



CASSAVA DEVELOPMENT: PILOT PROJECT IN CEARA,
NORTHEAST BRAZIL

**INTEGRATED PRODUCTION, PROCESSING AND COMMERCIALIZATION
OF DRY CASSAVA CHIPS FOR ANIMAL CONSUMPTION**

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PROLOGUE

The present document constitutes the final report of the three-year project "Cassava Development: Pilot Project in Ceara, Northeast Brazil." The contents of the report represent a collaborative effort among the institutions that participated in the implementation of the project: the International Center for Tropical Agriculture (CIAT), the Ceara State Technical Assistance and Rural Extension Agency (EMATERCE), and the Ceara State Agricultural Research Agency (EPACE). Coordination of project implementation was the responsibility of the Ceara State Cassava Committee (CCC). The following is a list of the professionals who made up the project team.

1. Ceara State Technical Assistance And Rural Extension Agency--EMATERCE.

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Henrique Araujo Lima
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83 technicians at field level (Extension personnel).

2. Ceara State Agricultural Research Agency--EPACE

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3. Ceara State Cassava Committee--CCC

Roberio Xavier dos Santos, Programmer
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4. International Center for Tropical Agriculture--CIAT

Rupert Best, Cassava Program Leader
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EXECUTIVE SUMMARY

The present report contains a description of the activities and results obtained in the project "Cassava Development: Integrated Production, Processing and Commercialization of Dry Cassava for Animal Consumption in Ceara, Northeast Brazil." The overall objective of the project was to improve the welfare of poor rural communities involved in cassava production, processing and commercialization activities throughout the main cassava-producing areas of the State of Ceara, through the introduction and adoption of improved technologies as well as appropriate organizational forms for institutions and farmer groups. The main project implementation strategy was to establish a pilot project aimed at providing the experience required to develop local institutional capacity to carry out cassava-based rural development projects on behalf of the target group. The project was executed jointly by the Centro Internacional de Agricultura Tropical, CIAT and the Ceara State Secretariat of Agriculture and Land Reform-SEARA, through its affiliate agencies EMATERCE (technical assistance and rural extension) and EPACE (agricultural research).

The principal accomplishments were as follows:

- ▶ The selection of the State of Ceara as the site for implementing the pilot project was well justified. The fact that local counterpart agencies had been involved in previous activities related to small-scale cassava farmer processing served as a basis on which to build the organizational and institutional intervention catalyzed by the Kellogg Foundation-funded project. Moreover, the existence of a working group that included policymakers and technicians highly motivated toward cassava development and further stimulated by their exposure to similar projects and participation in overseas training activities, greatly facilitated project implementation.
- ▶ The building of local institutional capacity and support for project activities progressed steadily during the span of the pilot project. The existing state-level cassava committee was strengthened, becoming a well-recognized statewide coordinating body for all activities related to the cassava crop. Moreover, the establishment of seven regional cassava committees (RCC) in the main areas of project influence made it possible to decentralize project activities quickly and efficiently. The RCCs have also been instrumental in facilitating and enhancing farmer groups' participation in project implementation, as well as the contacts and exchange of experiences among extension agents involved in project activities.
- ▶ The building of local capacity among farmers was a very important achievement, with a total of 147 cassava-based farmer organizations established during the pilot project. Another 11 producer groups existing before the project were reorganized and reactivated. The total number of project beneficiaries in the 158 groups now exceeds 3100 farmers.

- ▶ Identification of local financial resources for supporting project activities was successful. A total of US\$1,002,000 was allocated directly by local agencies and programs during the period in order to finance project activities including the installation of dry cassava agroindustries, credit programs for cassava production and processing, cassava planting material distribution, and financial support for adaptive research on pest and disease control. Another important contribution of the local agencies was the payment of salaries for the cadre of 95 researchers and extension agents at the central and regional levels who were engaged full time in project implementation.
- ▶ A total of 56 pre-production trials were established, whereby 43 farmer groups were exposed to improved technological packages for cassava production. Trial administration and management were entirely the farmers' responsibility. Results obtained for the 1990-91 cropping season indicated average yields for the trials of 22.4 t/ha, a 59% increase over farmers' plots. In the 1991-92 trials, average yields were 19.5 t/ha, representing a 116% increase over farmers' yields for that season.
- ▶ A component for producing planting material was included as part of project activities. Results were not very encouraging as farmers placed more emphasis on the plots as a source of roots for the dry cassava agroindustries than as a source of good-quality planting material, which could have been obtained easily through pruning practices in the plots. Most farmers preferred to leave the plots unpruned and rely on additional sources of planting material, usually of poor quality. Although the results were not as expected, the production from the plots became an additional source of income for the farmers.
- ▶ Important adaptive research activities were carried out with technical and financial support from the project, aimed at finding solutions for two major constraints affecting cassava production in the state: witches' broom disease and the cassava hornworm (*Erinnyis ello*). Initial results are already providing local agencies with low-cost, environmentally sound control practices.
- ▶ Production of dry cassava chips by the small-scale farmer groups was one of the main project activities. The number of agroindustries functioning during the project expanded rapidly from 12 the first year to 33 the second year, and to 43 the last year. Total output of dry chips was 2677 t (7094 t of fresh roots).
- ▶ Adaptation of the farmer groups to the new cassava processing technology was easy. A factor that is becoming crucial for the performance of the cassava agroindustries is the group's ability to assure an adequate and timely supply of fresh roots for their processing units. A sharp reduction in the average annual output (38%) of some drying plants was monitored during the third year, contrasting dramatically with a 140% increase during the previous year.

- ▶ Commercialization channels for the chips produced within the project served to open and consolidate an alternative market for cassava producers in the state. A total of 975 consumers purchased dry cassava during the three years, with 92.6% of them being low-volume consumers (< 5 t/yr), accounting for 32.4% of the total project output. Conversely, only 4.6% of the consumers were classified as large-volume purchasers, representing 58.7% of the total volume produced.
- ▶ Production of farinha (toasted flour) is the principal commercialization outlet for cassava farmers in Ceara, and all too often they get paid very low prices for their product. With the introduction of dry cassava chips for animal feed as an alternative marketing outlet, the relationship between the farinha and the chips must be constantly monitored regarding prices, costs and profit margins in order to offer sound advice to farmers as to the more profitable outlet for their crop. During the pilot project, farmers producing dry cassava during the 1990 processing season were able to make a net profit of Cr\$11.7/kg; whereas those who produced farinha had a net loss of Cr\$24.5/kg. During the 1991 processing season, the dynamics of price variation for cassava products was evident, with the farinha being a more profitable outlet than the chips although both activities gave positive margins for the farmers. The important fact is that project activities contributed to build enough capacity among farmers so as to be able to choose the best option for commercializing their production.
- ▶ Training was an important strategy for developing human resources and enhancing capacity building among participating institutions and farmer groups. A total of 108 training activities covering different areas of work were organized during the pilot project for a total of 832 technicians and 2123 farmers.
- ▶ The monitoring and evaluation (M&E) model implemented during the project resulted in improving the information flow and exchange among farmers, technicians and project coordinating team at regional and central levels. Processed information is now being disseminated in a timely and frequent manner to beneficiaries and the larger target audience and is also currently used by extension staff and farmer groups to plan and evaluate activities.
- ▶ Data collected on the performance of farmer groups during the project provides the following information:
 - At present there are 133 cassava producer groups with processing facilities ready for dry cassava production; a further 25 farmer groups are not included as their membership is still being defined. Total membership of these groups is 2962 farmers; their land tenure systems include 58.6% owners, 28.9% renters and 12.5% sharecroppers. Of the owners, 21% belong to land reform settlements.
 - Of the 133 cassava producer groups, 36 have women among their members (3% of the total beneficiaries).

- Almost half the project beneficiaries have no basic reading and writing skills.
- Size of cassava plantings among project participants has maintained the same tendency: some 56% of the farmers plant less than 1.0 ha of cassava and fewer than 15% of the entire population plant more than 2.0 ha. Data available on the relationship of plot size with land tenure system indicate that smallholders planted larger areas to cassava than renters and sharecroppers. By the end of the pilot project, average plot size for the entire population presented a slight decline (8%) as compared to project outset, principally among landholders whose area planted to cassava was 13% less than three years ago.
- Overall results of the three processing seasons show that 7094 t of fresh roots were processed, with 38.3% coming from members of the drying plants and 61.6% corresponding to nonmembers. Only 39.6% of the beneficiaries supplied cassava during the project.
- Annual incomes received by project beneficiaries totaled US\$163,689, of which 37% corresponded to root sales, 10% to wages paid by the agroindustries, and 52% to profits from commercializing the dry chips.
- Distribution of annual incomes according to land tenure systems of the beneficiaries indicated that the smallholders gained 58.9%, renters 32.4%, and sharecroppers, 8.7%. The relationship between income and cassava plot size showed that 77% went to farmers planting areas no larger than 2.0 ha and 14% to those with more than 3.0 ha--a 115% increase in relation to the initiation of the project.
- Several important constraints were identified that were limiting to project implementation and its continuity after the initial external support terminates. These constraints are related to organizational, financial, political-economic and resource conservation factors. The identification and implementation of strategies appropriate for dealing with these limitations was initiated during the pilot project. Constant monitoring and adjustments will be crucial for the long-term impact and continuity of these activities.
- Rapid diffusion and adoption of project activities was readily assessed by the end of the project, based on the analysis of data currently provided by the M&E system. Quantified data on project impact at the farm level and the aggregate are still lacking. Two surveys conducted during the project revealed that farmers are now increasing the size of their cassava plots in response to the project stimulus. Average areas planted to cassava are 30% larger among the farmers surveyed than 3 years ago.

THE PROJECT

"Cassava Development: Pilot Project in Ceara, Northeast Brazil" is a special project supported by a three-year grant (March 1989-June 1992) from the W.K. Kellogg Foundation to the International Center for Tropical Agriculture (CIAT). The purpose of the grant was to enable CIAT--in partnership with Brazilian agricultural research and technical assistance agencies and farmer organizations, at both national and state levels--to introduce improved cassava production and processing technologies and appropriate organizational schemes for institutions and farmer groups throughout the State of Ceara.

PROJECT OBJECTIVES AND EXPECTED OUTCOMES

The overall objective of the project was to improve the welfare of poor rural communities involved in cassava production, processing and commercialization in the main cassava-producing areas of the State of Ceara, Northeast Brazil, through the adoption of improved cassava production, processing and commercialization technologies and the establishment of appropriate organizational schemes.

The specific objective was to establish a pilot project aimed at providing the experience required to develop and improve local institutional capacity to carry out cassava-based rural development programs that will benefit the rural population of the State of Ceara. In the longer term, it was expected that the experience gained in the pilot project would be used to improve national institutional capacity to promote development of the cassava crop within the context of rural development programs.

The expected benefits of the project were:

► Agroindustrial development

- In the short term, promotion of small-scale, cassava-based agroindustries in the State of Ceara, which will provide employment, raise incomes, stimulate local industry, provide new markets for cassava and encourage community development.
- In the longer term the generation and testing of a small-scale cassava-based agroindustrial development model that can be used in other cassava-producing areas of Northeast Brazil.

► Institution building

Strengthening of local institutions and community-based organizations, developing and improving their capacity to continue and expand project activities after support from the Kellogg Foundation terminates.

▶ **Improved welfare**

Increased income and additional employment opportunities for small farmers and landless laborers in the rural communities covered by the project area.

The overall structure of the work plan used for project implementation included the following activities:

- ▶ Development of a macroeconomic planning frame
- ▶ Selection of an initial site for developing the pilot project.
- ▶ Identification of local institutions, establishment of a working group and identification of local financial resources
- ▶ Design and establishment of the pilot project
- ▶ Observation of the operation and in situ modification of the modus operandum to adapt it to local conditions
- ▶ Monitoring of project performance and modification of project design
- ▶ Design of the expansion phase to commercial scale

The macroeconomic planning phase (activity # 1) was conducted prior to project initiation through joint studies carried out by CIAT, EMBRAPA, EMBRATER, the EMATER's and other Brazilian agencies at national and state levels. Major findings indicated the production of dry cassava for animal feed in the Northeast as the most promising enterprise.

The selection of the State of Ceara as the most suitable site for establishing the pilot project (activity # 2) was strongly influenced by the prior existence of strong research and extension efforts in cassava, coupled with considerable small-scale cassava farming and processing activities.

PROJECT RESULTS

1. Development of the Pilot Project

At the onset of the project in May 1989, there were already 11 cassava farmer groups which had been organized around dry cassava processing agroindustries during the period 1980-81. These cassava agroindustries were established as a result of the state-level Brazilian Technical Assistance and Rural Extension Agency's (EMBRATER) strong commitment to cassava promotion activities, which included intensive training activities for state-level extension agents in Brazil and abroad, and financial support for building dry cassava agroindustries in collaboration with farmer groups. The State of Ceara was one of the regions where EMBRATER was more active; and during the period 1980-87 8 farmer groups with dry cassava agroindustries were established in the state, only three of which were active when CIAT Cassava Program personnel started to have a stronger

presence in the area in 1988. The main reasons for the failure of the other five groups were the intensive drought that hit Ceara from 1979 to 1983 and the fact that these agroindustries were based on very large producer groups.

In 1988 the coordination of work among technicians and policymakers led to the formation of the Ceara Cassava Committee (CCC) with the aim of coordinating the work with the cassava crop statewide. The incipient CCC played a fundamental role in identifying additional financial resources, which made it possible to install another 8 dry cassava agroindustries during the period 1988-89.

CIAT's participation in this area was greatly enhanced by the formation of the CCC, and this partnership resulted in formulating a proposal submitted later to the Kellogg Foundation requesting financial support for implementing an Integrated Cassava Development Project in the State of Ceara.

Upon approval of the proposal by the Kellogg Foundation, project activities were initiated in May 1989 in the main cassava-producing areas of Ceara, aimed at establishing the production of dry cassava chips for animal feeding as a viable agroindustrial activity among small-scale farmers.

As part of project activities, the 11 groups existing at the onset of the project were reorganized and/or reactivated, and another 147 farmer groups were established for a total of 158 producer groups organized around dry cassava agroindustries by June 30, 1992. Table 1.1 presents the location of the dry cassava agroindustries established during the span of the project. The majority of these groups (75%) were organized during the last year of the project and will only be initiating dry cassava processing activities during the period July-December 1992.

Of the 158 farmer groups established by the end of the pilot project, 12 are not considered ready as they are facing serious problems for lack of availability of funds, raw material and, in some cases, consolidation of the groups themselves. Despite the fact that the project has been able to achieve significant growth in the number of producer groups participating in project activities, there are some issues that need to be raised in order to draw lessons that could be useful to similar projects in other regions (see Box 1).

2. Local Institutional and Financial Support

■ Institutional support

The CCC, created in 1988 and still incipient at the time project activities began in May 1989, has become a coordinating body for all activities related to the cassava crop in the State of Ceara. The CCC is formed principally by representatives of the two main counterpart agencies (EMATERCE and EPACE); and during the project, these two agencies accepted and considered the CCC as part of the institutional and organizational

TABLE 1.1 Dry cassava agroindustries established in Ceara, 1986-92.

Region	Period					Total
	1986-87	1988-89	1989-90	1990-91	1991-92	
Ubajara	1	2	1	2	13	19
Sobral	-	2	3	3	13	21
Itapipoca	1	3	2	5	32	43
Cariri	1	-	2	2	20	25
Limoeiro	-	1	2	-	2	5
Quixada	-	-	1	-	4	5
Crateus	-	-	-	1	14	15
Fortaleza	-	-	-	-	15	15
Russas	-	-	-	5	-	5
Baturite	-	-	-	-	4	4
Jaguaribe	-	-	-	-	1	1
Total	3	8	11	18	118¹	158

¹ Only 106 farmer groups are considered hereafter in this report as the other groups are facing serious organizational problems and will not be fully organized before the 1992 dry cassava processing season.

structure prevailing in the state. The CCC has been functioning under the administrative responsibility of the Secretariat of Agriculture, with its operational expenses fully covered with funds provided by the project grant.

The activities of the CCC have been crucial in the task of identifying financial sources that could be used to support project activities and to benefit farmer groups. The general recognition and credibility gained by the CCC with the good initial results of the project greatly facilitated the contacts of the CCC with both state- and national-level agencies that were carrying out development programs in rural areas of Ceará. At the national level, the CCC was included as a member of the Cassava National Council (Camara Setorial da Mandioca), a deliberative body set up by the Ministry of Agriculture with the aim of formulating policies related to the cassava sector at the national level.

