Methodology Development for the Planning and Evaluation of Integrated Cassava Development Projects

JOHN K. LYNAM
WILLEM JANSSEN

Methodology Development for the Planning and Evaluation of Integrated Cassava Development Projects.

1. Objectives and Constraints in Cassava Development in Latin America:

Latin America economies in the last two decades have undergone very significant structural change, of which the most important components are substantial expansion in the industrial sector, even higher growth in the service sector, and extremely rapid urban growth, caused by high rates of rural-urban migration and an overall population growth rate that was about 2.8% per year. While the weight of the agricultural sector in total GNP naturally declined in this period, substantial demands were nevertheless made upon it. Rising income and urbanization created a rapid increase in demand for food products, of which an increasing percentage had to be commercialized. Moreover, the structure of food demand changed, as consumption patterns shifted from a rural to an urban setting.

In the period 1961-1979 agricultural production grew at an annual rate of 3.1% per annum, a rate above population growth but below demand growth. Such an imbalance between demand and supply either puts upward pressure on food prices or results in a deteriorating agricultural trade balance. Both have serious ramifications on policy issues. Rising food prices obviously have implications for the nutritional situation of the lower income strata. A deteriorating trade balance, on the other hand,

puts strains on the ability of Latin American countries to meet their very severe debt repayment requirements. This growing trade imbalance is most critical in the area of cereals. All countries in tropical Latin America are net importers of cereals and the ability of these countries to produce their cereal needs have deteriorated over time (Table 1).

While governments have tried to curb this cereal deficit through price policy intervention, investment in research and extension, and subsidized production credit, governments have almost never looked beyond the cereals themselves to supply this increasing demand for carbohydrates. Moreover, because of this oversight, traditional starchy staples, such as cassava, have had to compete with grains at a substantial disadvantage, and as a result such crops have stagnated, due to both traditional production techniques and the declining importance of traditional markets.

Cassava's center of origin is Latin America and historically the crop has played a fundamental role in supplying the carbohydrate requirements of the human population of the lowland tropics. The crop's advantages, high carbohydrate production per unit of land and labor, adaptation to soil and climatic stresses, and its indeterminate harvest period, were all efficacious in supplying the needs of a rural population. However, as the economy urbanized the crop's production advantages were neutralized by marketing disadvantages, particularly bulkiness and rapid perishability, and the crop not only failed to

respond to but was retarded by the structural change occurring in Latin American economies.

In the 1971-81 period cassava production in Latin America declined at an annual rate of 1.3%. The reasons for this lie more on the demand side than in constraints on production. Cassava production goes into three principal types of end utilization (Table 2). First is human consumption of fresh roots. In this fresh market demand is limited by the declining rural population and the very high cost of marketing cassava roots in urban areas. Second, a large portion of cassava is consumed in traditionally processed forms, particularly farinha in Brazil and cassabe in the Caribbean. In these markets consumption is already relatively high and consumers would rather consume other carbohydrate sources with increases in income; demand is thus inelastic and limited by consumer preferences. Thirdly, the remainder of the crop is principally fed fresh to swine in on-farm feeding systems. Apart from the relatively technified systems in Paraguay and the south of Brazil, this use is generally limited by extensive management systems for swine and the lack of a cheap protein source. Overall, demand in these traditional markets is either static or declining.

While there are structural reasons why cassava has not developed, there are as well economic and social policy reasons why cassava development should be encouraged. First, cassava is one of the few remaining crops where new technology can be utilized as a means to increase the incomes of small-scale farmers. It is expensive to mechanize cassava production. Thus, small-scale farmers are the

principal producers of cassava, and under the soil and moisture stresses under which many of these farmers must produce, cassava is their most productive and least risky alternative. Providing productive employment in the rural sector is a potential solution to the unemployment and high cost of social infrastructure in the urban sector.

Second, given that it is properly processed, cassava has the potential of entering a multiplicity of end markets. Markets such as starch, composite flour, and animal feed concentrates, all enjoy rising internal demand, and moreover increased cassava production could reduce the imports of grains, which are increasingly being used to meet increasing domestic requirements. The linkage of small-scale producers to these expansive growth markets would help to meet several social policy objectives without transferring land and labor resources from other productive activities in the economy.

While the creation of this linkage offers substantial benefits, it will not occur spontaneously. For cassava to compete in these alternative markets will generally require lower farm-level prices in addition to the investment costs in new processing capacity. Moreover, improved production and utilization technologies per se are not sufficient to induce a coordinated expansion in production, processing and utilization.

