES PRODUCTION	%CONCENTRATES FOR POULTY	%CONCENTRATES FOR SWINE	%CONCENTRATES OTHER
BRAZIL	13.0	75	15	10
COLOMBIA	12.6	76	16	8
MEXICO	8.4	68	20	12
PERU	12.9	87	N.A.	N.A.
VENEZUELA	10.9	60	27	13

N.A. = NOT AVAILABLE

SOURCE: FEDERAL, BOLETÍN ESTADÍSTICO NO. 5, BOGOTÁ, 1980; CONJUNTURA ECONÓMICA, FUNDACIÓN GETULIO VARGAS, RÍO DE JANEIRO, 1979; ANÁLISIS DE SITUACIÓN AGRO-INDUSTRIAL, H.A. TORRES Y J. HERNÁNDEZ, LIMA; ANNUARIO ESTADÍSTICO AGROPECUARIO, MINISTERIO DE AGRICULTURA, CARACAS, VENEZUELA

TABLE 3.20 MAIZE AND SORGHUM IMPORTS

	MAIZE IMPORTS [a]			SORGHUM IMPORTS [a]		
	1971-73 (000 TONS)	1976-78 (000 TONS)	IMPORTS AS % OF CONSUMPTION (1976-78)	1971-73 (000 TONS)	1976-78 (000 TONS)	IMPORTS AS % OF CONSUMPTION (1976-78)
BRAZIL	- 495	- 450	-	- 3	- 20	-
MEXICO	210	1340	13	73	540	12
BOLIVIA	2	0	0	-	-	-
COLOMBIA	69	66	7	24	43	9
ECUADOR	- 1	13	5	0	6	67
PARAGUAY	- 6	- 4	0	0	0	0
PERU	107	212	24	27	18	23
VENEZUELA	140	543	44	361	511	62
CENTRAL AMERICA	84	133	7	3	48	12
CARIBBEAN [b]	383	722	67	2	7	4
TOTAL	495	2575	16	487	853	13 [c]

SOURCE : FAO PRODUCTION YEARBOOK AND TRADE YEARBOOKS, VARIOUS ISSUES.

a MINUS SIGNS DENOTE EXPORTS

b INCLUDES CUBA, DOMINICAN REPUBLIC, GUYANA, HAITI, JAMAICA, TRINIDAD

c EXCLUDES BRAZIL

TABLE 3.21. GROWTH POTENTIAL OF CASSAVA MARKETS, COLOMBIA PROJECTIONS FOR 1990.

	FRESH CASSAVA MARKET	FLOUR MARKET	POULTRY FEED MARKET
CONSUMPTION 1979 (1000 TONS)	547	0	0
POTENTIAL MARKET, 1980 (1000 TONS)	-	203	540
ANNUAL GROWTH RATE IN DEMAND	2.7	4.8	6.2
PROJECTED MARKET INCREASE 1990 VS 1980 (1000 TONS)	168	324	986

TABLE 3.22

CONSUMPTION OF FRESH CASSAVA AND POTATOES (KG/CAPITA/YEAR)

REGION	FRESH CASSAVA	POTATOES
LIMA	2.9	28.4
CARACAS	11.2	18.4
BOGOTA	8.9	42.4
BRAZIL - URBAN		
BELO HORIZONTE	1.7	14.0
PORTO ALEGRE	7.6	25.3
RECIFE	3.2	5.3
SAO PAULO	1.3	16.6
BRAZIL - RURAL		
NORTHEAST	5.2	0.3
SOUTH	23.2	26.4
MINAS GERAIS	5.3	5.4