BOX 1. DEVELOPMENT OF THE PILOT PROJECT

- ▶ Activities carried out by the state's agricultural research and technical assistance agencies in relation to the promotion of small-scale cassava farming and processing prior to the present project made it possible to draw on significant experience, which proved highly useful throughout the project. Furthermore, the state's institutional setting at the onset of the project included policymakers and top-level administrators and technicians of local agencies who had been exposed to similar experiences in other countries and whose participation was fundamental in defining the organizational and operational strategies of the project.
- ▶ Rapid expansion of the project in terms of the number of farmer groups that were organized was especially significant during the third year of activities. This fast growth was mainly due to the strong intervention of the Ceara State Secretariat of Industry and Commerce, which launched a program of grant-type financial aid that permitted 69 rural communities to build dry cassava agroindustries during the period January 1991-May 1992.
- ▶ Despite the importance of having these additional sources of financial support so that farmer groups can engage in dry cassava processing activities, their activities need to be coordinated at state level, preferably through the CCC to avoid the type of problems already occurring with the distribution of the grants such as (a) the poor selection of the farmer groups; (b) the lack of institutional presence in some areas, making it very difficult to offer technical assistance support to the farmers; and (c) the delay in delivering the economic resources to the farmers, which caused delays in the installation of the dry cassava agroindustries. Moreover, these processes have, all too often, been characterized by the need for rapid action, with minimum time for careful deliberation with farmer groups.

Coordination of project activities--especially the integration with the research and extension agencies located in the areas of influence of the project--was pursued through the establishment of the Regional Cassava Committees (RCC), composed of representatives from the main executing agencies and the farmer organizations. To date, there are 5 RCCs fully functioning and 2 more are expected to be organized during 1992.

The work of these committees allowed the rapid decentralization of all project activities, facilitating their implementation in critical areas such as training, selection and organization of new farmer groups and technical assistance. Another important result of the

establishment of the RCCs was the improvement in the quantity and quality of the exchanges of experiences among extension agents working in the different areas of influence of the project--a fact that was very difficult before the project given the extremely rigid organizational structure of the executing agencies.

■ Financial support

Despite the adverse economic situation faced by the country during the three years of project activities, the identification of sources of financial resources and the channeling of them toward benefiting farmer groups participating in the project was very active allowing project activities to be carried out within the proposed goals. These resources were used mainly to finance the establishment of the dry cassava agroindustries although some other programs were implemented in relation to working capital and cassava production credit for the farmer groups.

Table 2.1 presents information on the estimated value of the financial contribution of the Brazilian programs and agencies to the setting up of small-scale cassava-based agroindustries as part of project activities. Table 2.2 summarizes the different sources of financial support received during the last three years. Some important issues in relation to local institutional and financial support are discussed in Box 2.

TABLE 2.1 Estimated financial contribution of Brazilian agencies and development programs to the installation of cassava-based agroindustries in the State of Ceara, 1986-92.

Period	Agroindustries Installed	SOURCES OF FUNDING (US\$) ¹					Total
		Bird	BNB	PAPP	SIC ²	Others	
1986-87	3	11,946	-	-	-	-	11,946
1988-89	8	7,434	13,972	1,163	-	2,036	24,425
1989-90	11	10,029	9,909	26,777	-	-	46,715
1990-91	18	13,595	-	123,476	37,000	-	174,071
1991-92	118	215,330	-	31,555	120,952	-	367,837
Total	158	258,368	23,701	182,971	157,952	2,036	624,994

¹ Values were estimated using official US dollar exchange rates at the moment the grants were made available to the farmer groups.

² SIC supported organization of a total of 70 farmer groups, but given the serious problems they are facing with regard to availability of funds and lack of organization, 12 of them are not included hereafter in this report as they will not be fully organized by July 1992.

TABLE 2.2 Sources of financial support at national and state level for project activities, 1989-92.

Institution	Type of Financial Support	Beneficiaries (# of Groups)	Value¹ (US\$)	Date
BIRD	Establishment of dry cassava agroindustries	52	215,330	1989-92
SIC	Establishment of dry cassava agroindustries	57	152,953	1990-92
PAPP	Establishment of dry cassava agroindustries	23	189,508	1989-92
BNB	Establishment of dry cassava agroindustries	3	9,909	1989-92
	Credit program for purchasing oxen-driven wagons	50	50,000	1991
LBA	Credit program for cassava production	115	144,800	1992
Government of Ceara	Credit program for working capital for dry cassava agroindustries	150	153,000	1992
SEARA	Funding for project aimed at controlling witches' broom disease		25,000	1991-92
	Funding for distributing cassava planting material	80	41,500	1992
EMATERCE EPACE	Revolving fund for working capital	71	20,000	1990-91

¹ Total local agency financial support for project activities during the last three years was **US\$1,002,000**, not including the salaries of the technicians who participated in the project at all levels. Values were estimated using official US dollar exchange rates at the moment grant funds became available.

BOX 2. LOCAL INSTITUTIONAL AND FINANCIAL SUPPORT

► Institutional support

Onset of project activities coincided with changes in Government at national and state level in Brazil and in the State of Ceara, which resulted in a process of merging the two local counterpart agencies into a new agency with integrated responsibilities for agricultural research and technical assistance. This seriously affected their organizational and operational capacity. By the end of the pilot project, the merging of these two agencies had not yet been fully defined, creating uncertainty and instability among staff of both institutions. The technical teams organized in the main areas of influence of the cassava project have had several of their members either fired or transferred to other regions, while others have quit their jobs. The effects of this situation on project activities have started to be felt, making it extremely important to reorganize some of the technical teams if the coverage and efficiency of the technical assistance offered to the farmer groups is to be maintained. Of course this reorganization will be feasible only when the organizational structure of the two local agencies becomes definitive.

► Financial support

Rapid expansion of the social base of the project has been enhanced as a result of the existence of several sources of grant-type financial resources, which have been mainly used for setting up the dry cassava agroindustries. These financial sources are likely to become scarce and the activities initiated during the last year of the pilot project related to the implementation of loan-type credit programs for establishing agroindustries, cassava production and cassava processing bear special significance and must be carefully monitored and evaluated as they may become the most readily available source of financial funds for expanding project activities. These credit programs are based on price variation of cassava products such as dry cassava; and given the very high inflation rates prevailing in Brazil (25-30% monthly), they are thought to represent a less risky credit scheme for farmers as compared with the other credit sources available, which include monthly index-linked adjustments for inflation.

3. Production Technology

One of the more important components within the strategy of the Cassava Integrated Development Projects is production technology. The methodology used by the Ceara Cassava Project to address this component included two types of activities: pre-

production trials and planting material production plots. The issues raised from the work carried out in these areas are summarized in Box 3.

BOX 3. PRODUCTION TECHNOLOGY

- ▶ Cassava production in Ceara is carried out mainly by small-scale, resource-poor farmers, with very little use of improved technology. Project activities included the methodology of the pre-production plots with the purpose of demonstrating improved cassava production technology for the farmers' benefit. Initial results obtained with this activity have been very clear in the sense that the adoption of improved technology components makes it feasible to increase currently low cassava productivity levels (8.3 t/ha, statewide average).
- ▶ The results obtained with the pre-production plots must be considered cautiously as they were obtained in a situation where all expenses were paid by the project. It remains to be assessed to what extent small-scale cassava farmers will be willing to invest scarce economic resources in inputs such as organic fertilizer (10 t/ha) or weed control practices. Cow manure, for example, has become very expensive in Ceara, and its high transportation costs usually make its use unfeasible. Moreover, increased weed control activities may not be attractive, given the farmers' scarce economic resources. Future project activities in this area must continue to evaluate this adoption process as well as assess the use of other alternatives such as green manure and cover crops as a means of maintaining soil productivity and sustaining reasonable cassava yields.
- ▶ Improved cassava planting material production and distribution are perhaps the best short-term strategies for increasing cassava production and productivity levels in Ceara. Results obtained with this activity during the pilot project showed that the strategy of farmer-administered plots for producing cassava planting material mixed with pruning practices before the planting period is likely to fail. Besides, the planting material distribution program carried out by SEARA is costly and covers only limited areas. It will be necessary to reformulate this strategy for the future, including activities such as the regional commercial-scale production of best local cultivars and integration with the interinstitutional cassava breeding efforts currently been implemented in Ceara, where high-yield-potential gene pools are being developed and characterized.

- **Pre-production trials.** These trials were oriented toward reducing the effect of minimal adoption of improved production technology by farmers, a fact identified as one of the main limiting factors on the generation and dissemination of improved agricultural technology among cassava producers. Planning, establishing and evaluating these trials involved the active participation of technicians from the two main counterpart agencies--EPACE and EMATERCE--and farmer participation was also enhanced.

Project activities were initiated in May 1989, well after the planting season for cassava was over; for this reason the first pre-production trials were planted only in March 1990. Moreover, cassava production is a biannual activity in Ceara, usually taking 15 to 18 months to harvest. Implementation of these pre-production trials included the selection of several technology components developed by Ceara researchers and extension agents over the last 15 years.

These production components had not been previously validated in large plots (> 0.25 ha), under complete farmer management, to ascertain their compatibility with current farmer production practices. The selection of these technology components was done through discussions in which researchers and extension agents from local counterpart agencies, farmers and CIAT scientists participated. Table 3.1 presents the main technology components in the two cassava production systems. In 1990, 15 pre-production trials were established and harvested at 15 months. In 1991, 41 new trials were added, 28 of which were in new communities. Farmers were instructed on how to apply the new technology components, and the administration and management of the plots were their responsibility. Nearby plots planted by the same or different farmers were previously selected as checks; and at harvest time, two samples of 100 m² each were taken from the pre-production and the check plots to compare the yield with the improved and the traditional technology.

In the 1990-91 cropping season, average yield for the pre-production trials was 22.4 t/ha, a significant 59% more than the average yield obtained in farmers' plots. In the 1991-92 cropping season, average yield of the trials was 19.5 t/ha, representing 116% more than the average yield obtained in farmers' plots (Table 3.2).

- **Planting material production plots.** This activity was planned to increase the availability of good-quality planting material and meet the expected increased demand for improved planting material resulting from the impact of the project. The best available cassava cultivars in each region, improved and local selections, were used to set up large plots (1 ha), which were under complete farmer management and were planted using improved production technology components. During the 1990-91 cropping season, a total of 15 plant material plots were installed; for the 1991-92 season the number was increased to 41.

TABLE 3.1 Components of improved and traditional cassava production technology in pre-production trials in Ceara, 1990-92.

Item	Improved Technology	Traditional Technology
Soil preparation	Farmers	Farmers
Planting material	Selection, no treatment	Local variety selection, no treatment
Weed control	Hand weeding	No herbicides
Insect control	No control	No control
Fertilization	Organic manure	No fertilizer

TABLE 3.2 Average cassava yields of pre-production trials and farmers' fields, Ceara, 1990-92.

Region	Community	FRESH ROOTS YIELDS (t/ha)			
		1990-91		1991-92	
		PPP ¹	FF ²	PPP	FF
Cariri	Serra Santana	36.70	22.30	25.3	12.1
Itapipoca	Lagoa Grande	11.72	4.12	10.1	6.0
Sobral	Folha Larga	12.70	11.90	14.9	8.7
Limoeiro	Aroerias	12.70	7.60	27.3	8.4
Ubajara	Jua dos Vieiras	15.38	6.47	19.9	8.3
Average		22.44	14.11	19.50	9.02

¹ PPP = Pre-production plots; plot area of 2,500 m² and planting density of 10,000 pl/ha.

² FF = Farmers' fields.

Results obtained with this project activity were not as satisfactory as expected because the farmer groups gave more importance to the plots as a source of roots for their agroindustries than as a source of planting material. There is a lag period of at least 6 months between harvesting and planting in Ceara, depending upon the start of the rainy season; for this reason storing of cassava stakes for use as planting material is not a feasible practice. To eliminate this constraint, the project strategy for this activity was to try to introduce the practice of pruning the plants to obtain good-quality planting material at the onset of the rainy season.

With very few exceptions, most of the farmer groups that participated in this activity preferred to leave the planting material plot unpruned at planting time, relying on additional sources of planting material, generally of poor quality.

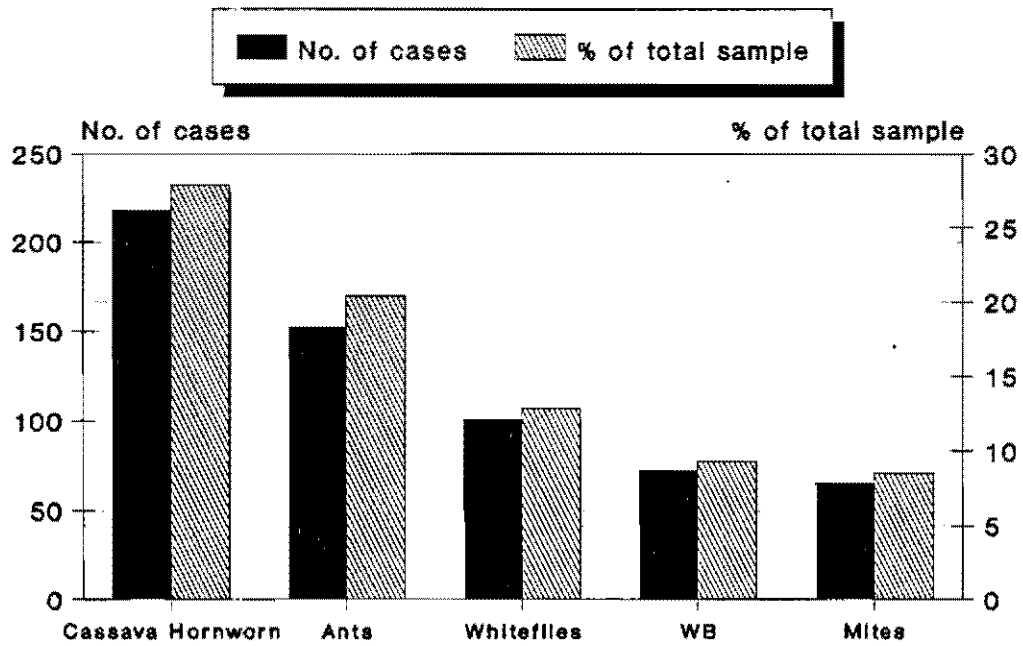
Despite the fact that this activity allowed the producer groups to attain significant amounts of cassava roots as raw material for their agroindustries, the results sought by the project were not achieved.

The Secretariat of Agriculture of Ceara has been implementing a program of cassava planting material distribution among farmers groups at planting time. Effectiveness of this program was seriously questioned by the CCC, mainly because of the poor quality and the lack of adaptation of the material distributed to the farmers.

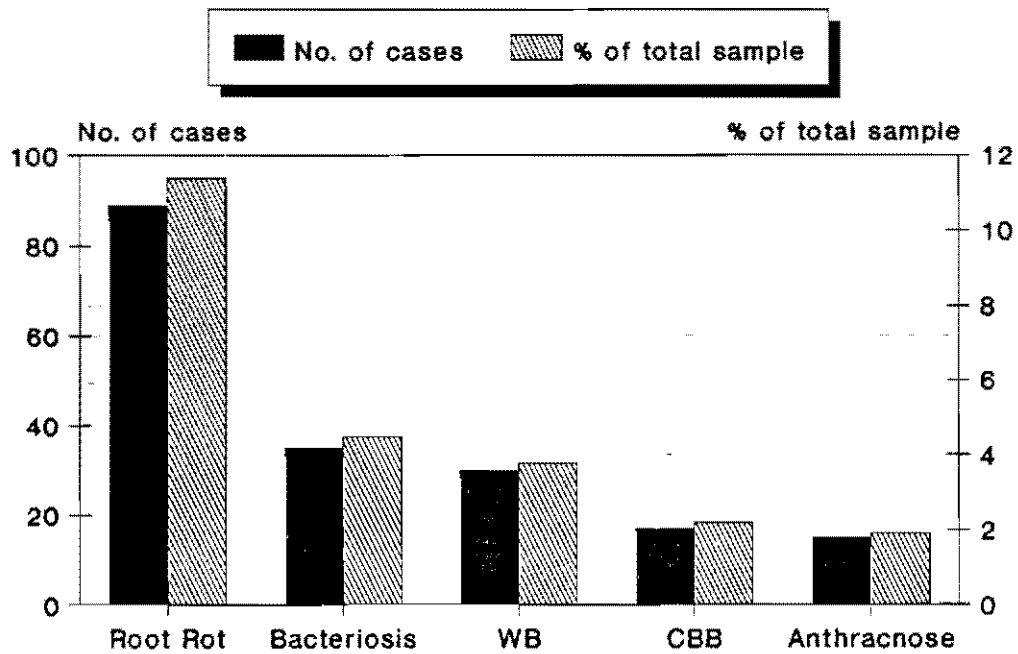
Nevertheless, not everything was a failure with the cassava planting material activity of the project. In the 1992 planting season, the CCC was able to intervene directly in the implementation of this program, introducing requisites such as selection of the planting material suppliers, supervising harvesting and packing of the planting material, and selecting the cultivars according to their destination. A total of 4,735 m³ of planting material were distributed in 80 farmer communities, for a total cost of US\$ 41,500.