Reasons for this are many but what may be terned a high price illusion is probably the principal factor. In a great many cassava producing areas outside Brazil, farm-level prices are substantially

above production costs; so much so, that an incentive to plant an increased area to cassava should be operative. Farmers do not do so partly because of the known marketing risks, of either lower prices or, more often, the inability to sell the cassava. Also, the high farmgate prices reflect a price premium for quality characteristics, since often a significant percentage of the cassava roots are not saleable. As well, the structure of a marketing chain for a highly perishable crop induces a high price level. The result of this high price illusion is that potential end users will not invest in cassava processing, because cassava prices appear uncompetitive. On the other hand, cassava farmers will not expand production without the guarantee of a more expansive market. Developing the organizational intervention by which small-scale cassava farmers are linked to high growth markets is the principal objective of integrated cassava development projects.

2. Integrated Cassava Development Projects:

Many small farm development projects have not succeeded because the focus has been only on increasing crop productivity and/or access to production credit. In a Latin American setting one of the principal problems faced by small-farm crops is inelastic demand, so that any gains made by new technology are negated by a fall in price. Because of cassava's multiple end uses, it is not only possible but necessary to attack the demand problem jointly with the development and release of new technology.

Conversely, for new cassava technology to have any beneficial impact, market/consumption studies and related development of processing

capacity are integral parts of the technology transfer process. Moreover, there must be an institutional capacity to adapt production and processing technology to local conditions, to provide extension, credit, and other production support services, to promote investment in processing capacity and to develop the required market channels. These activities must be phased in a coordinated manner, and the means of integrating these activities is best done in a project framework. In a sense such projects extend the farming systems methodology, now so much in vogue in small farm development, one step further by coordinating changes in the farming system with changes in the marketing system.

The set of activities required in the successful execution of integrated cassava development projects have not yet been worked out to a sufficient level of detail. Nevertheless, the development of a sufficiently generalizable methodology for such projects is currently seen to involve six principal activities, each of which will be briefly described.

2.1 Development of a macro planning frame

The activities in this section focus on defining the most appropriate alternative market, identifying the initial target region, and providing a first approximation of the cost structure in each sub-system. Characterization of present production and utilization patterns of cassava provides the starting point. An evaluation of growth prospects, substitution possibilities, and competing prices of grain substitutes in alternative markets provides a first assessment on which market to focus. Government policy objectives are also essential

determinants of this choice. Finally, the target region is selected. The principal criteria in this choice are the capacity to expand cassava production, the potential level of profitability of cassava production and regional development priorities on the part of the government.

2.2 Assessment of institutional capacity

There is a large institutional component in the initial phases of project development. It is assumed that at a critical point growth in cassava production and utilization will be self-sustaining and institutional support will then decline. The pilot projects at their inception involve a multifarous set of activities, usually outside the scope of any one institution. The institutional assessment will encompass three principal components: (1) identification of a coordinating institution, (2) designation of the necessary functions between existing institutions, and (3) development of a coordinating mechanism at the project, regional and national level.

2.3 Project financing

Pilot projects, in order that they have a certain degree of autonomy in decision making and planning, should have a certain level of independent financing, principally for the core, coordinating staff. These projects are not a short-term activity and financing for a five-year period would probably be the minimum acceptable.

2.4 Phasing of activities in project execution

Once the target region has been selected, it is still necessary to screen production systems and sites within the region (see section

3.3). The idea is to start where the constraints on system profitability are least binding. A pilot processing plant is then constructed to ascertain any adaptation necessary in processing technology, to work out the management of the processing, and to develop an accurate account of investment and operating costs. At the same time a survey is made of the production systems and a first set of technology adaptation trials are designed. These will include necessary adjustments in production systems to meet the needs of the new market. The more experimental results there are to draw on, the easier this process is. Particularly important, however, is the requirement for some previous capacity to multiply and screen varieties. The project necessarily relies on a link to a system for varietal introduction, usually in the form of a regional trial of 12 to 20 varieties. The on-farm research then feeds into, but is not a substitute for, a production expansion program. Critical issues in this program are seed multiplication, monitoring of labor or machinery constraints, extending the planting and harvest season, and the phasing of production expansion with increases in processing capacity.

2.5 Support activities

There are critical support activities which usually must be coordinated between institutions. The principal activities are:

(1) Opening of credit lines: a special type of credit line must be found or created for the financing of the processing plants; moreover, there are many cases where production credit for cassava is not an established credit line.