FIGURE 3.1 CONSUMER MEAT PRICES IN CONSTANT TERMS IN COLOMBIA

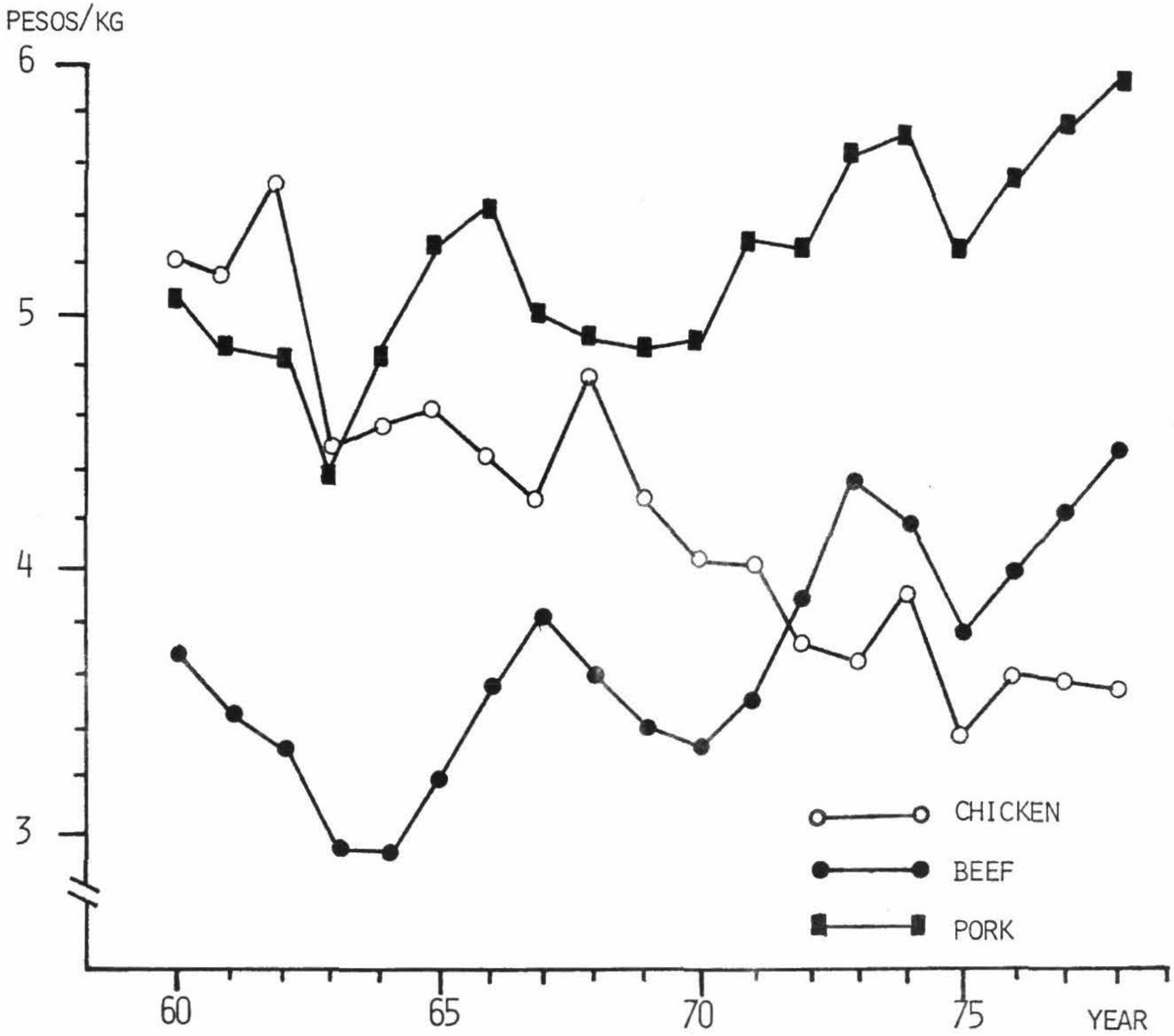
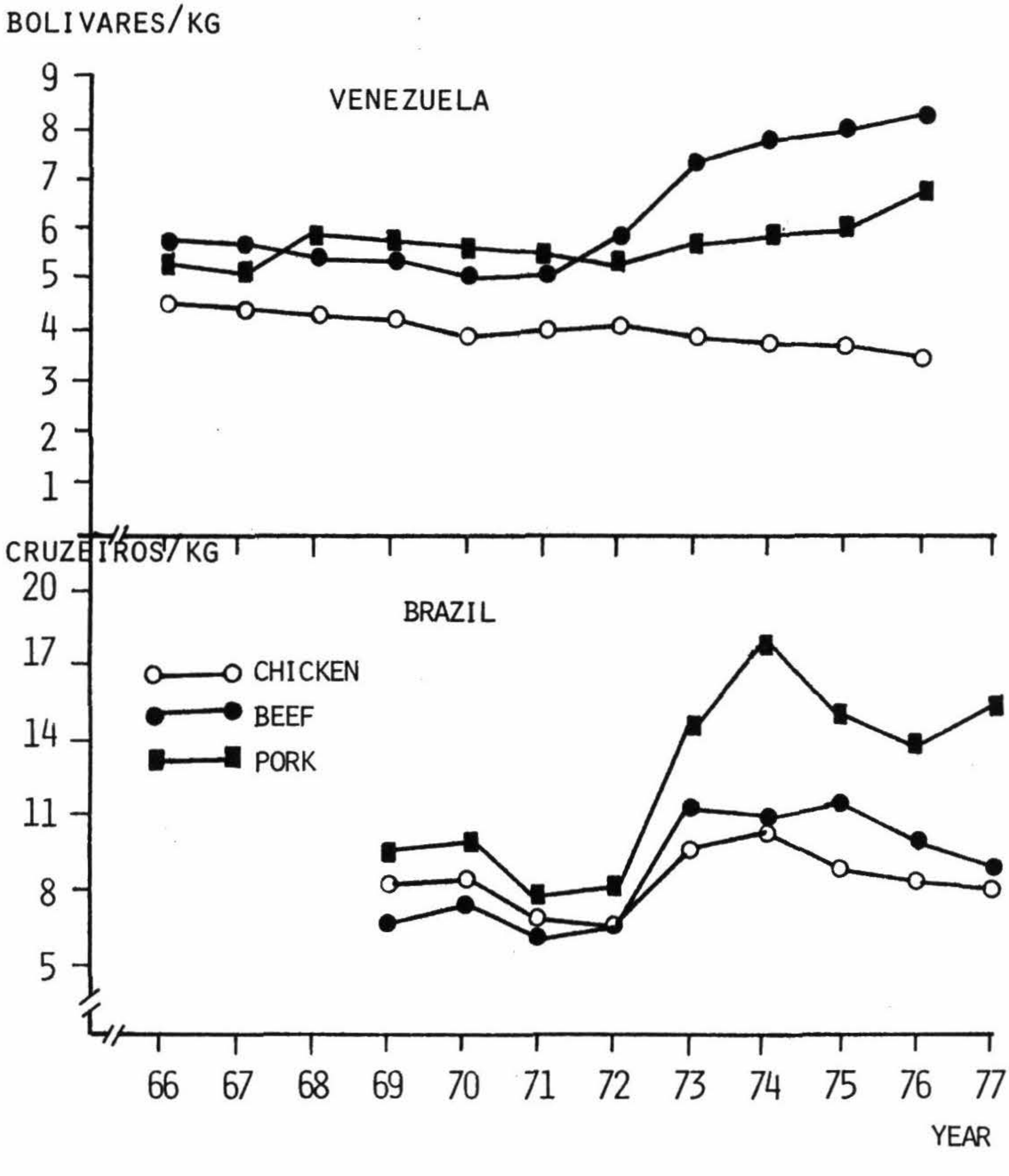