- **Other activities.** Cassava cultivation in Ceara as in most of the seasonally dry lowlands of the Neotropics is associated with a large complex of pests and diseases that attack the crop over a long period of time (3-6 months), causing severe losses aggravated by the fact that cassava is produced primarily by small-scale, resource-poor farmers, with limited or negligible use of biological or chemical control practices.

Project activities had given economic and logistical support to research and extension activities carried out by the two local counterpart agencies related to two problems identified as the major prevailing constraints for cassava production in Ceara: witches' broom (WB) disease and the cassava hornworm (*Erinnyis ello*). This fact was further evidenced in a recent field survey conducted in the project's area of influence, which included 8 different regions, 30 municipalities, 46 communities and 781 cassava farmers. Survey results are shown in Figure 3.1.



N = 781 farmers



N = 781 farmers

CBB: Cassava bacterial blight
WB : Witches broom disease

FIGURE 3.1 Principal cassava pests and diseases in Ceara.

- ▶ Cassava hornworm. Considered the principal pest in cassava cultivation in Ceara, the hornworm has affected various regions during the last years causing significant losses in farmers' fields. Severe hornworm attacks usually result in complete plant defoliation, bulk root loss and poor root quality. The most common control measures rely on ill-timed pesticide applications that are costly and toxic to natural enemies and to the environment. Control measures based on sound ecological principles are thus needed.

Activities supported economically and logistically by the Kellogg Foundation funded-project have been oriented toward adapting and implementing, under the conditions of the State of Ceara, a biological control technology for the cassava hornworm: Baculovirus, already available on a commercial scale in other cassava-producing regions of Brazil. The baculovirus is a granulosis virus of the family Baculoviridae that infects the hornworm and has proven effective in managing hornworm populations .

State program staff have mastered the production of hornworm eggs and larvae of known ages for experimental purposes, as well as the production and testing of the virus under controlled conditions. Future activities in this research area will be oriented toward (a) testing the efficiency of the virus in hornworm-infested farmers' fields and (b) developing storage and application methodologies for the virus.

- ▶ WB disease. Since 1985 the appearance of WB was reported affecting a very important cassava-producing area of the State of Ceara; and in 1987 yield losses in the affected area were estimated as high as 40% of total root production. Research efforts to control WB were initiated in 1986 with participation of EMBRAPA/CNPMF and CIAT and with financial support from the Ceara State Secretariat of Agriculture. Since its inception in 1989, the Ceara Cassava project has supported the implementation of these research efforts. Thus far the following results have been obtained:

- Identification of characteristics specific to mycoplasmlike organisms in vascular strands of diseased plants using electron microscopy
- Identification of WB-resistant clones (at least 10 clones are showing high resistance)
- Identification of a group of field-resistant clones, which were susceptible to grafting and mechanical transmission but showed a high rate of field resistance during three growing cycles; they are probably resistant to an unknown motile vector.
- Definition of a production system for WB-endemic areas

- Publication of a pamphlet including a description of the production system and the symptoms of the disease for distribution among farmers, extension agents and community leaders
- Establishment of several demonstration plots to be used for field days and technology transfer purposes
- Initiation of a Secretariat of Agriculture-financed program aimed at producing planting material on a commercial scale in areas where ecological conditions restrict pathogenic multiplication and invasion; distribution to cassava producers will be during the 1993 planting season
- In general, significant reduction in WB incidence and increases in root yields in those locations of the affected area where farmers had followed the recommendations

4. Processing Technology

Cassava processing in the form of "*casas de farinha de mandioca*" have historically been one of the main agricultural activities in rural areas throughout the state. Despite the fact that farmer groups participating in the project were already accustomed to cassava processing activities, their adaptation to the new processing technology--the production of dry cassava chips for animal feeding--has been and will continue to be, one of the most crucial factors in implementing this cassava-based rural development effort.

The target markets for the dry cassava usually present specific characteristics of demand, quantity, quality and frequency, which the farmer groups find difficult to meet--at least during the initial stages of the project. Experiences in similar projects in other countries (Colombia, Ecuador) indicate that cassava producers usually require an adjustment period of 2 to 3 years before they are able to operate and administer their agroindustries efficiently. To evaluate the results obtained by the project in this activity, two types of parameters were used: "**yields and conversion ratios**" and "**efficiency of processing.**"

- **Yields and conversion ratios.** Production of dried cassava is an indicator of the potential the agroindustries have of becoming important end-markets for cassava production in their areas of influence. Results obtained during the pilot project show that the total amount of cassava roots processed was 7,094 t, with a total output of 2,677 t of dry cassava. This production was obtained with 12 farmer groups functioning during the first year, 33 in the second and 45 during the last year. Total and average annual output for the agroindustries varied considerably throughout the project, showing that an assured supply of cassava roots for the drying plants depends on several factors including (a) strong competition from local and regional markets (e.g., farinha, animal feeds); (b) lack of working capital to purchase cassava

TABLE 4.1 Yields and conversion ratios, 1989-92.

Period	No. Of Groups	Fresh Cassava (t)	Dry Cassava (t)	CONVERSION RATES	
				CF ¹	%
1989-90	12	702	265	2.64	37.8
1990-91	33	3,802	1,431	2.65	37.7
1991-92	43	2,590	981	2.64	37.8
TOTAL		7,094	2,677		
AVERAGE				2.64	37.7

¹ CF: Conversion factor, t of fresh cassava roots required to produce 1 t of dry cassava chips.

roots, a constraint that remained unsolved during the three processing seasons; and (c) insufficient cassava production in several regions due to climatic factors (Table 4.1).

Average conversion rates obtained during the three years were normal considering that in several cases, pest attacks (especially *Erinnyis ello*) affected root quality. In general, it could be said that the farmers were able to control efficiently the final moisture content of the cassava dry chips, the most critical factor in the drying technology.

- **Efficiency of Processing.** Under the climatic conditions prevailing in the state, where there is a 5-month period suitable for solar drying of cassava chips, it was assumed that a given agroindustry would be capable of processing a batch of dried cassava chips by the end of 2 sunny days and that this operation could be performed at least 3 times weekly, for a total of 60 batches per year. This means that under normal conditions, a dry cassava agroindustry should be capable of processing 0.6 t of fresh cassava roots/m² of drying surface per year. Achieving this output depends on climatic and management factors, which combined, determine the efficiency and the level of profitability that farmer groups are able to obtain operating the agroindustries.

Considering the fact that the climatic factors cannot be controlled by the farmers, the efficiency of processing depends primarily on management factors, among which the

group's ability to secure a local supply of roots for the drying plant has shown to be of overwhelming importance. On the other hand, producers appear to be adjusting easily to the chipping and drying technology. To assess the results obtained during the pilot project in these aspects, a parameter called "Efficiency of Processing" was calculated for a sample of the agroindustries throughout the project period (Table 4.2). It can be seen from these results that the farmer groups' ability to adjust to cassava production factors in their area directly affects the annual output and efficiency that they are able to obtain administering their cassava-based agroindustries.

In general, the pilot project showed a 140% increase dry cassava output from the first to the second year. Conversely, during the third year there was a sharp reduction (38%) in the average annual output as compared with the previous year. These variations affected the project's area of influence as a whole although they were more pronounced in some regions. Additionally, the issue of drying plant size is becoming evident, with larger installed capacity not always resulting in larger annual outputs and better processing efficiency (Table 4.2).

Box 4 summarizes important learnings from the experience in setting up the cassava drying plants.

5. Commercialization

- **Marketing channels.** An underlying assumption in the market component of dry cassava-based integrated projects is the identification and consolidation of markets for the product represented by few large-scale consumers such as the animal feed industries. In the case of the Ceara cassava project, this operational hypothesis has not been validated as fully as was the case in similar projects in other countries, as most of the dried cassava produced during the pilot project was sold directly to a large number of low- to medium-volume consumers, mainly dairy farmers located in the vicinity of the agroindustries.

Total dry cassava output during the project was 2,604 t purchased by a total of 975 consumers of whom 92.6% were low-volume consumers (less than 5 t of dry cassava/yr) and only 4.6% were large-volume consumers (more than 10 t/yr). In relation to volumes purchased during these three years, the situation was reversed, with the large-volume consumers accounting for 58.7% of the total production of dry cassava and the low-volume consumers purchasing 32.4% of the total output (Fig. 5.1).

Despite the fact that large-volume consumers are now purchasing almost two-thirds of the total output, their total number is still low, considering the potential market for the dry cassava in Ceara. This situation will probably remain unchanged in the near

TABLE 4.2 Efficiency of processing of cassava drying plants in the Ceara pilot project, 1989-92.

Farmer Groups	Drying Area (m ²)	T.O. ²	ANNUAL OUTPUT (t/yr)			EFFICIENCY OF PROCESSING (%) ¹		
			Actual			1989	1990	1991
			1989	1990	1991			
LGRAN	434	260	120.0	311.5	187.1	46.1	119.8	71.9
SOLID	450	270	118.0	232.2	188.2	43.7	86.0	69.7
POCAV	600	360	108.3	269.3	82.5	30.1	74.8	22.9
JUAVI	600	360	96.9	238.8	59.3	26.9	66.3	16.4
FOLHA	700	420	92.6	248.9	121.5	22.0	59.2	28.9
LMAT	700	420	47.5	166.5	146.5	11.3	39.6	34.9
SERSA	400	240	5.0	86.4	91.7	2.1	36.0	38.2
SAOVI	400	240	-	241.7	78.8	-	100.7	32.8
QUEJO	400	240	-	147.4	135.9	-	61.4	56.6
PAUBA	420	252	-	333.3	223.4	-	132.2	88.6
IBUAS	400	240	-	68.9	131.0	-	28.7	54.5
CABON	400	240	-	80.3	50.2	-	33.4	20.9
TOTAL		3542	588	2425	1496			
AVERAGE			84	202	124	26	69	44
INCREASE (%)			140			165		
DECREASE (%)				38			36	

¹ Efficiency of Processing calculated as the relationship between actual and theoretical annual output.

² T.O. = Theoretical output ; estimated according to the following assumptions: loading rate of 10 kg/m² and 60 batches per year.

BOX 4. PROCESSING TECHNOLOGY

- ▶ Cassava farmers in Ceara appear to be adapting easily to the new dry cassava processing technology, given its simplicity and especially the fact that cassava processing activities in the region have historically been carried out by farmer groups who produce farinha de mandioca, a traditional staple food in Northeastern Brazil.

- ▶ The relationship between farinha de mandioca and dry cassava chips as two commercialization options for cassava farmers will be the main factor determining the financial success of the dry cassava-based agroindustries that are being installed in the State. When market prices for the farinha de mandioca are low, as was the case in 1989 and 1990, the agroindustries become important commercialization outlets for cassava production statewide. Conversely, when the farinha markets offer prices attractive to the farmers, it becomes difficult for producers to find sufficient cassava root supply to maintain the agroindustries operating efficiently. Farmer group performance is further affected by factors such as skewed land and farm size distribution and semi-arid climate, which have a strong influence on the seasonal availability of cassava roots.

- ▶ Implementation of the Kellogg Foundation-funded cassava project (1989-92) covered three processing seasons, throughout which the lack of working capital was a major constraint for the farmer groups engaged in dry cassava production. The absence of credit programs oriented toward supporting cassava production, processing and commercialization, has been a historical constraint in Ceara. In 1992, for the first time this situation appears to be changing with the implementation of a credit program for working capital in which 150 farmer groups will be allowed to use loans for dry cassava processing. The innovative factor in this credit program is that the producers will pay back the loans based on price variations of the dry cassava as the inflation index parameter. This type of credit scheme represents a pioneering effort in the history of cassava production in Ceara, and as such deserves careful monitoring to assess its effectiveness.

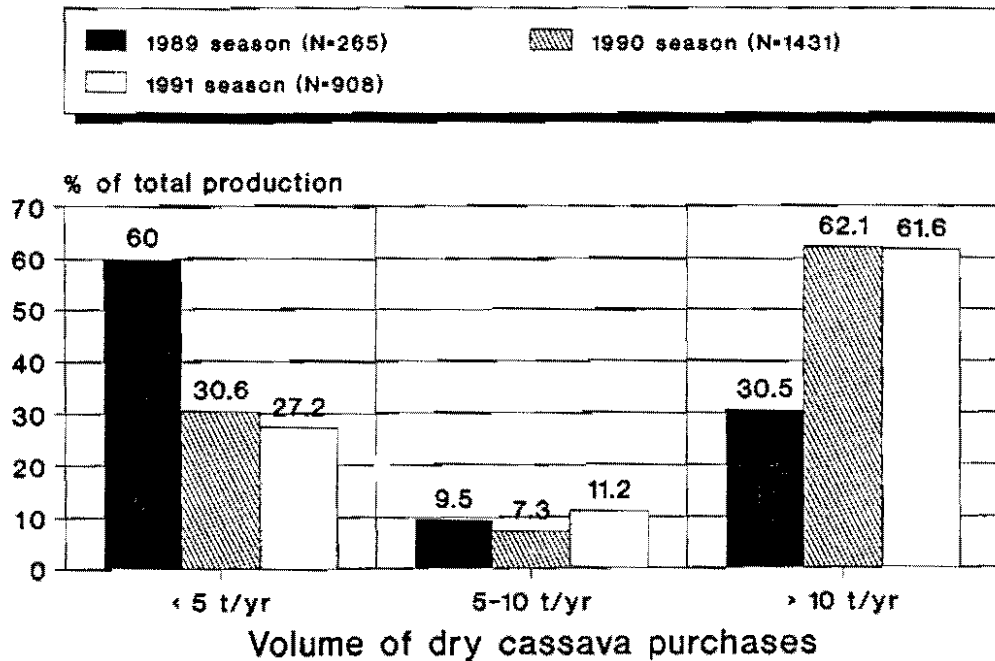
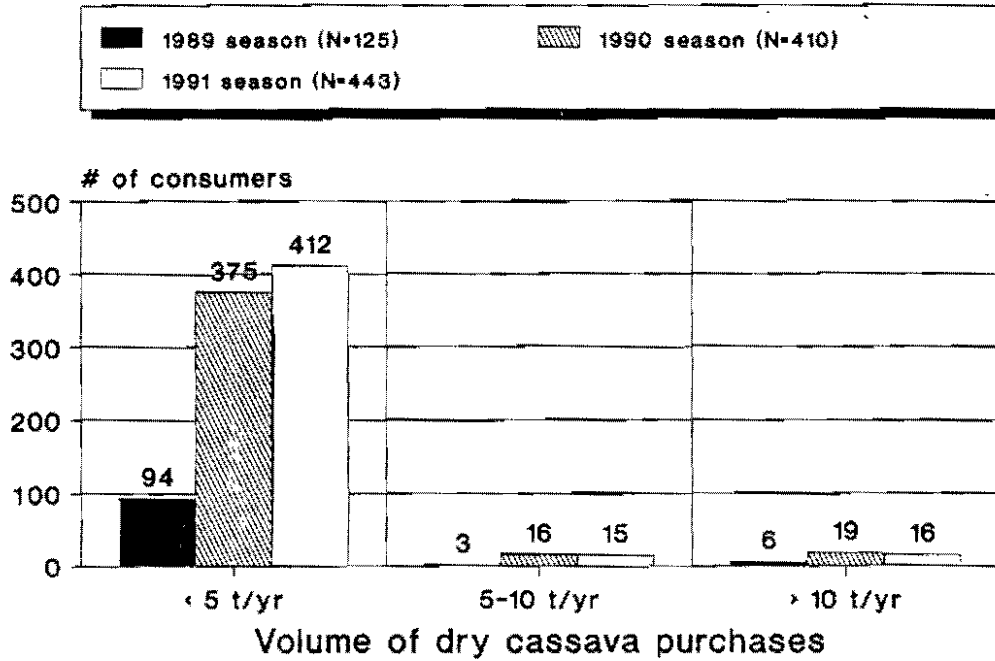


FIGURE 5.1 Volumes of dry cassava marketed by number of consumers (above) and by percent of total production (below). Ceara, 1989-92.

future as the principal animal feed producers and mixers in Ceara demand high volumes over extended periods and the scale of the dry cassava agroindustrial sector is not yet fully developed to meet this demand.