(2) Farmer organization and training: whether and how to organize small-scale farmers into associations to finance and manage the plants is a key issue; a procedure for farmer screening and organization needs to be elaborated and training in plant management, in basic accounting, and in production technology is critical.

(3) Opening market channels: identifying buyers for the processed cassava, occasionally motivating investment in equipment to utilize the processed cassava (eg. mixing of composite flour), defining the mode and costs of transport, and working out sales and payment arrangements are key activities.

(4) Policy intervention in factor and output markets: these activities focus on relieving constraints on cassava expansion due to lack of access to labor, tractors or land and price policy intervention for cassava where grain subsidies are particularly large.

2.6 Replication and monitoring

The project should focus on maximizing the demonstration effect of the plants, in order to reduce investment of institutional resources. Site screening is again key to this objective. Production and processing costs and the profitability of the whole system must be monitored carefully in the initial phases, especially where the success of the project is dependent on yield increasing technology. Also, the interaction between traditional cassava markets and the new market should be monitored. Especially important in this context is whether to

introduce an industrial variety as the basis for the project and the impact this has on food markets.

3. The Colombian Cassava Development Project:

The cassava program of the Centro Internacional de Agricultura Tropical (CIAT) is currently assisting the Colombian Integrated Rural Development (DRI) program in setting up the first such integrated cassava project. This project is in full measure an exercise in learning by doing and it is on the basis of the experience in this project that a generalized methodology will be developed.

The overall project design is based on two basic objectives: (a) to develop a dried cassava industry in a region which has a comparative advantage in cassava production and (b) to ensure that small-scale cassava producers are principal beneficiaries of the project. These objectives led to the basic structure of the project. First, the project focuses on developing the market for dried cassava chips or pellets for the expanding animal feed industry in Colombia. Second, the project is located on the Atlantic Coast and will eventually encompass the five principal departments. The area is characterized by high temperatures, a long dry season and relatively infertile soils but has relatively good infrastructure and underemployed land and labor resources. Third, the organization of the project is based on farmer associations (FA), a group of 15 to 30 small-scale farmers which are organized by institutions within the DRI program. The associations have legal status and can act as an entity in obtaining credit.

3.1 The Integrated Rural Development Program

The Integrated Rural Development Program (DRI) was started in 1976 and set out as its objectives the increase in the production of basic food staples, improvement in the employment and income of small-scale farmers, and better linkage of small-scale producers to input and output markets. DRI was conceived of as a coordinating institution, which would bring together various other institutions in a particular region, together with a certain amount of financial resources, in order to improve the welfare of the small-scale farmer in that region. The program at its inception focused only on a limited number of well-defined regions. It was thought that if development would not respond to generalized policies, then it must be susceptible to an intensive concentration of institutional resources in limited areas. As such, the DRI program was seen as an alternative strategy and replacement for the agrarian reform program.

In what was called the first phase of the DRI program (1976-80), parts of the departments of Sucre and Cordoba were selected as project areas for the Atlantic Coast. Most of what came out of that phase was institutional: a mechanism for coordination of institutions working in the region, organization of farmer associations, and experience in problem identification. However, what was lacking was the identification of a means of increasing farmer incomes. Credit programs and a yam storage project had limited success, but the creation of a credit line to expand cassava production failed completely. Cassava production increased substantially, but this coincided with a relatively good year for cassava in the Coast in general, and farmers could find no

market for their cassava. In many cases it was turned back into the soil. Since cassava was the principal crop for most of these farmers, means of increasing farmer income appeared limited indeed.

The problem of marketing small-farm crops thereby became a dominant concern and a post-harvest committee was created to develop marketing projects. In 1981 CIAT was contacted by this committee for advise in how to resolve the marketing problem in cassava. At the same time the DRI program entered phase two in which the coverage of the program was extended, and for the Atlantic Coast all the principal departments were brought under the DRI umbrella.

Because of the structure of the DRI program, institutional support is wide-ranging. ICA is responsible for production technology and testing. SENA is responsible for training, both for professionals involved in the project but also for the farmer associations. Caja Agraria is responsible for agricultural production credit. CECORA is responsible for organization of the farmer associations and FINANCIACOOP provides credit for the processing plants. Institutional coordination is achieved through the post-harvest committee and the departamental directors of the DRI programs. Also, since the participating institutions are organized hierarchically, DRI as well provides a coordinating role at the project level, at the regional level, and at the national level. This coordinating function at various hierarchical levels is critical to effective functioning of the local projects.