FIGURE 3.2. CONSUMER MEAT PRICES IN COSTANT TERMS IN VENEZUELA AND BRAZIL



Data Appendix 4

Cassava

CASSAVA PRODUCTION.RELATIVE IMPORTANCE IN THE REGION AND PER CAPITA CONSUMPTION LEVELS (U.S.D.)

COUNTRY	PRODUCTION 1000 MT 1960/62	1970/72	1977/79	PERCENTAGE OF TOTAL % 1977/79	PER CAPITA PRODUCTION KG 1977/79
BRAZIL	18505	29841	25407	80.600	213
MEXICO	0	0	79	0.252	1
BOLIVIA	114	232	300	0.952	57
PERU	368	486	407	1.291	24
COLOMBIA	758	1382	2099	6.660	82
VENEZUELA	321	319	344	1.091	25
PARAGUAY	990	1329	1697	5.384	587
CUBA	162	217	298	0.945	31
ECUADOR	225	377	187	0.594	25
DOMINICAN RP	147	183	169	0.536	30
	21589	34366	30989	98.306	114
HONDURAS	17	37	8	0.025	2
NICARAGUA	12	17	26	0.081	10
COSTA RICA	9	10	14	0.044	7
PANAMA	12	37	40	0.127	22
GUATEMALA	5	7	8	0.025	1
EL SALVADOR	9	13	13	0.042	3
CENTRAL AMERICA	64	121	109	0.346	5
GUYANA	10	0	0	0.000	0
HAITI	110	135	189	0.601	34
JAMAICA	11	17	31	0.099	15
TRINIDAD ETC	4	4	5	0.016	4
BARBADOS	1	1	1	0.003	4
CARIBBEAN	136	156	227	0.719	23
TROPICAL LATIN AMERICA	21789	34644	31324	99.371	103
ARGENTINA	248	277	198	0.629	8
TEMPERATE LATIN AMERICA	248	277	198	0.629	5
LATIN AMERICA	22037	34921	31523	100.000	92