- **Dry cassava and farinha prices.** Cassava processing in Ceara is principally in the form of farinha, accounting for almost 65% of the total annual production of cassava roots. These intensive processing activities are carried out mainly in communally-owned, small-scale processing units ("casas de farinha") found in just about every single farming community throughout the rural areas of the state. Farinha demand statewide is quite high, and it is estimated that nearly 40% of total consumption is imported from nearby states. Despite this high demand, farinha prices are very variable and cassava farmers all too often get paid low prices and have difficulties selling their product. Among the reasons for this vulnerability are the smallness of their operations, the low quality of the final product, their lack of transportation means, and their poor organizational levels.

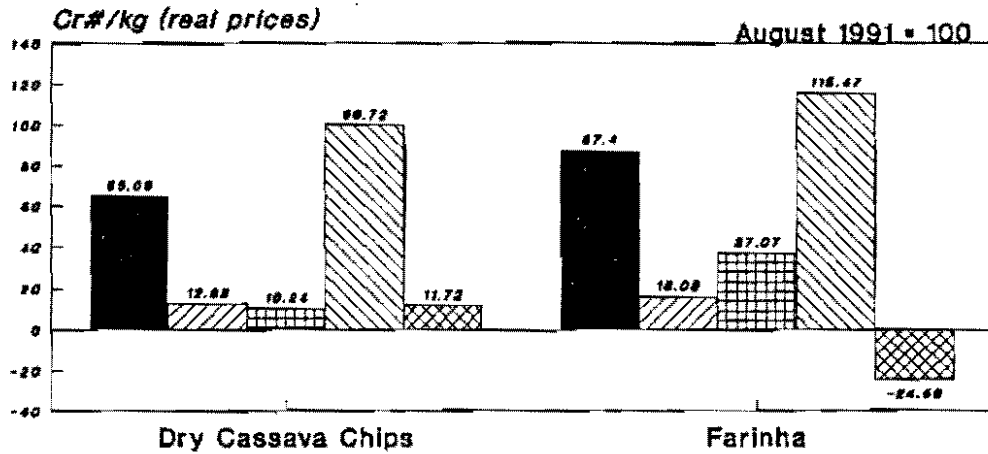
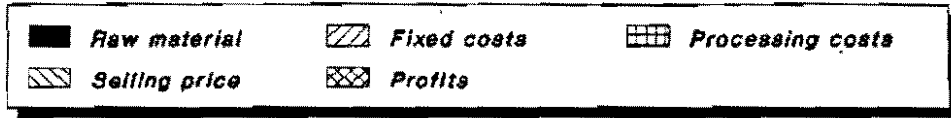
The establishment of dry cassava-based agroindustries, as an alternative commercialization outlet for cassava production, is being carried out with farmer groups that were generally formed as part of the larger communal-type organizations that own the farinha houses. As such, farmers participating in the project are faced with two options: process their crop individually in the communal farinha house or sell the roots to the dry cassava agroindustry, where there will be a collective processing activity in which they will also participate.

Efforts were made during the pilot project to implement a monitoring system for price variations of cassava products so that the technicians could offer advice to farmers and improve the rationality of the economic decisions they have to make. Data collected during the pilot project indicated that during 1990, the production of dry cassava chips was a more profitable activity for farmers than the production of farinha. Farmers received a net profit of Cr\$ 11.7/kg of dry cassava whereas the farinha gave them a net loss of Cr\$ 24.5/kg produced. During the 1991 processing season, the dynamics and variability of the commercialization system were very evident, with dry cassava still giving farmers a net profit of Cr\$ 9.5/kg and with farinha prices responding vigorously, allowing the farmers a net profit of Cr\$ 36.4/kg produced (Fig. 5.2).¹

Since September 1991--right at the middle of the processing season--and until the onset of 1992 processing season--prices of farinha have been increasing continually at rates that exceed the official inflation rates; whereas dry cassava prices have

¹ Prices of cassava products collected at farm level and averaged for the main areas of project influence.

Processing Season 1990



Processing Season 1991

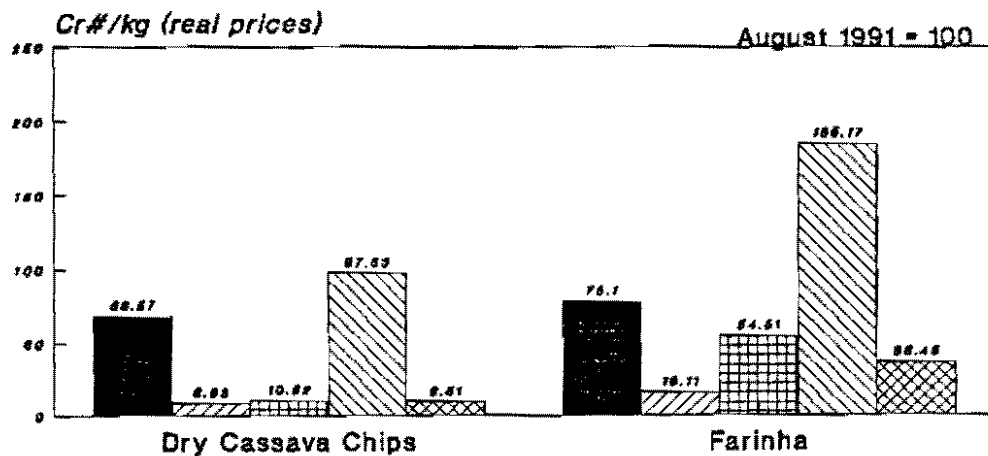


FIGURE 5.2 Profitability of dry cassava and farinha in Ceara, 1990-91.

maintained steady increases (Fig. 5.3).² Data are collected and analyzed based on reports sent to the CCC by the field-level extension agents; however, these prices do not always reflect the prices received by farmers at farm-gate, which are generally lower. The important fact is that cassava farmers in Ceará now have two options for the commercialization of their crop, both of which are profitable. Choosing the final outlet is a decision that depends not only on economic factors but also on aspects such as land tenancy, availability of processing units and labor, storage capacity and transportation, among others.

Box 5 highlights the conclusions from the experience of identifying and consolidating a market for dry cassava chips.

6. Organization

- **Institutions.** Pilot project implementation was greatly favored by the existence of prior considerable attention to creating the CCC, which rapidly became a fundamental working group for carrying out project activities. Despite the fact that the CCC is now fully established as the coordinating body for statewide activities related to the cassava crop, its work has been done mainly within the context of an internationally financed rural development project, in which the central coordination of activities has been closely shared with CIAT.

From now on the CCC will have to be given the legal status necessary to act as a legitimate agency within the agricultural institutional setting of the state. A movement in this direction was initiated during the last year of the pilot project with the CCC now under the administrative responsibility of the Secretariat of Agriculture; and plans are under way to transform it into a technical assistance group under a local agency yet to be defined. To facilitate decentralization of the planning and execution of project activities as well as to enhance beneficiary participation, seven RCC's were organized in the main areas of influence of the project, two only this year. One of the main achievements of the RCC's has been to facilitate the participation of local agency field staff and farmers, whose active participation is rapidly transforming these committees into effective decentralized decision-making units. By the end of the pilot project, a total of 95 technicians from the two local counterpart agencies were participating in project implementation, at the state and regional levels.

- **Farmer groups.** A central strategy for implementing the pilot project was the organization of farmer groups around dry cassava-based agroindustries. Defining the organizational structure most appropriate for Ceará's cassava producer groups has not been an easy task. The majority of the 146 groups that participated during pilot

² Constant prices, August 1991 = 100; IGP-DI = General Price Index-Internal Availability.

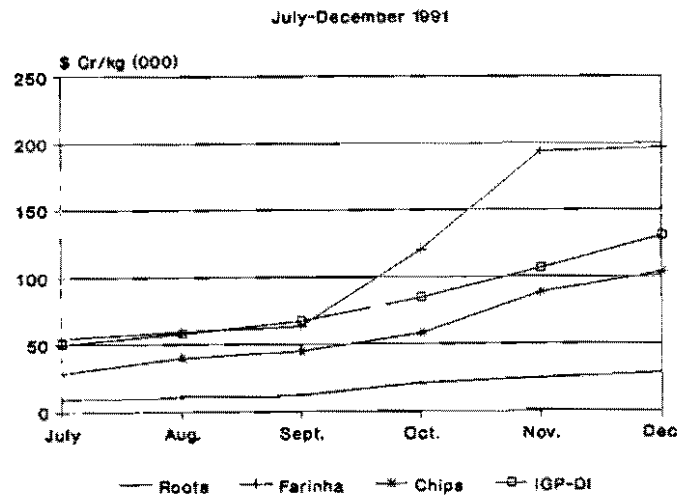
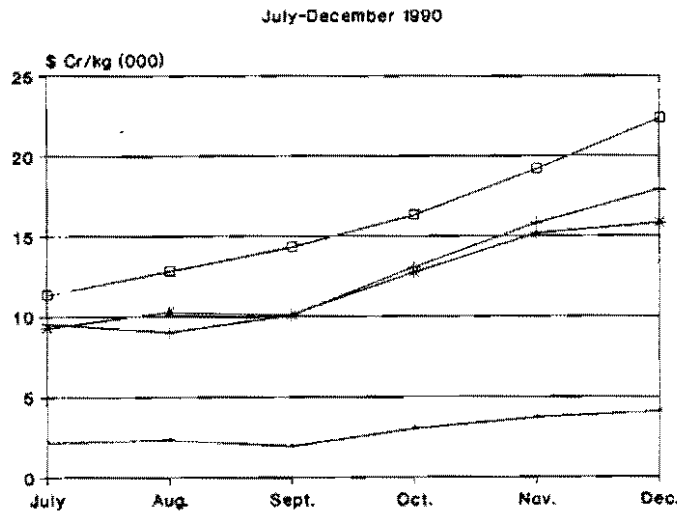
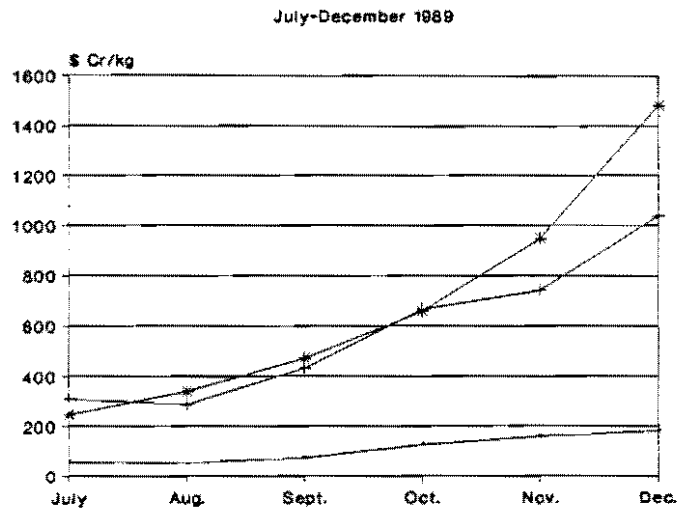


FIGURE 5.3 Price variations of cassava products, 1989-92.

BOX 5. COMMERCIALIZATION

- ▶ Utilization of dry cassava chips as an alternative source of energy in the animal feeding industry is no longer a technological problem given the extensive know-how available. The central issue in the substitution of classical cereal-based diets with diets based on cassava products is the economics of the whole production process. In the case of Ceara, the animal production sector presents an increasing growth rate and consequently a growing demand for raw materials. The poultry, swine and dairy sectors have developed strong union organizations and lobbying capacity, which have rendered them significant political and economical support by federal and local governments during the last decades. Availability of imported grains at subsidized prices has been one of the principal support mechanisms that the animal production sectors in Ceara had been able to attain.
- ▶ Despite the fact that current changes in government policies have diminished these subsidy structures considerably, the utilization of dry cassava as a component by the animal feed industry and the animal production sectors will depend to a larger extent on policy interventions oriented toward strengthening the organizational levels and the bargaining power of the dry cassava producers. One example of such interventions is the program currently being implemented by the Secretariat of Agriculture in which animal feedstuffs are being purchased out of Ceara and sold among animal producer groups at competitive prices. Thus far, the participation of the dry cassava agroindustries in this program has been very modest.
- ▶ Project activities, although biased toward the establishment of dry cassava-based agroindustries, have also reinforced the importance of farinha processing as the main economic activity among small-scale cassava farmers throughout the state. Farinha production accounts for an estimated two-thirds of the total annual output of cassava roots; yet the total consumption of farinha in Ceara has not been met, making it necessary to import the deficit from nearby regions. Any institutional intervention aimed at improving net incomes among cassava farmers will have to address this issue of farinha production, especially the aspects related to its poor quality.

project activities originated in larger communal-type organizations, the most prevalent producer group at communal level in rural Ceara, although in some cases parallel groups were organized, often with overlapping leadership. Efforts were made throughout the project to maintain the degree of social cohesion that already existed

in these rural communities. By the end of the pilot project, a total of 135 new groups were established, and another 11 previously existing groups were reorganized and/or reactivated. Seventy percent of these groups were formed during the last year of the pilot project.

Another strategy implemented to enhance farmer organization was to stimulate the creation of second-order cassava producers' groups at the regional level, with the specific objective of increasing their bargaining power and their participation in planning and implementation of all project and cassava-related activities, with initial emphasis on the commercialization of cassava products. By the end of the pilot project, three cooperative, second-order type organizations were finishing the administrative red tape required to obtain their legal status; and it is expected that throughout the 1992 processing season, the first collective actions at regional level would be performed by these organizations, which were already accounting for nearly

CEARA INTEGRATED CASSAVA DEVELOPMENT PROJECT

ORGANIZATIONAL STRUCTURE

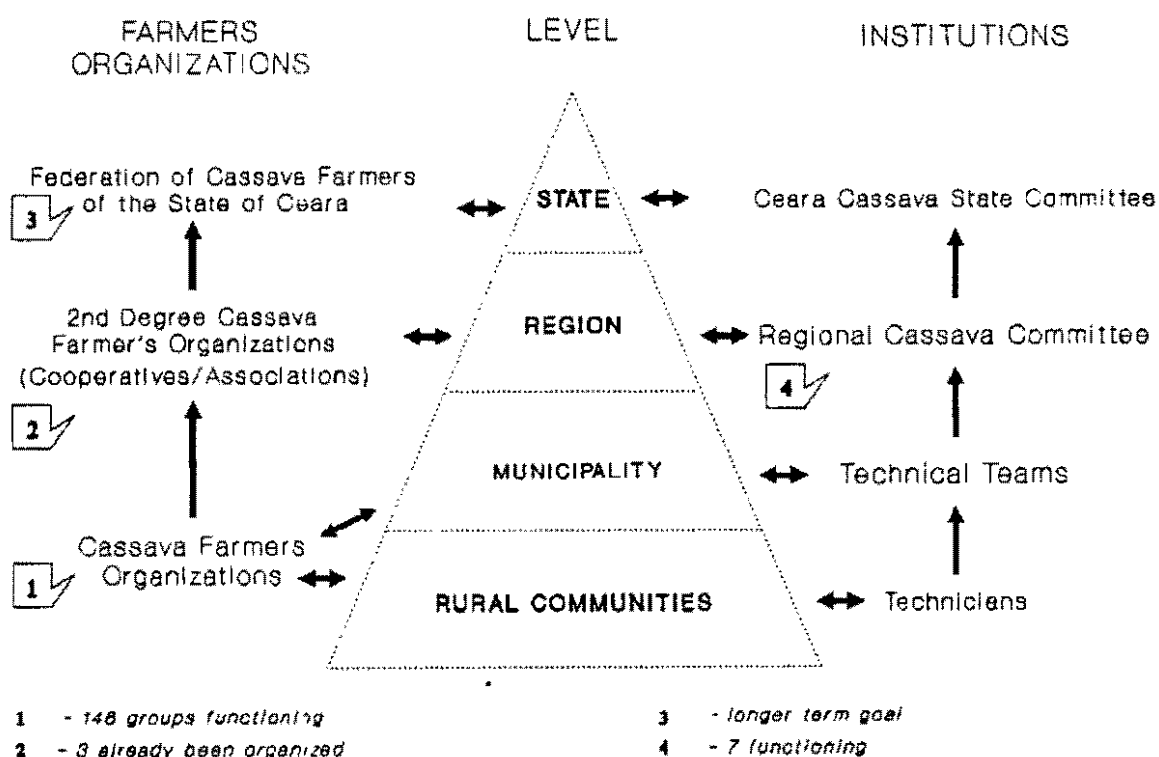


FIGURE 6.1. Organizational Structure for the pilot project

one-third of all cassava farmers participating in the project. Initial results with these organizational schemes are meant to stimulate the formation of similar groups in other areas of project influence. Another long-term objective envisaged initially--the formation of a statewide third-order group, a Federation-- was not pursued, given the slow progress achieved during these three years in the setting up of the farmers' organizational component. Figure 6.1 presents the organizational strategy that has guided project activities in this area.