3.2 Socio-Economic Characteristics of Target Region

The Atlantic Coast of Colombia provides the target region for the integrated cassava development project. The region has an extremely skewed land distribution, with close to 80% of the farms being less than 20 ha in size and making up less than 10% of the land in farms. The region is characterized by large, extensive cattle operations interspersed with small-scale farming. Tenants form a significant portion of small-scale farms and land invasions are a common occurrence in the region.

Cassava is the principal crop of small-scale producers in the region, making up almost half of cultivated land of farms less than 20 ha in size (Table 3). Nevertheless, rarely does the area planted to cassava average over 1 ha and a substantial portion of these small-scale farms remain uncultivated. Since there is surplus rural labor in the region, this underutilization of land and labor can be attributed to marketing constraints. Planting other crops is not a solution because of the stresses of temperature, rainfall, and in some areas, soils. Means of increasing farmer income are few and cassava is viewed as one of the principal means. Moreover, these characteristics are generally typical of the major cassava producing areas in much of Latin America, that is, where cassava is grown, it is the major crop and access to markets limits its expansion.

3.3 The Screening Process

The Atlantic coast of Colombia was selected as the primary target region because it was the major cassava producing area, agro-climatic

stresses limited other crop production and made for low cassava production costs, small-scale producers were a large component in crop production, and marketing was the major constraint on cassava production. In the present cassava system of the Atlantic Coast most production is destined to fresh consumption. A small part (±10%) is processed into a number of products (bollo, casabe, starch) that have different markets. A study of market potential suggested that dried cassava for the animal feed market had the largest capacity to absorb increased cassava production. Preliminary economic analysis suggested that chip production would be economically feasible at a raw material price of 4 to 5 pesos/kg of cassava, a price well within existing production costs. To diminish supply problems and transport costs it was decided to locate plants in their immediate production region. The issue was how to select the production system and site on which to focus.

Appropriateness of production systems were defined by two factors:

(1) The potential to increase cassava production for utilization by the feed concentrate industry. This production potential is determined by underutilized land availability, possibility to mechanize land preparation, low competition with the fresh market, the possibility to increase productivity, presence of a good dry season and presence of good institutional support.

(2) The impact that a project would have on the income of cassava farmers in the region. The potential impact will be larger when crop alternatives are few, when other employment is

lacking and when infrastructure and institutional support is limited.

To determine which sites are best suited for the establishment of drying plants, a screening procedure was developed, that takes in account production potential as well as possible impact on farmers' incomes. Data were gathered by surveying the spectrum of potential target sites in the departments of Atlantico, Bolivar, Sucre y Cordoba. Target sites were zones of influence of the DRI program. 420 farmers distributed through these zones were surveyed in this screening procedure. Some of the results of this screening are shown in table 4.

Screening results can as well be interpreted in two ways:

(1) The screening results identify the appropriateness of different zones. Sucre and Cordoba appear to be the zones where the project would best succeed at present. Mechanization opportunities are reasonable to good and competition with the fresh market is limited. Sucre has a tenancy and farm size problem that could limit expansion of cassava production. A reflection of the appropriateness of the different zones was found when farmers were asked whether they would start growing cassava at a fixed price of 5 pesos per kilo (see Table 5).

In Cordoba 38% of the farmers would grow more cassava at such a fixed price. In Sucre this was 24%. In Bolivar, as well, 38% of farmers were interested in a fixed, five peso price, but the area is hardly appropriate to extend cassava

cultivation because of the severe slopes. In Atlantico only 12% of the farmers would be interested in a guaranteed price of 5 pesos. The impact of the project would be slightly less in Bolivar and Atlantico. In Atlantico the institutional support is quite good and employment is a less severe problem than in Sucre and Cordoba. In Bolivar maize is a very good cropping alternative and people often find employment in other activities (eg. the tobacco industry).

(2) The screening results indicate institutional support activities within the whole target region. In Cordoba and Sucre a major effort has to be made to change the cropping system (at present cassava/yam/maize) to one more qualified for industrial use. In Cordoba a credit line for tractors might well be useful. In Bolivar the institutional support in the zone should be upgraded. As well, one of the biggest constraints, as much in Sucre as in Atlantico, is the size of small farms, which limits the potential expansion in the area in cassava. A well functioning land rental market would relieve this constraint. However, this is a problem which cannot be solved within the framework of an integrated cassava project and this criterion must weigh heavily in the final decision of where to locate plants.