(U.S.D.) CASSAVA (ANNUAL GROWTH RATES)

COUNTRY	PRODUCTION 1960/69	1970/79	1960/79	AREA 1960/69	1970/79	1960/79	YIELD 1960/69	1970/79	1960/79
BRAZIL	6.1***	-2.0***	1.5***	4.8***	0.7**	2.3*	1.3***	-2.7***	-0.8***
MEXICO	0.0	13.2	13.2	0.0	20.3	20.3	0.0	-7.0	-7.0
BOLIVIA	9.2***	3.8***	6.2***	6.8***	4.4***	4.9*	-1.1	-0.6	0.3
PERU	2.7*	-2.3***	0.5	4.1	0.3	0.7	-1.4	-2.6***	-0.1
COLOMBIA	2.5***	6.5***	6.5***	1.9**	5.8***	3.6*	1.1***	0.7	3.5***
VENEZUELA	-0.2	1.6*	0.2	-0.7	-0.3	1.2	0.5	1.8**	-1.0
PARAGUAY	6.1***	3.2*	2.1***	5.5***	2.7*	1.9*	0.6**	0.4	0.2
CUBA	4.6***	4.5***	3.3***	4.4***	3.7***	3.3*	0.2	0.7***	-0.0
ECUADOR	4.8**	-8.4*	1.9	2.2*	-5.2*	2.1*	2.6*	-3.2	-0.2
DOMINICAN RP	1.0**	-1.3	1.1***	-1.6*	0.3	0.8*	2.8***	-1.7**	0.2
	5.9***	-1.2**	1.8***	5.4***	1.1***	2.6*	0.5	-2.4***	-0.8***
HONDURAS	9.1***	-19.5***	-5.1**	1.9***	-6.4**	0.0	7.2***	-13.0*	-5.1**
NICARAGUA	5.3***	5.3***	4.1***	5.0***	5.3***	4.2*	0.3	-0.5	-0.1
COSTA RICA	3.8***	3.7**	1.6***	3.2	-4.5***	-1.8*	0.6	8.2***	3.5***
PANAMA	11.6***	1.3***	7.6***	3.0***	1.7***	7.0*	1.7***	-0.4	-1.1***
GUATEMALA	3.6***	2.7***	3.1***	0.2	4.3***	2.8*	3.4***	-1.6***	0.3
EL SALVADOR	4.1***	1.4	3.6***	6.6***	-2.2	0.2	-2.5*	3.7**	3.3***
CENTRAL AMER	18.1***	-1.0	6.3***	14.9***	0.5	5.9*	3.1**	-1.5	0.4
GUYANA	0.0	0.0	0.0	-0.0	0.0	-0.0	-0.0	0.0	-0.0
HAITI	0.7*	4.7**	3.1***	0.5	5.9**	2.8*	0.3**	-1.1	0.6
JAMAICA	-0.9	9.3***	6.3***	-15.2***	7.8**	-0.6	14.3***	1.5	6.9***
TRINIDAD ETC	-2.3*	4.4***	1.9***	0.2	-0.2	-0.2	0.0	6.5***	4.2***
BARBADOS	-4.7**	2.5***	0.2	5.5	2.8***	4.0*	-0.8	-0.8**	-1.1***
CARIBEAN	9.0	5.3***	5.7***	20.0**	5.9***	7.8*	-11.1	-0.6	-2.1
TROPICAL LAT	5.9***	-1.2**	1.9***	5.6***	1.2***	2.7*	0.4	-2.4***	-0.8***
ARGENTINA	2.1*	-4.3*	-0.9	3.3***	-2.2**	0.4	-1.3**	-2.2	-1.3**
TEMPERATE LA	2.1*	-4.3*	-0.9	3.3***	-2.2**	0.4	-1.3**	-2.2	-1.3**
LATIN AMERIC	5.9***	-1.2**	1.8***	5.5***	1.2***	2.7*	0.4	-2.4***	-0.8***