Box 6 summarizes the principal organizational aspects of the project and the constraints being faced in this area.

7. Training

The pilot project training strategy included four types of events: courses, seminars, field trips and special days. A total of 108 training events were held with the participation of 832 technicians and 2123 farmers as follows:

- ▶ **Courses.** The training courses were conducted at state and regional levels, with the RCCs assuming greater responsibility for the latter. A total of 27 courses covering different areas of work--9 at the state level and 18 at the regional level--were held during the pilot project for 290 technicians and 157 farmers. Table 7.1 presents a summary of the training activities held during the project.
- ▶ **Seminars.** These events were organized with the aim of enhancing the active involvement of regional-level staff from counterpart agencies and farmers in implementing and evaluating project activities and gaining a well-grounded understanding of project objectives and constraints. During the last three years, a total of 30 seminars were organized--5 at the state level and 25 at the regional level--attended by a total of 367 technicians and 561 farmers.
- ▶ **Field trips.** These events were held to allow members of new farmer groups to become familiar with the principal technical, organizational and administrative aspects needed to operate the dry cassava-based agroindustries efficiently. In general the field trips consisted of a two-day, hands-on period spent at one of the more experienced agroindustries in each region, during which the aforementioned skills were discussed. This farmer-to-farmer training methodology made it possible to reduce costs significantly, stimulate interaction and exchange of experiences among technicians and farmers from different regions, and enhance farmer participation in project activities. A total of 35 field trips were carried out during the pilot project, involving 58 technicians and 271 farmers.

BOX 6. ORGANIZATION

► Institutions

Progress in pilot project implementation was rapidly achieved during the last three years, mainly as a result of the organizational scheme proposed by the project based on the functioning of the Cassava Committees at state and regional levels, which have become very important working units for all cassava-related development and promotion work in Ceara. A serious problem has now arisen because these committees have not yet become official components of the prevailing institutional landscape. They are composed mainly of technicians from the two main executing agencies--EMATERCE and EPACE--which are being directly affected by the ongoing stream of events in the larger statewide institutional environment. Consolidation of the initial results obtained with the institutional and organizational intervention brought about by the pilot project will not be fully achieved until these committees find their own legal niche within the state's agricultural institutional setting.

► Farmer groups

Three aspects have been fundamental to the process of rapid expansion of the social basis upon which the Kellogg Foundation-funded project has been built:

- Formation of the farmer groups has been based on collective action, in which the function of the group has been to gain access to a grant-type financial resource for the specific purpose--decided upon by the group--of installing a dry cassava agroindustry.
- Membership of the groups has been initially decided upon among potentially interested members, and any decision regarding new membership is totally under their control.
- The role of the local agencies has been crucial in the task of approaching different sources of financial resources on behalf of the farmer groups to obtain grants. At the same time, these institutions have had continuous access to pilot project funds for supporting farmer activities.

Rapid growth of the number of farmer groups participating in the project was also enhanced by the fact that these groups are organized around specific income-generating activities--to improve their cassava production.

TABLE 7.1 Training events for the pilot project, 1989-92.

Training Events	1989			1990			1991 ¹		
	# of events	Trainees ²		# of events	Trainees		# of events	Trainees	
		T	F		T	F		T	F
I. COURSES									
A. <u>State Level</u>									
• Production	1	38		2	30		1	24	
• Organization of farmer's groups	1	30		1	20		1	30	
• Processing				1	15				
• Diagnostic skills							1	24	
B. <u>Regional Level</u>									
• Processing				5	21	46	13	58	111
II. SEMINARS									
A. <u>State Level</u>									
• Planning	1	26	16						
• Evaluation	1	14	17	1	22	33	1	33	141
• Organization	1	35							
B. <u>Regional Level</u>									
• Planning				5	47	54	6	60	119
• Evaluation				5	25	35	9	105	146
III. FIELD TRIPS									
	15	30	123	11	12	82	9	16	66
VI. SPECIAL DAYS									
	2	15	120	1	15	120	11	61	890
V. OTHERS									
• Study tour to Colombia and Ecuador							1	6	4
• Course for extension agents from Paraiba and Pernambuco				1	20				
TOTAL	22	188	276	33	227	370	53	417	1477

¹ Training activities reported for 1991 include events carried out until July 1992.

² T = Technicians; F = Farmers

- ▶ **Special days.** A total of 14 special days were organized for technology transfer and information purposes with the participation of 91 technicians and 1130 farmers.
- ▶ **Others.** Additional training activities carried out during the pilot project included (a) a study tour to Ecuador and Colombia, in which a group of 6 technicians and 4 farmers who participated in the project were able to get first-hand experience in similar projects being implemented in these countries; and (b) a training course for technicians from two nearby states.

Box 7 summarizes the opportunities provided by the extensive project training program and highlight the major constraints to developing human resources.

BOX 7. TRAINING

- ▶ Human resource development, a well-recognized constraint in most rural development projects, is not the least of the problems that are currently affecting implementation of the Ceara pilot project. Training activities held during this period have been mainly orientated toward building capacity among local agency staff members rather than toward farmers, given the class structure and organizational profile of the local environment in which project activities are being implemented—especially the fact that illiteracy rates among project beneficiaries are very high (> 50%).
- ▶ Training strategies for technicians sought to link training and work, using current and real work-related problems as the training issues and work groups as the basic training unit. Throughout the pilot project phase, average participation in training activities for the cadre of field-level extension agents and researchers engaged in project activities was 9 events per technician, which represents a considerable increase in the availability of training opportunities for local agency staff members.
- ▶ Educational and organizational needs of project beneficiaries are much greater than those of project staff. High rates of illiteracy and lack of organizational skills—particularly those related to handling funds, keeping records, organizing meetings—are cited among the major constraints affecting greater farmer participation in project activities and preventing a more efficient two-way information flow between them and the project staff.
- ▶ Current farmer training strategies used by local agencies and technicians include mainly formal training and mass communication activities and are basically centered upon the extension of technological services rather than upon training and education. As such, these training methodologies tend to be useful only for those farmers with the needed skills and thus end up segregating people chosen for training from the rest of the community, making it more difficult to develop a broader leadership base at the community level.
- ▶ A very interesting, innovative approach to farmer education was initiated during the last year of the pilot project aimed at providing 50 dry cassava-based farmers' groups with basic reading and writing skills. This Kellogg Foundation-supported educational effort is coordinated by ESPLAR, an NGO group based in Ceara. The program also benefits members of the larger community within which each agroindustry operates. Initial results have been very encouraging and have generated great support and enthusiasm among cassava farmers, to the extent that several other communities are already asking to be included in the program. Coverage of this training effort is limited; and given the rapid expansion of the social basis of the cassava project and the very high rates of illiteracy among the beneficiaries, it becomes extremely important for local agencies to find the means of creating an institutional structure—at local, regional and state levels—which could guarantee the continuity and orientate the expansion of this new training approach to other rural areas of the state when available external funds terminate.

8. Monitoring and Evaluation (M&E)

■ The Model

From the onset of the dry cassava-based pilot project, M&E activities were considered an integral part of its implementation strategy. An M&E model was structured in which monitoring activities were carried out at three different levels, differentiated on the basis of specific project objectives, target population and methodologies. Table 8.1 presents the structure of the M&E model.

TABLE 8.1. Monitoring and evaluation system for the cassava pilot project.

FACTOR	DATA BANK	SURVEYS	INTENSIVE MONITORING
Populations	<ul style="list-style-type: none"> a. Organizations--cassava processors b. Farmers who sell cassava 	Population sample of cassava sellers in the data bank, structured according to region, landholdings & links to cassava processing organizations	Subsample for surveys
Objectives	<ul style="list-style-type: none"> a. Obtain basic information on the functioning of processing and beneficiaries of the project b. Create a sampling frame to extrapolate results from surveys and intensive monitoring 	<ul style="list-style-type: none"> a. Obtain information on the impact of the project on cassava production b. Analyze the impact of the project at the level of the small-farmer economy 	<ul style="list-style-type: none"> a. Obtain information regarding production technology at the farm level
Areas	<ul style="list-style-type: none"> a. Purchased cassava: variety, harvest period b. Sellers: landholdings, location, area planted c. Processing: production costs, labor, commercialization profits, credit 	<ul style="list-style-type: none"> a. Landholdings b. Intercropping systems c. Availability of labor d. Commercialization of cassava e. Yields 	<ul style="list-style-type: none"> a. Farmers' production technology b. Availability and use of resources in production
Method	<ul style="list-style-type: none"> a. Data collection based on needs of cassava processing groups b. Information centralized in data bank for later systematic computerized analysis 	Annual survey with 200-300 farmers based on a stratified sample	Periodic visits to a selected group of farmers

By the end of the pilot project, **the first level**--baseline data--already included information on 133 cassava processing farmer groups with a total of 2962 members¹. **The second level**--an annual survey--was conducted twice: in 1989 with 160 farmers and in 1991 with 932 cassava producers. **The third level**--an intensive monitoring of a selected, smaller subsample of farmers--was conducted throughout the pre-production trials.

Data generation and collection for the three levels of the M&E was done mainly by farmer managers of the cassava processing organizations and the extension agents, under the coordination of the RCCs. This information has been centralized and analyzed by the CCC and reported back to beneficiaries and project staff through monthly reports and to donors and decision-makers by means of annual reports. The output of the Monitoring & Evaluation Model is presented below. The characteristics of the Model and the

¹ 25 additional farmer groups were still facing organizational and/or institutional problems, and information on their social basis was not yet available by the end of the project.

constraints to its continued use as a feedback mechanism for reorienting project objectives and activities are summarized in Box 8.

■ Output of the M&E model

Areas in which the M&E system was currently providing information by the end of the pilot project were as follows:

▶ Characteristics of the farmers

- Land Tenure. A total of 133 farmer groups were actively engaged in project activities with 2962 members. The land tenure system under which these farmers operate their holdings includes three forms distributed as follows (Fig.8.1): owners (58.6%), renters (28.9%) and sharecroppers (12.5%). Of the owners, 21% belong to land reform settlements.

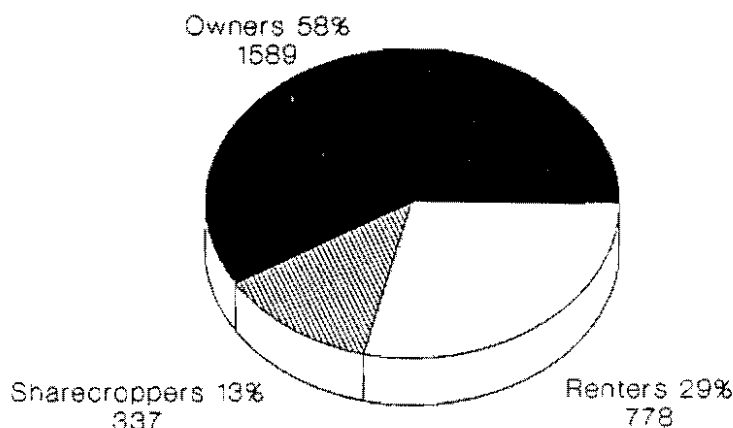


FIGURE 8.1 Land tenure.

- Age of the participants. 70% of project beneficiaries are between the ages of 30 to 60, 17% are younger than 30, and only 13% are older than 60.
- Gender. 97% of project beneficiaries are men and only 3% are women. Only 36 groups include women among their members (Fig. 8.2).



FIGURE 8.2 Age and gender of participants.

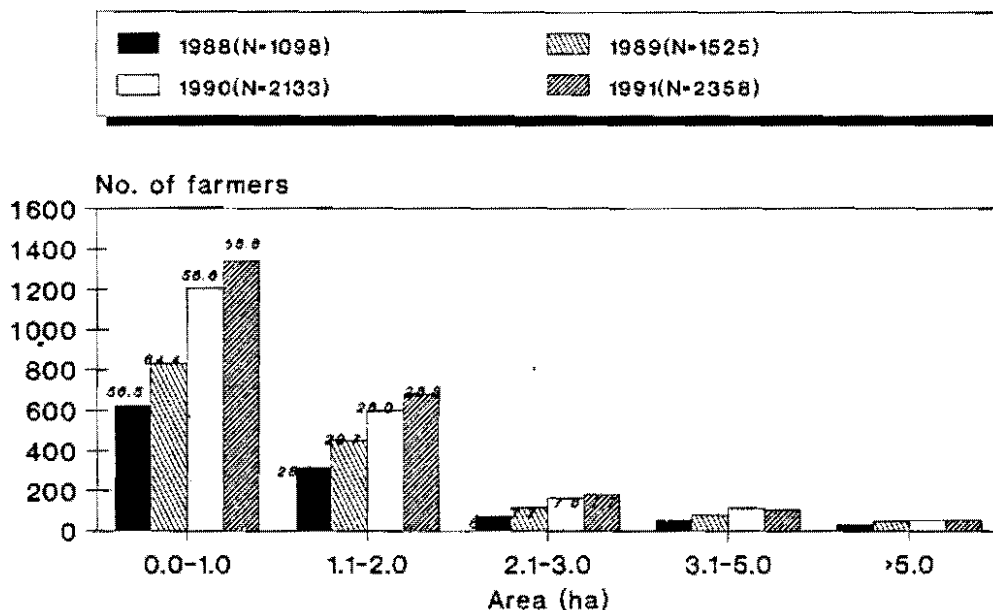
- **Literacy.** 55% of the current beneficiaries are illiterate, and 45% do not have any basic reading and writing skills. 90% of the illiterate farmers have had from only 1 to 3 years of schooling.
- ▶ **Size of cassava farmers' organizations.** By 1992, the pilot project was already covering 11 regions with a total of 133 farmers' groups and 2,962 direct beneficiaries. The overall average size for these producers groups was 22 farmers per group although the social basis has been changing from year to year, mainly due to the fact that farmers' organizations are still facing a transition period from larger, farinha-based groups to generally smaller, dry cassava-based agroindustries (Table 8.2).
- ▶ **Cassava production.** The underlying philosophy behind the cassava-based rural development projects in relation to cassava production is that as a result of the opening up of an alternative, more profitable marketing channel, cassava plantings among beneficiaries will be expanded. To test the validity of this assumption and, consequently, the success of the project, two factors were monitored during the project: (1) size of cassava plots planted by farmers engaged in project activities, and (2) the relationship between the farmers' land tenure system and the size of their cassava plots.

TABLE 8.2: Size of cassava farmers' groups.