The screening process was developed in the context of choosing seven sites in our departments to construct drying plants. As the project expands further the screening process will be used much more systematically in both site selection and provision of support services.

3.4 Progress of the Project to Date

Project implementation is now in its fourth year and the project can be viewed as having passed through three phases. The first stage or experimental phase involved the selection of a single farmer association, the construction of a pilot plant,the development of an operational drying scheme adapted to local conditions and the monitoring of the reaction of potential buyers to the product. In the second, or demonstration, phase the plant was run by the farmer association on a commercial basis and a preliminary economic feasibility study of the plant was done. This stage established the commercial viability of investment in the plants, supplied the data for credit lines for additional plants, and provided a demonstration model for introducing the idea to other farmer associations. The third, or replication, phase has focused on building plants in other areas, and in the past year six additional plants in four different departments were established and are operating. Plans to 1985 call for an increase in the number of plants to 24.

The impact on cassava production is also being noted. Farmers in the original farmer association have increased their area in cassava by more than four-fold. Farmers as well have intensified management of the crop; greater attention is given to weed control, seed selection and plant population. Also, there is a tendency as area expands to move more to monoculture systems. On-farm research trials have been established. To date these have focused on varietal evaluation trials, evaluation of monoculture and intercropping systems, and trials to

determine an optimum system of planting and harvesting dates to ensure a continuous supply of cassava.

The plants to date have been based on solar drying in the four-month, dry season from December to mid-April. Extending the root production and drying through the year would insure that there were fewer peaks in demand for labor and tractor resources and that there was a more continuous supply of dried cassava to feed concentrate plants. Research is now underway at one of the plants to develop through-circulation bin drying of cassava chips for drying during the rainy season. This will then be followed by development of the most appropriate management system for combining solar and bin drying.

3.5 Potential Economic Benefits

The viability of an integrated cassava project obviously depends on whether cassava can compete in alternative markets. In the Colombian case the issue was dried cassava's ability to compete with sorghum in the animal feed concentrate industry. Sorghum prices determine the price of dried cassava and because of the difference in protein content, cassava chips are discounted in price, in this case by 20%. This factory price must then cover the costs of transport and handling, processing, and root production. As shown in Figure 1, the project was economically viable at existing yield levels of about 8 t/ha. However, while the margin was positive, it was not large but nevertheless provided a starting point.

The income generating potential of the project is located at the level of the cassava producer. The project both allows expansion of cassava area and motivates adoption of improved technology. However, it is the cost reductions that come from yield-increasing technology that produce the principal gains in income (Table 6). Net margins are increased 3.7 fold by increasing yields from 8 to 16 tons, a level which the farm trials suggest is eminently feasible.

Given economic viability, the succeeding question is the capacity to expand cassava production and to utilize the dried cassava. If (1) a 25% yield increase is assumed, (2) for farms between 10 to 20 ha it is assumed that cassava is planted in 25% of the land, and (3) for farms less than 10 ha that half the fallow land is planted to cassava, production can be expanded by 640 thousand tons, or 1.6 times the present production level (Janssen, 1983). This amounts to 259 thousand tons of dried cassava. As shown in Tables 7 and 8, this level of dried cassava production is equivalent to 17% of total concentrate production and would effectively replace sorghum and maize imports. The project in affect balances production and utilization capacity and would markedly contribute to national policy objectives.

5. CIAT and Integrated Cassava Projects:

CIAT is an applied agricultural research center, of which the cassava program has been a functioning component since 1972. As such, the progress of the CIAT cassava program is measured less by the research performed and published than by the technology being utilized at the farm level. The cassava program since its inception has faced

two interrelated constraints in its international cooperation and technology transfer activities. First, when the CIAT cassava program started, there were no functioning national cassava programs to do the adaptive research and varietal testing so necessary for effective technology transfer to the farm level. Second, there were no institutional mechanisms for linking the production technology to growth markets.

Initial international cooperation activities focused on the traditional activities of training and assistance in the development of cassava research programs. There has been modest success in creating national programs in Mexico, Cuba and Brazil and to date over 300 professionals from almost all cassava producing countries in Latin America have been trained. Yet national programs have been marked by a rapid turnover in personnel and instability in program planning and research. Moreover, a large percentage of trainees were not retained in cassava research. The reason for this limited progress is simple. There was not effective demand for cassava research in most Latin American countries and those researchers that worked on the crop were continually frustrated by the lack of interest in new cassava technology, extending from farmers up to policy makers.

Demand for cassava research will only arise as the result of an effective demand for cassava. In this regard integrated cassava development projects are seen as integral to an international cooperation strategy for Latin America. Within the scope of the project there is a clear mechanism for varietal evaluation and adaptive research

on production technology. If necessary, adaptive research on processing technology can also be accomodated. But, the projects, in integrating the components necessary to expand both production and utilization, in themselves generate the demand for more generalized applied research in cassava. This, in turn, gives the national cassava research program a clearer focus, with a clearer definition of objectives.

The integrated cassava project on the Atlantic Coast of Colombia is seen as something of a prototype. The project will serve three primary purposes in regards to CIAT's objectives. First, is the mere demonstration effect that cassava can be a basis for the regional development of the small farm sector, especially in more marginal production areas. The project moves the discussion with other Latin American countries from the possible to actual tangible benefits. Second, the project provides the opportunity to develop the methodology required for establishment of similar projects in other countries. In this regard the focus will be on maintaining a certain level of generality in the methodology and on identifying the principal issues affecting the potential success of such projects. Third, the project site can be used as a training vehicle both for CIAT scientists and for professionals involved in similar projects in other countries.

CIAT would potentially act as a catalyst in the development and financing of these projects outside Colombia. A network consisting of such projects would be a more effective means of testing and adapting new production and utilization technologies and in providing the impetus for eventual investment in national cassava research programs. Mexico

and Panama have just started developing such projects and the Dominican Republic has expressed strong interest.

Table 1. Self-Sufficiency Ratios for Agricultural Commodities in Latin America

	Cereals (%)	Other Food (%)	Other Non-Food (%)	Livestock (%)	Total (%)
Mexico and Central America					
1961/65	100	115	324	104	123
1975	86	115	274	100	113
1980	80	117	227	100	110
Caribbean Countries					
1961/65	36	222	163	83	139
1975	35	194	198	79	120
1980	39	199	158	81	122
Andean Countries					
1961/65	75	108	277	92	110
1975	71	107	271	96	107
1980	63	103	256	92	102
Southern Cone					
1961-65	158	112	71	119	121
1975	147	110	98	110	113
1980	173	138	98	115	124
Northeast Atlantic					
1961/65	91	108	193	101	114
1975	95	124	217	101	117
1980	85	129	192	101	115
Total Region					
1961	102	116	202	105	118
1975	97	121	166	101	114
1980	91	127	156	102	114

SOURCE : FAO, Agriculture Toward 2000, 1981.

Table 2. Utilization of Cassava in Latin America, 1971-76

Region and Country	Human Consumption Fresh (metric tons)	Human Consumption Processed (metric tons)	Starch (metric tons)	Animal Feed (metric tons)	Total Utilization (metric tons)
Argentina (75/76)	78,000	44,000	15,000	88,000	225,000
Brazil (75)	687,730	6,553,457	411,000	4,020,552	11,672,739
Paraguay (76)	299,825	136,998	38,500	361,617	836,940
Venezuela (75)	119,917	42,606	24,064	130,806	317,392
Andean					
Bolivia (72)	68,923	-	4,800	128,493	201,196
Colombia (70)	466,470	-	29,200	186,486	682,156
Ecuador (74)	124,109	195	2,850	9,640	136,794
Peru (76)	173,708	750	2,500	125,208	302,166
Central America					
Costa Rica (73)	10,960	925	1,000	-	12,885
El Salvador (71)	16,470	-	-	-	16,470
Guatemala (72/74)	4,488	-	2,512	-	7,000
Honduras (74)	11,284	-	-	-	11,284
Nicaragua (74)	22,108	-	2,500	-	24,608
Panama (70)	28,803	300	3,633	5,900	38,636
Caribbean					
Cuba (76)	179,414	-	13,000	61,586	254,000
Dominican Rep. (75)	169,205	?	2,880	4,050	176,135
Haiti (79)	-	246,083	-	7,610	253,693
Jamaica (75)	5,426	13,725	2,554	-	21,705
Total Latin America	2,466,840	7,039,039	555,993	5,129,948	15,191,880

SOURCE : CIAT data files.