Region	No. of Farmer Groups	Total No. of Members	Average Regional Group Size
Brejo Santo	2	65	32.5
Baturite	3	119	39.6
Crateus	11	308	28.0
Crato	18	316	17.5
Fortaleza	11	218	19.8
Iguatu	2	46	23.0
Itapipoca	38	761	20.0
Limoeiro	9	196	21.7
Quixada	4	81	20.2
Sobral	16	411	25.6
Ubajara	19	441	26.0
TOTAL	133	2962	
AVERAGE			22.2

• **Size of cassava plots, 1988-91.** Information collected among project beneficiaries regarding size of their cassava plantings over a four-year period indicates that they have remained fairly constant during this period, with nearly 56% of the farmers planting cassava areas smaller than 1 ha, and with nearly 85% of the entire population involved in the project planting cassava plots of no more than 2.0 ha in size. Conversely, fewer than 15% of the entire population were planting cassava plots larger than 2.0 ha (Fig. 8.3).

• **Cassava plot size and land tenure systems, 1988-91.** Data available on the relationship between land tenure system and cassava plot size among project beneficiaries indicates that for the last four years the owners have generally been planting larger cassava areas than renters and sharecroppers. By the end of the pilot project, the average size of cassava plots for the entire population presents a slight decline (8%) in relation to average size of cassava plots at the beginning



The figures above the bars represent the percentage of the total number of farmers

FIGURE 8.3 Distribution of cassava farmers by size of their cassava plots. 1988-1991.

of the project (1989). This decline appears to refer primarily to the smallholders, whose average cassava plantings are now 13% smaller than 2 years ago. Also the sharecroppers are now planting cassava plots 5% larger than in 1989; whereas the renters have practically maintained constant the size of their cassava areas during the last three years (Fig. 8.4). Among the factors that may explain this slight decline in cassava production by project beneficiaries, it is worth mentioning the fact that 75% of total project population belong to farmer organizations that joined the project only during the last year (1992), as well as the total lack of credit available for cassava production that farmers faced during the project.

- **Results of the processing seasons, 1989-91.** Cassava farmers engaged in dry cassava-based rural development projects have the possibility of receiving three types of benefits: (a) the availability of a new market for their cassava roots, (b) additional employment opportunities in the form of processing dry cassava, and (c) the annual share of profits generated by the cassava-based agroindustries. Benefits (a) and (b) are open to any member of the larger community within which the agroindustry operates; whereas (c) is available only for organization

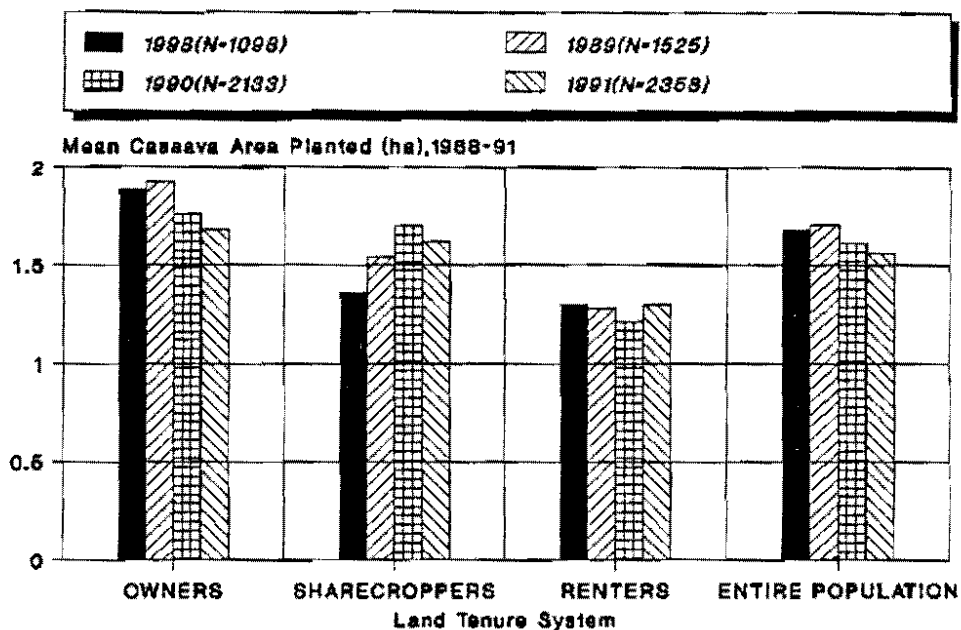


FIGURE.8.4 Cassava plot size vs.land tenure, 1988-91.

members. Information gathered on the results of farmer groups during pilot project processing activities is described below:

- **Cassava sales, 1989-92.** During the pilot project, a total of 7094 t of cassava roots were processed, of which an average 38.3% came from members and 61.6% from nonmembers near the cassava processing units. Member participation as raw material suppliers for the dry cassava agroindustries was especially low during the second year although by the end of the pilot project their contribution to total cassava purchases was already equal to that of nonmembers (Fig. 8.5).

Additionally, data collected on the number of farmer members who sold cassava roots to the agroindustries and their relation to the total number of beneficiaries also indicate a greater participation of farmer members as raw material suppliers. During the last year of the pilot project, 51.2% of the total membership of the

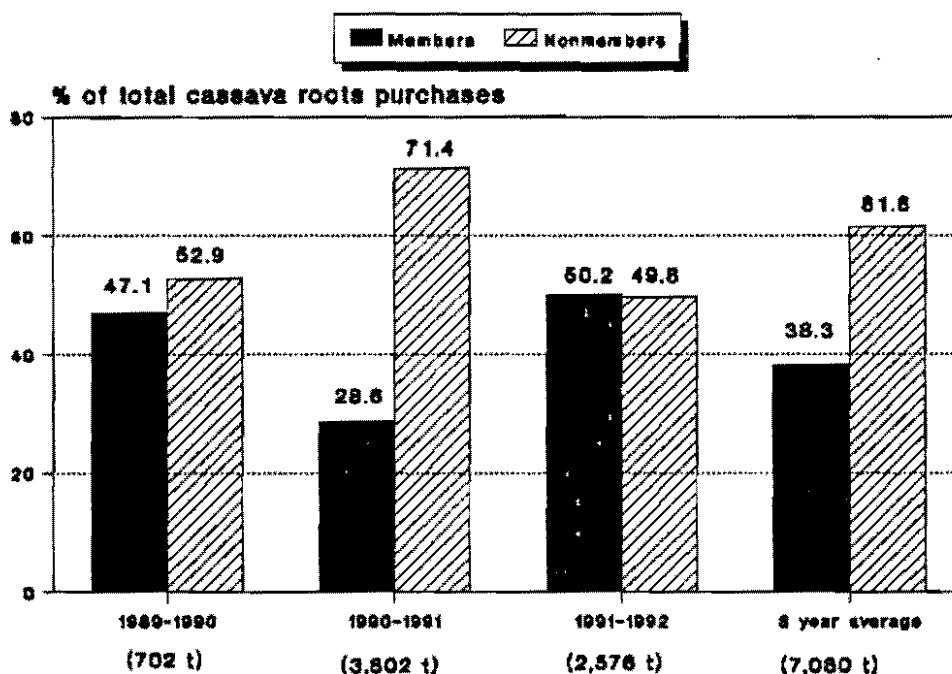


FIGURE 8.5 Cassava sales by members and nonmembers, 1989-92.

agroindustries sold cassava roots to the agroindustries, representing an increase of 51% and 70%, respectively, in relation to the first and the second processing seasons. Average participation of farmer members as cassava suppliers during the pilot project was 39.6% (Fig. 8.6).

◆ **Total annual incomes, 1989-92.** The total annual incomes received by farmer members of the dry cassava agroindustries was monitored during the pilot project. Total income includes cassava sales¹, processing wages and the sharing among members of the annual profits obtained from the sale of the dry cassava. During the three years covered by the project, the total incomes gained by the farmers reached US\$163,689, of which 37.3% corresponded to cassava sales, 10% to processing wages and 52.7% to sharing of annual profits (Fig. 8.7). According to the land tenure system of the beneficiaries, the distribution of these total incomes indicates that 58.9% went to smallholders and 32.45% to renters, but sharecroppers received only 8.7%.

¹ It is assumed that cassava production costs have been already covered and that the actual amount of cassava roots sold to the agroindustries represents a net profit for farmers.

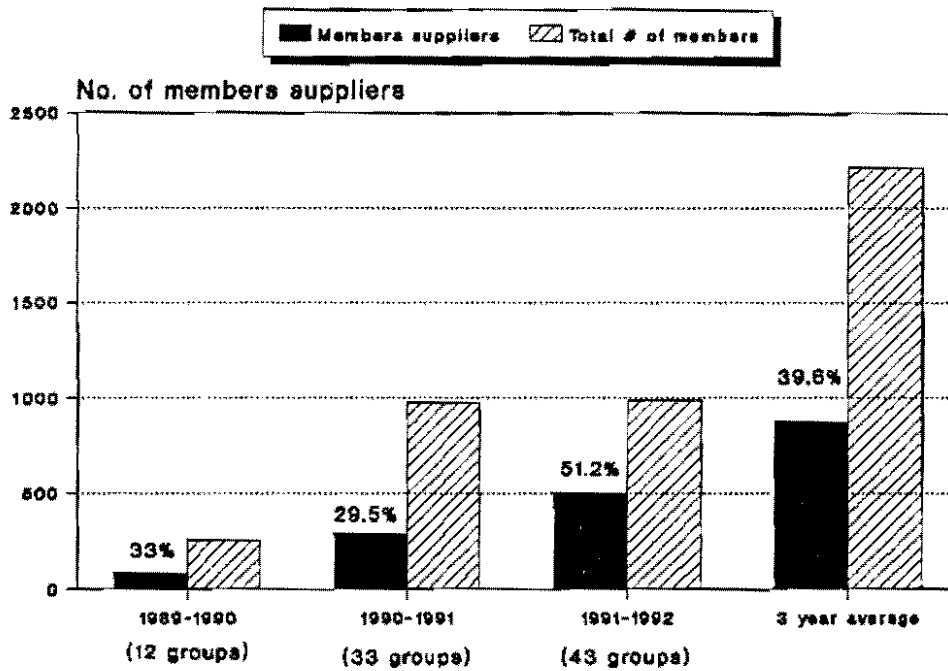


FIGURE 8.6 Membership participation as cassava suppliers.

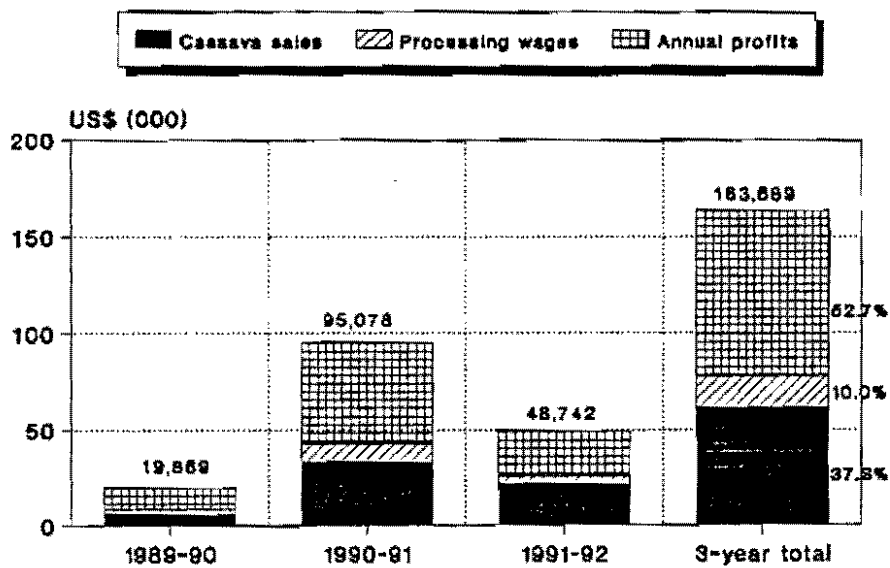


FIGURE 8.7 Total incomes 1989-92.

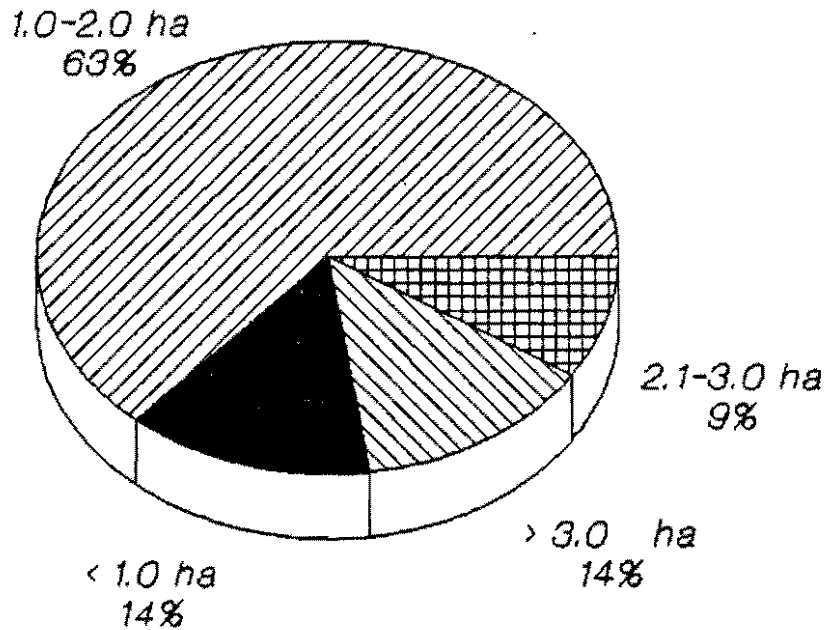


FIGURE 8.8 Total incomes by cassava plot size, 1989-92.

The relationship between the total annual incomes gained by project beneficiaries and the size of their cassava plots was another parameter included in the M&E system. Data collected on the results obtained during the project indicate that the greatest part of the benefits went to the farmers with the fewest resources. 77% of total incomes generated during the pilot project went to those farmers planting cassava areas no larger than 2.0 ha, and only 23% of total project income went to farmers with plots areas larger than 2.0 ha. Farmers planting areas larger than 3.0 ha obtained only 14% of the total income generated during the three processing seasons covered by the pilot project (Fig. 8.8).

The pattern of distribution of total project incomes among farmers remained practically the same during the pilot project, except for the beneficiaries planting larger cassava plots (> 3.0 ha), whose share of the total incomes by the end of the project presented a significant increase of 115% in relation to the situation at the onset of the project (Fig. 8.9).

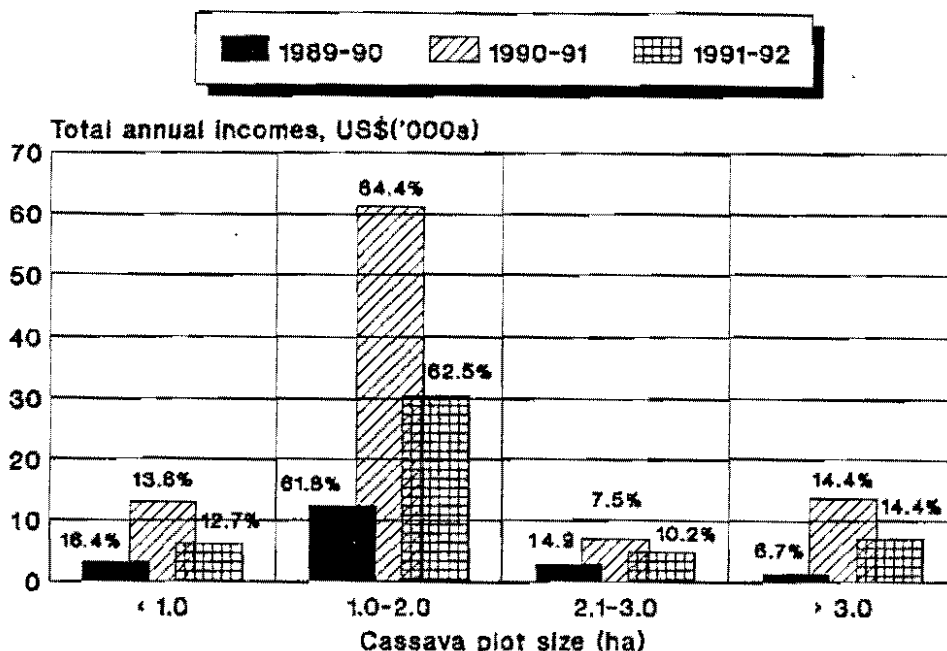


FIGURE 8.9 Total annual incomes by cassava plot size, 1989-92.