Table 3. The Importance of Cassava in Farms of 20 Hectares or Less, Atlantic Coast, 1982

	Atlantico	Bolivar	Sucre	Cordoba
% of farms less than 20 ha.	79.6	69.0	75.0	77.0
% of land in farms less than 20 ha.	14.2	7.6	6.0	6.2
Average farm size of farms less than 20 ha.	5.5	7.1	6.0	6.5
Area in cassava (ha)	1.1	0.7	0.9	0.6
% of cultivated land in cassava	48	20-44	50	42
% of farm area in crops	40	51	30	23
Most common cassava system [a]	C/M	C/M	M/Y/C	M/Y/C
% of cassava in most common system	82	N.A.	61	80
Yields of cassava in cropping system (t/ha)	8.3	8.0	6.0	6.0
Yields of cassava in monoculture (t/ha)	N.A.	12.0	11.0	7.4

[a] C = cassava, M - maize, Y = yam

SOURCE : W. Janssen, unpublished survey data

Table 4. Screening of Production Zones in the Atlantic Coast for their Appropriateness for Establishing a Cassava-drying Industry (scale 0 to 4, 0 = unappropriate; 4 = very approriate).

		Atlantico	Bolivar	Sucre	Cordoba
	Production potential				
Land availability	- size of the farms	0	4	1	3
	- tenancy of the land [1]	3	2	3	4
Mechanization possibilities	- tractor availability [2]	3	0	4	2
	- mechanisation feasible [3]	1	0	3	3
Fresh market competition	- present market access [4]	1	3	2	3
	- cassava quality *)	2	2	2	2
Dry season [5]		3	1	2	2
Productivity increase	- soil quality *)	2	2	2	2
	- crop systems [6]	3	3	1	1
Institutional support [7]		3	1	3	2
	Project impact				
Crop alternatives [8]		3	2	1	1
Available employment [9]		2	1	3	4
Available institutional assistance [10]		1	3	2	2

Notes: 1) Share of land in property. 2) % of farmers who say they can rent tractors. 3) % of farmers who say their land can be mechanized. 4) average sales per farm between May "82 and May "83. 5) weather-maps by Agustin Codazzi. 6) ease in increasing present cropping system' productivity and area. 7) subjective analysis of the author. 8) indicated importance by farmers of cassava. 9) weighted average of off-farm income and wages. 10) subjective analysis of the author. *) too variable within zones to form a conclusion.

SOURCE : Farm survey in the ICA-DRI zones among 420 farmers, March to May 1983.

Table 5A. % of farmers that would grow more cassava at a fixed price of

	4 pesos	5 pesos	6 pesos	7 pesos
Atlantico	12%	12%	30%	72%
Bolivar	26%	38%	60%	74%
Sucre	8%	24%	59%	77%
Cordoba	37%	39%	61%	77%

Table 5B. % of farmers that would grow less cassava at a quaranteed price of

	4 pesos	5 pesos	6 pesos	7 pesos
Atlantico	58%	40%	22%	10%
Bolivar	58%	42%	24%	6%
Sucre	46%	31%	6%	2%
Cordoba	37%	25%	9%	5%

SOURCE: CIAT/ICA/DRI-farm survey, March-May 1983

Table 6. Sucre: Relationships between Yields per Hectare and Costs and Margins per ton of Dried Cassava

Yield (t of fresh roots/ha)	Production Costs[1] (pesos/t of dried cassava)	Margin (pesos/t of dried cassava)
8	9563	1749
10	7650	3662
12	6375	4937
16	4781	6531

[1] Based on land costs of 7,000 pesos per ha.

Table 7. Colombia: Production of Animal Feed Concentrates, 1960-82.

Year	Total (000t)	Poultry (000t)
1960	125.7	87.8
1965	216.1	151.1
1970	563.1	395.0
1975	970.3	730.7
1976	978.2	714.1
1977	1085.8	722.7
1978	1205.3	872.9
1979	1386.1	1011.8
1982	1509.8	1146.7

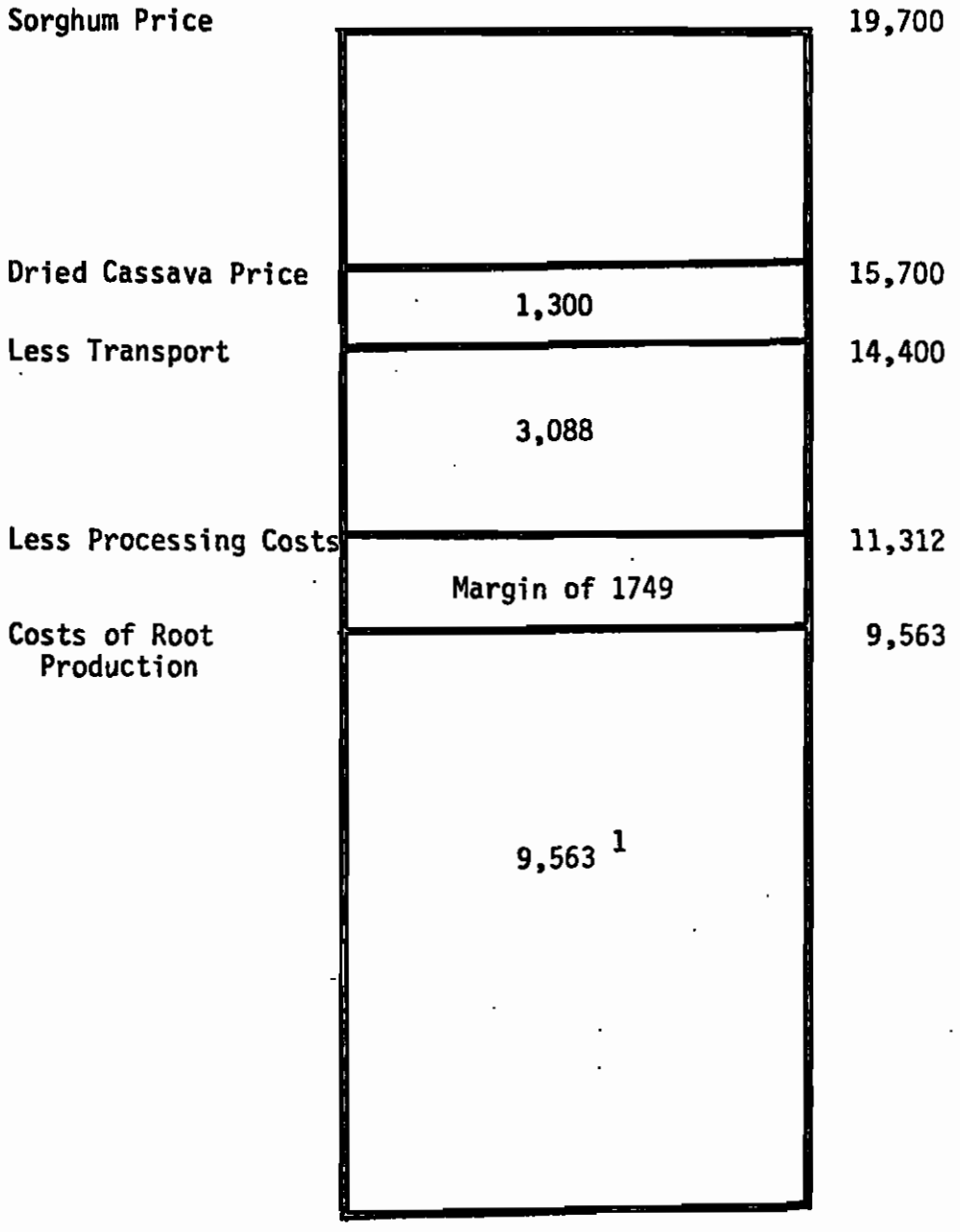
Table 7. Colombia: Production of Animal Feed Concentrates, 1960-82.

Year	Total (000t)	Poultry (000t)
1960	125.7	87.8
1965	216.1	151.1
1970	563.1	395.0
1975	970.3	730.7
1976	978.2	714.1
1977	1085.8	722.7
1978	1205.3	872.9
1979	1386.1	1011.8
1982	1509.8	1146.7

Table 8. Colombia: Area and Production of Sorghum and Imports of Coarse Grains, 1970-1981.

Year	Sorghum			Imports	
	Area (000ha)	Yield (t/ha)	Production (000t)	Sorghum (000t)	Maize (000t)
1970	53.6	3.1	165.0	-	6.6
1972	84.0	2.8	238.0	-	0.6
1975	134.0	2.5	335.0	-	3.1
1976	173.6	2.5	427.7	-	16.2
1977	189.5	2.1	406.2	126.8	100.7
1978	224.8	2.3	516.7	50.6	66.2
1979	221.2	2.3	501.3	4.8	60.0
1980	206.0	2.1	430.5	176.9	192.6
1981	231.3	2.3	532.0	11.0	79.6

Figure 1. Colombia: Determination of the Price and Cost per Ton of Dried Cassava



1 Based on yield of 8t/ha and conversion rate of 2.5:1