9. Sustainability

From the inception of the project, several constraints were identified as affecting negatively the continuity of actions and the development of a self-sustaining dynamic that would continue after project termination. These limiting factors can be separated into four categories: organizational, financial, economic-political and natural resource base constraints.

■ Organizational constraints

- ▶ **Institutions.** Project strategy included the implementation of an organizational structure for both institutions and farmer groups aimed at building enough capacity to assure that when external resources end, local institutions will be able to continue activities. This organizational structure included two specific organizational forms--**the Cassava State and Regional Committees**--which were new to the prevailing institutional landscape and whose institutionalization as valid components of the local agricultural sector setting will require a longer period than the three years of the pilot project. Moreover, the organization and operation of the local agencies in charge of project implementation is undergoing a radical reorganization that is affecting project implementation.

BOX 8 . MONITORING AND EVALUATION (M&E).

- ▶ M&E activities became an integral part of pilot project implementation strategy, the output of which is already providing useful and timely information to project staff at central and field levels, and to the larger target audience. By the end of the project, two aspects included in the M&E system were especially well covered and started to yield essential information for short-run decision-making and undertaking of appropriate actions: (a) Baseline data kept at central level regarding area of influence, target areas, cassava production potential and farmers' characteristics are allowing the rapid identification of potential sites suited for project expansion; and (b) the series of monthly processing, financial and technical reports on the performance of farmer groups produced jointly by field-level staff and farmer-managers and centralized in the data bank, is providing useful information regarding project benefits and their distribution among beneficiaries. This information has become the basis for the annual reports, the main current instrument for feeding back the processed information to collaborators, donors and the decision-making audience.
- ▶ Longer term objectives of the M&E system--especially those related to generating data on project impact on cassava production systems in Ceara (area, yields, technology adoption)--have not been fully achieved yet, mainly due to the fact that cassava cultivation in the region is a biannual activity with a growing period of at least 15 months, and the assessment of any changes in cassava production due to project activities demands a longer horizon than the three years covered by the pilot project.
- ▶ Main responsibilities for designing and implementing the M&E system lie with the CCC and the RCCs. The fact that these working groups do not yet have a legal status within the local institutional landscape could affect their short- and long-term sustainability. Furthermore, second-order farmer organizations, which have the potential of becoming appropriate coordinators of monitoring activities, are just being organized. The extent to which ongoing changes in the larger institutional environment will affect local agencies in charge of project implementation, the rapid definition of a legal status for the CCC and the RCCs, and their integration with second-order farmer groups will be some of the more critical factors for strengthening and consolidating the M&E system.

The strategy followed to deal with this limitation was to increase the efforts aimed at improving local policymakers' knowledge of the nature and importance of the project and the critical role of the cassava committees in the implementation of project activities. It is expected that through raising policymakers' consciousness, the needed support will be obtained to strengthen and legalize the status of the aforementioned organizational forms.

▶ **Farmer groups**

Organization building among farmers participating in the project was pursued through the establishment of small-scale farmers organizations responsible for installing, operating and administering the cassava processing agroindustries. Participation of farmers in this process has meant a reorientation of their activities toward tasks different from those they were traditionally used to, principally the processing of cassava roots into farinha for human consumption, on an individual non entrepreneurial basis.

The extent to which these small-scale cassava producers will be willing to make these changes is difficult to predict. It will certainly require a transition period during which many farmer organizations may show poor member participation and low performance. This constraint is augmented by the high rates of illiteracy prevailing among project beneficiaries (40-50%).

To overcome these constraints, the pilot project has emphasized training activities with farmer groups in which the new behaviors are demonstrated and discussed, with their active participation. This capacity-enhancing training strategy has been reinforced with the use of farmer-to-farmer training methodologies, in which experienced farmers act as trainers.

■ **Financial Constraints**

The economic situation in Brazil has continued to be adverse during the project period. Project growth in social terms has been possible only because of the strong support received by local agencies and programs that have offered grant-type financial resources to farmer groups for installing the cassava processing agroindustries. Unfortunately, the availability of these economic resources is limited. The expansion of project activities to other regions and farmer groups is already facing financial limitations. Loan-type credit programs, although available as a financial alternative, have hardly been used by farmers because they include debt indexation in their payment scheme. Combined with the very high inflation rates prevailing in Brazil, this option becomes very risky for farmers.

These financial constraints have also affected the performance of the already established producer groups, which have not found credit programs readily available

to support production and processing activities. The strategy employed during the pilot project to deal with this constraint was to formulate credit programs that included loan-repayment systems based on price variations of cassava products, preferably dry cassava chips. These credit programs were finally accepted by the local agencies during the last year, and some of the farmer groups engaged in project activities are already using this financial support for cassava processing and, to a lesser extent, for cassava production. Installation of cassava processing infrastructure has not yet been included under these credit schemes and the appearance of new dry cassava-based producers' groups is likely to be affected, given their lack of economic resources. Specific credit programs including low interest rates, long amortization periods and payments schemes based on price variations of cassava products will need to be designed if the expansion of project activities is going to be pursued.

These credit programs represent a pioneering effort in the context of small-scale farming systems in Northeast Brazil, and their development and initial results must be carefully monitored and evaluated to assess their effectiveness and to draw essential feedback information for policymakers and project strategy researchers.

■ **Economic-political constraints**

As with every other rural development project, the Ceara cassava-based development effort has co-existed within political and economic settings, at national and local levels, which affect the performance and potential of project participants. A policy of particular importance to the project implementation and impact has to do with the relationship, or the lack thereof, between the current land tenancy systems and the land reform programs. A large percent of project beneficiaries are either landless or have very small areas of land. A basic assumption of the project strategy was that the introduction of a new processing technology and consequently the development of a new market was likely to produce, in the short term, an increase in the size of the total cassava market for cassava and an incentive for farmers to increase their areas planted to cassava. In the intermediate term, it is expected that farmers will start to adopt improved cassava production technologies. In the case of the pilot project, its impact on farmer groups and their responses to project-induced stimuli have both been affected adversely by the weakness of the land reform programs currently being implemented in the region.

The strategy followed during the pilot project to alleviate this constraint has been to increase the awareness of policymakers in charge of land reform programs of project goals, objectives and results, with the purpose of gaining support for project beneficiaries.

Another political-economic constraint that is affecting pilot project implementation and sustainability is related to the minimum-prices policy for agricultural products existing at the national level, which in the case of cassava is influenced by the strong lobby

of cassava industrial producers and processors of southern Brazil, who tend to maintain minimum prices for the roots as low as possible in order to increase their profits in the processing activities. Conversely, in Northeast Brazil cassava is produced and processed mainly by small-scale, farmer-owned enterprises, which are interested in high prices for their product. However, their poor lobbying capacity, due to organizational weakness, has limited their ability to increase raw material prices.

The strategy followed during the project regarding this constraint was twofold: (1) increase training activities for farmer groups and (2) establish vertical linkages with policy-level decision-making groups at the national level. Currently, the CCC has been included as a permanent member of the countrywide coordinating committee for the cassava sector (Camara Setorial da Mandioca), which includes producers, agroindustrialists, consumers and government institutions; and whose main task it is to recommend policies to the Ministry of Agriculture regarding the cassava crop.

■ **Natural Resource Base Constraints**

Project activities and impact are expected to produce greater pressure on land use (expressed in increases in area planted to cassava) and a decrease in the amount of nonharvested area. Traditional cassava-based farming systems in the region are characterized by the lack of inputs--especially chemical or organic fertilizer--and the only alternative for reducing soil fertility decline lies in extending the fallow period. Furthermore, the lack of credit for cassava production prevents farmers from purchasing organic manure which is available in some areas. The strategy followed to address this issue was through the establishment of the pre-production trials in which improved, low-input technological packages available in the region for cassava production were tested against traditional technologies.

Despite the good initial results with this activity, it must be taken into account that these plots were installed under optimum conditions with timely availability of organic manure, which has now become a very expensive and scarce commodity in Ceara. Any future action in this direction will require a careful exploration of additional alternatives for soil fertility maintenance and enhancement such as mulching and green manure in order to improve the farmers' chances to increase the productivity of their cassava-based farming systems through better, sustainable, appropriate land management systems.

10. Adoption and Impact

Adoption and impact studies are important and necessary when a major technological and economic change is introduced into a quite stable small farm economy in order to ensure that research and extension activities are focused properly and in accordance with the preset objectives. Moreover, research and extension activities can be performed

efficiently and effectively only when there is sufficient feedback to research and extension institutions and donors on the returns to their investments and the distribution of these benefits.

Two basic types of impact assessment studies exist: ex-ante and ex-post. Ex-ante impact assessment studies evaluate different strategies for technology development and diffusion. These studies are based on expected returns and equity issues and are conducted before implementing the project. Based on this ex-ante assessment, the appropriate project strategy is selected. Throughout the life of the project, continuous M&E of the impact of research and extension activities is also important to refine the selected strategy in accordance with the project objectives and needs. In addition this continuous project M&E serves to integrate technical and socioeconomic aspects of the project and to improve the efficiency and equity of the project in the short- and medium-term.

On the other hand, ex-post assessment studies are made after the project has been implemented in order to respond to the governments and funding agencies on the use of the resources invested in the project. Ex-post analysis should also be viewed as a learning experience for future projects. Ex-post analysis are also assessed in terms of efficiency and equity. Efficiency analysis determines the economic returns of the resources invested in technology development and transfer. Equity analysis, on the other hand, determines how the economic benefits are distributed among the different groups in society. Once the impact is assessed in terms of efficiency and equity, it is also important to determine the extent to which these benefits are reflected in the region's economic development and the improvement of the quality of life of its population.

The Cassava Economics Section at CIAT is currently implementing a methodology to assess these type of impacts based on experiences drawn from a similar project in Colombia. This methodology is summarized in the flow diagram of Figure 10.1, in which production and processing technologies and their relationships to adoption and impact are shown.

At the adoption level there are two technologies: cassava drying and production technology. The new market for cassava created by the adoption of the cassava drying technology would influence on-farm utilization of cassava and stimulate cassava production in two ways: In the short run, the farmer is able to react by increasing cassava area using traditional technology, decreasing fallow period and reducing nonharvested cassava area. In the intermediate term, the farmer will attempt to increase productivity by adopting new production technology, creating a demand for improved cassava production technology. In the intermediate to long run, increases in area and yields would increase cassava supply at the aggregate level, putting a downward pressure on fresh cassava prices and creating benefits for fresh cassava consumers. On the other hand, the increase in cassava production would create a demand for labor and improve cassava farmers' incomes.

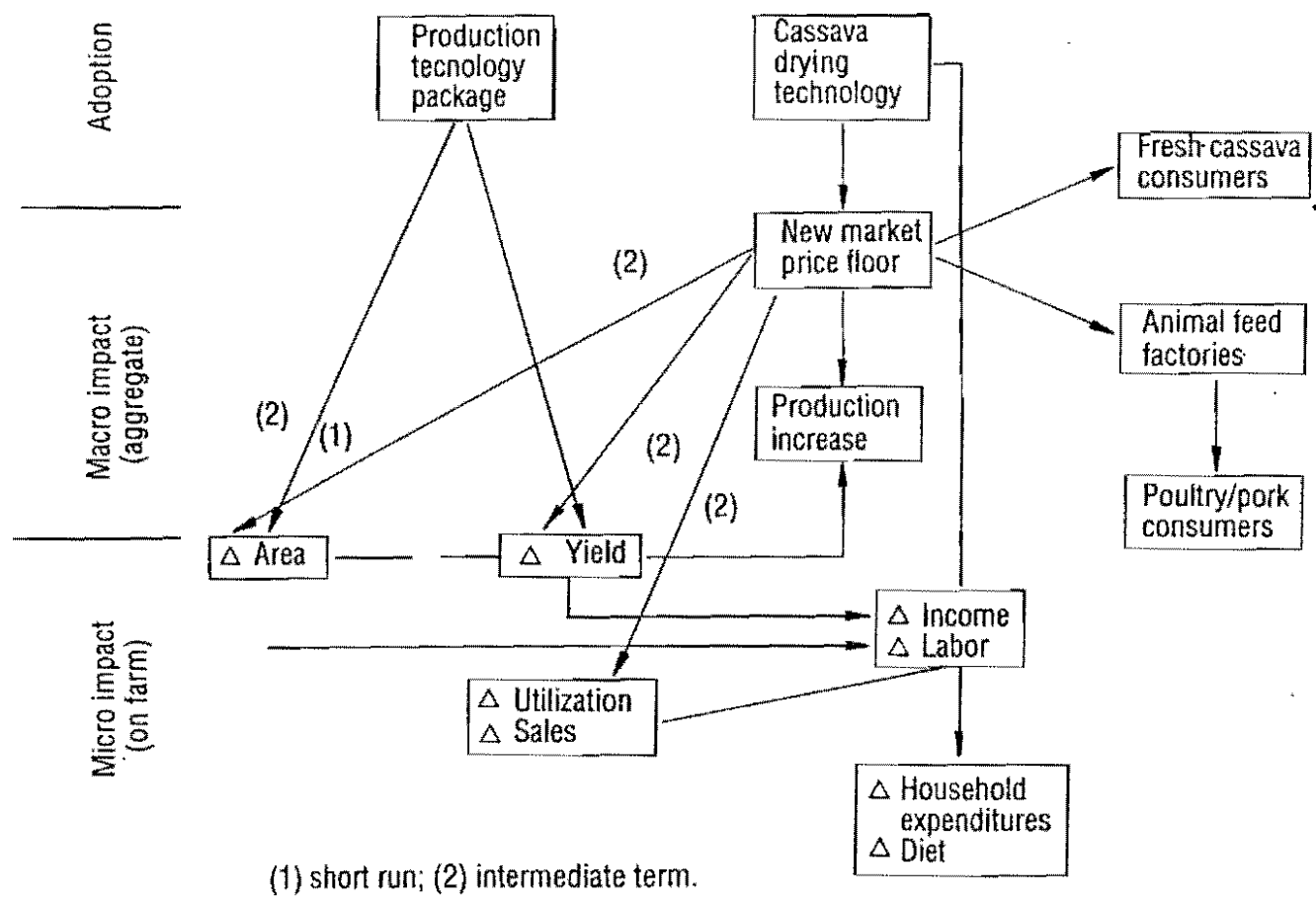


FIGURE 10.1 Flow diagram of the adoption and impact of cassava technologies.

As can be seen from the hypothesis raised, the methodology not only covers technology adoption but also the evaluation of impact at the farm level and the aggregate economy.

As this project was implemented only three years ago, it is not possible to conduct a complete ex-post evaluation, but the project has been under a continuous M&E. A previous section of this report presented the M&E system and discussed the importance of M&E activities in project strategy as a crucial mechanism for ensuring the feedback of farmer groups' performance data in order to fine-tune short-term objectives. Output of the M&E model utilized in the pilot project--especially the Data Bank--can be utilized to assess the rapid adoption of dry cassava processing technologies in the Kellogg Foundation-funded pilot project in Ceara.

- ▶ From the start up of the project, the number of drying plants increased from 11 to 138 and the number of regions of influence from 4 to 11, indicating the rapid spread of the dry cassava processing technology into new regions and rural communities.
- ▶ Despite the fact that buyers of the dry cassava chips have been mainly livestock producers near the processing plants, the actual number of clients for the product has been increasing continuously; and during the last year of the pilot project, a total of 443 different clients were purchasing the product.
- ▶ The organizational structure implemented during the project for both institutions and farmer groups, which by the end of the project included 5 Cassava Committees, 146 farmer organizations and 3 regional-level farmer cooperatives in process of formation. In addition, a total of 43 farmer groups were exposed to improved cassava production technologies in pre-production plots as part of project activities about which the M&E system is currently providing data that can be used to show short-term rapid diffusion and adoption.

Although the aforementioned data bank outputs can be analyzed to assess rapid diffusion and adoption in time and space, there is still a lack of quantified data on project impact at the farm level and the aggregate.

During pilot project implementation, two surveys were developed and tested. The first one in 1989 included 160 farmers; the second in 1992 surveyed 932 cassava producers and was meant to become a benchmark type of study for future adoption and impact analysis. The 1989 survey included old farmer groups that were dissolved during the pilot project, and the membership of other groups decreased considerably. Thus the sample size of farmers who participated in both surveys was reduced to only 86 cassava producers. A brief analysis of some of the results of the surveys allows some preliminary conclusions regarding impacts due to project activities:

■ On-Farm Cassava Consumption and Utilization Changes

It has been argued that newly created demand for cassava dried chips will have an immediate effect on on-farm consumption and sales. Figure 10.2 demonstrates that farmers are currently selling 53% of their production to the cassava drying agroindustries in contrast with the situation during the first years of the project when the share of total cassava production used for dry cassava processing was only 4.8%.

Additionally, the production of farinha for human consumption now accounts for nearly 38% of total production; whereas in 1989 it represented a 64.5% share of the total production.

The utilization of cassava for on-farm feeding of animals has remained almost the same. Furthermore, the selling of cassava roots to other markets such as dairy and cattle producers--which in 1989 represented a 25% share of the total production--is now insignificant.

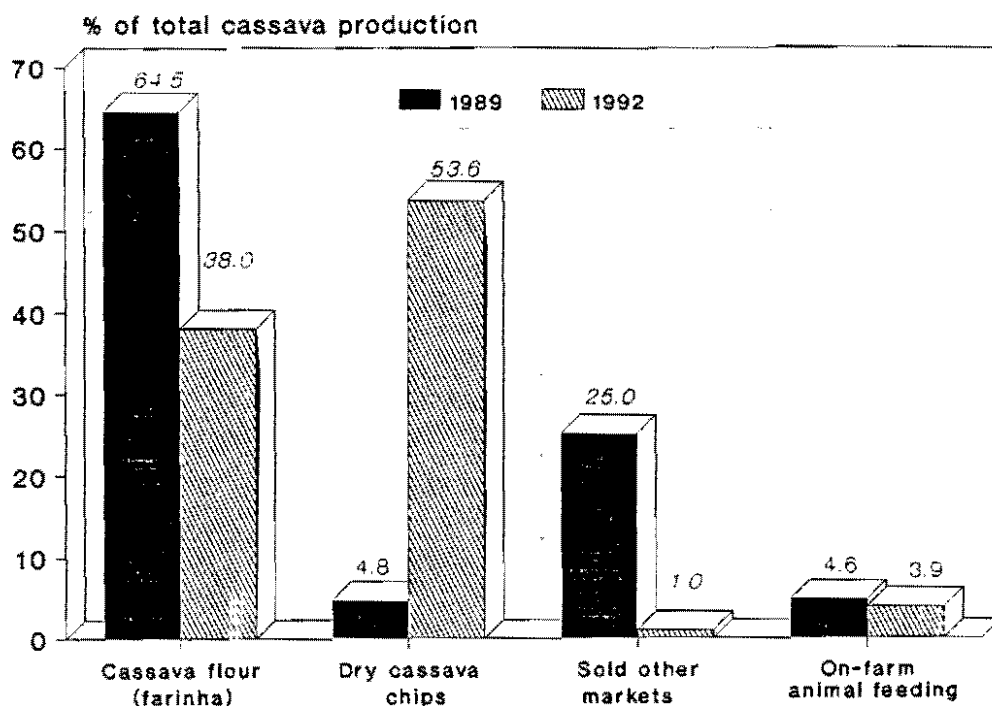


FIGURE 10.2 Change in utilization pattern of cassava. 1989 and 1992.

Indeed the cassava farmers participating in the project are starting to adopt the new processing technology and the new market has stimulated farmers to transform their cassava utilization patterns, becoming more market oriented.

■ Changes in Cassava Area

An expected result of project activities is the increase in total area planted to cassava. Survey results indicate that farmers have been increasing the size of their cassava plots (Fig. 10.3). A quick response to this kind of project-induced stimulus depends on several factors, among which the availability of production credit is a crucial one. The fact that this type of financial support has been absent throughout the pilot project has indeed affected farmer groups' possibilities of increasing their cassava areas.

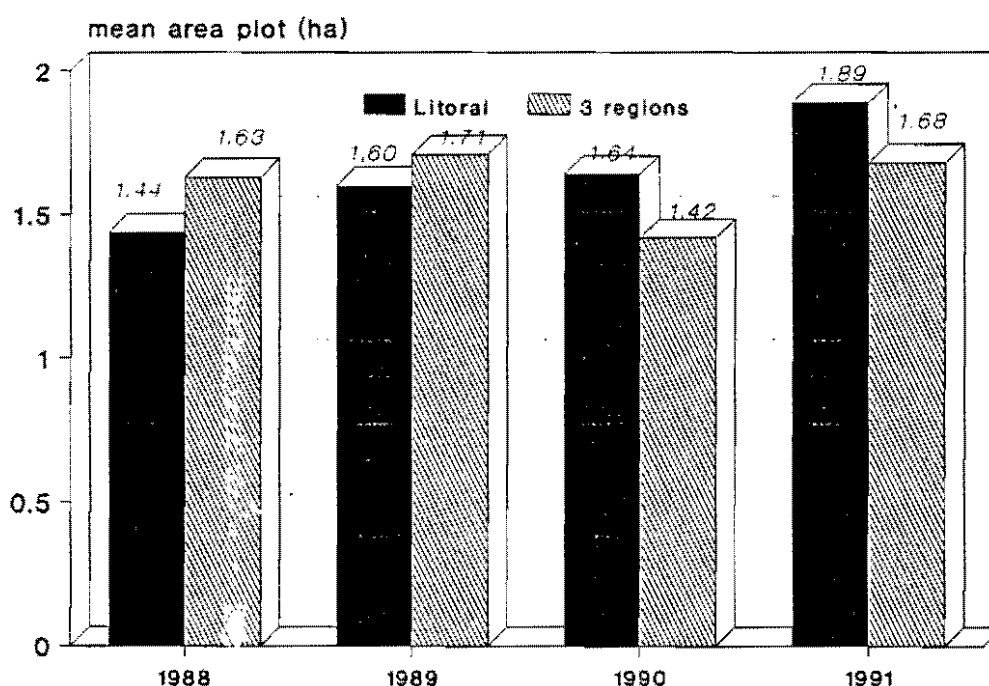


FIGURE 10.3 Change in mean plot area by region, 1989-1991.

■ Cassava Household Consumption

In relation to cassava consumption at the household level, results from the surveys indicate that total consumption of farinha increased from 5.5 to 6.8 kg per household per week in the coastal region. When considering the three regions, the same tendency is

observed with an increase from 4.6 to 6.2 kg per household per week. This increased consumption of farinha could be explained by the fact that farmers are now able to rationalize the destiny of their production getting better prices for the cassava roots and are not forced to utilize their production exclusively in the production of farinha. With the extra income generated from selling roots for the dry cassava market, their cash availability is increasing and the supplies of farinha are probably being used for additional household level consumption (Fig. 10.4).

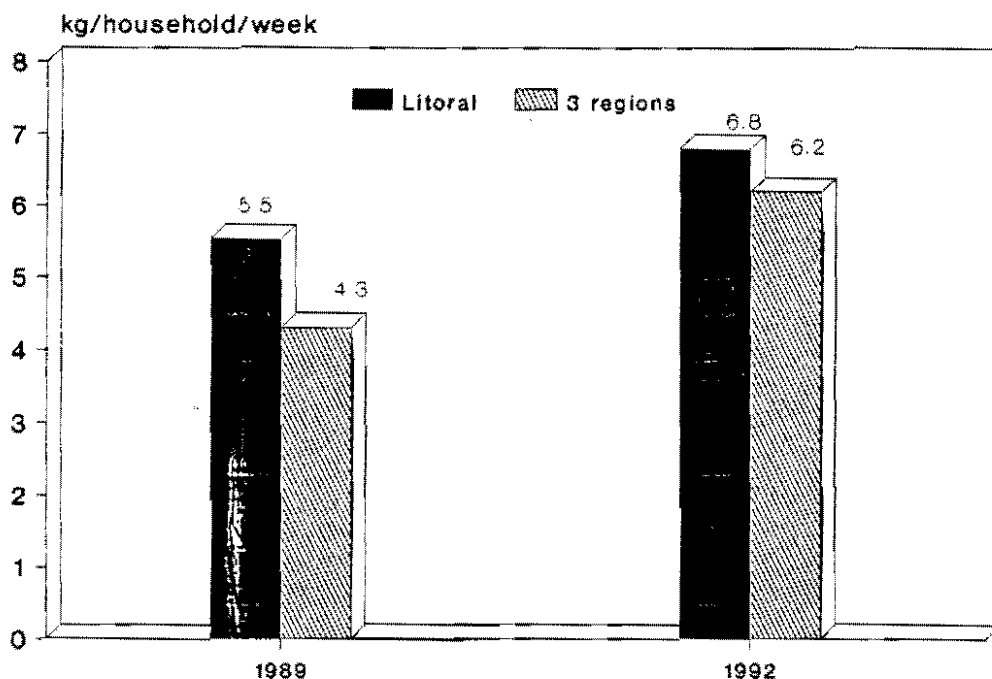


FIGURE 10.4 Changes in consumption of farinha by region, 1989 and 1992.

The aforementioned measures of dry cassava processing technology impact and, to a lesser extent, of production technology have been relatively easy to quantify based on the information available from the M&E system and the two surveys. Additional indirect impact on community welfare, institutional support and the general environment can only be described qualitatively at this stage. Figures 10.5 and 10.6 present 1992 survey regarding farmers' view of results of the impact of the project. It can be observed that the pilot project has served as a vehicle to increase community development in general (organization, knowledge, employment opportunities, incomes) and that the introduction

Impact of Ceara cassava project

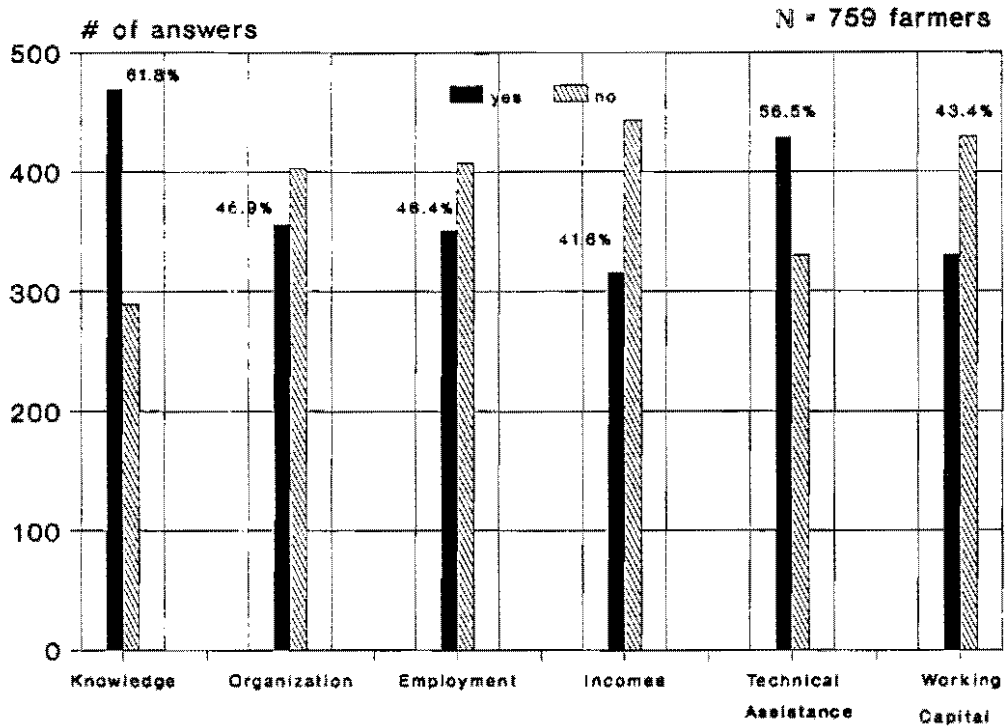


FIGURE 10.5 Farmers' perception of the cassava project's impact on community development variables, 1992.

Impact of Ceara cassava project

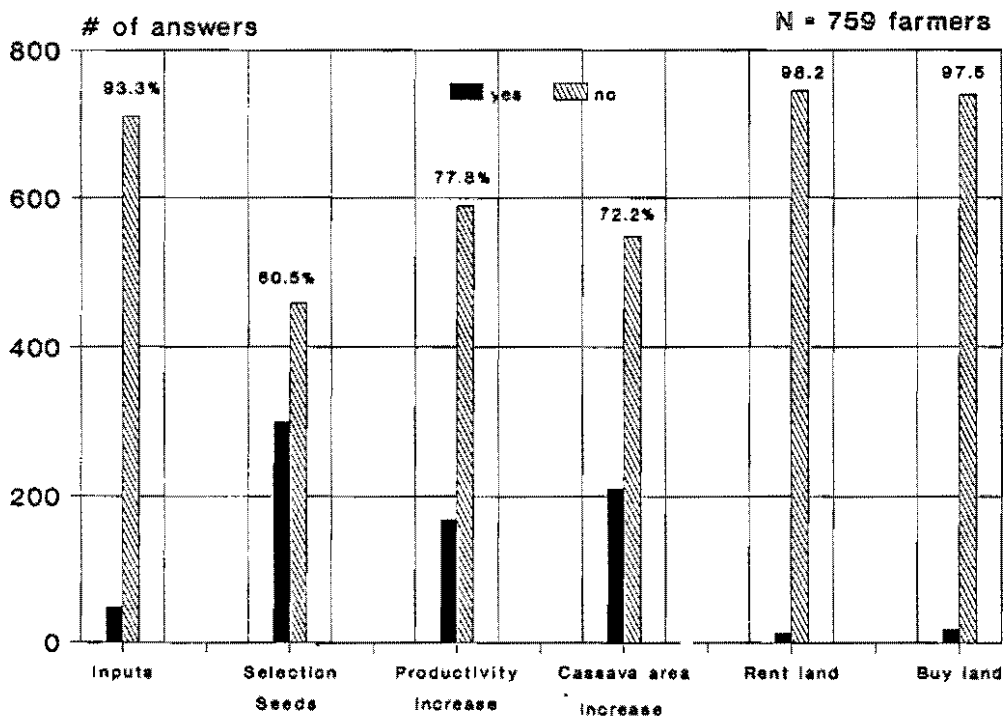


FIGURE 10.6 Farmers' perception of the cassava project's impact on cassava production variables, 1992.

of cassava-based farmer organizations has strengthened local institutional support (technical assistance, working capital). It could also be observed that project impacts on cassava production and productivity have been affected adversely by the lack of opportunities for farmers to purchase or rent additional land and that the adoption of improved technology is taking place slowly among project beneficiaries.

11. Conclusions and Recommendations

Based on the foregoing description of the activities carried out during the pilot project and the principal accomplishments, the overall conclusion to be drawn is that the project design proved to be flexible, takes advantage of existing resources, and facilitates effective decentralization and participation within the current institutional landscape of the agricultural sector in the State of Ceara and despite the adverse economic conditions that have prevailed for the last three years. Moreover, the linkage of an international agricultural research center with local agencies has proven to be a viable approach to promoting cassava-based development activities for small-scale poor-resource farmers and has made it possible to strengthen the institutional capacity of local agencies as well as enhancing their work methodologies, resulting in improved technical assistance and support systems for the farmers. The following reflections and recommendations are made in light of the expected project benefits:

► Agroindustrial development

The process of transforming cassava farmers from isolated, individual producers into organized groups capable of installing and administering dry cassava processing agroindustries proved to be easily assimilated by the farmers who achieve acceptable levels of efficiency within a relatively short period of time (2 to 3 years). The rapid growth in number of groups participating in the project contributed to increasing expectations and the potential of the dry cassava processing technology, which has become an important agroindustrial activity for cassava farmers in Ceara. The demand for the product as a partial substitute for cereals in the manufacture of animal feed concentrates exceeds by far current and short-term supplies, and the potential for expanding project activities to other regions appears highly promising.

► Institution building

Despite the fact that the proposed organizational structure was new to local agencies in charge of project implementation, they accepted it rapidly as a functional component of the institutional setting, and the working groups established at the central and regional levels have become effective and dynamic instruments for carrying out project activities. These activities included multiple training opportunities for human resources from local institutions and farmer groups, contributing to the enhancement of their skills, attitudes and knowledge about the different areas of project work and their overall performance as

technical advisors for cassava-based farmer groups. The availability of project funds for financing local agencies made it possible for them to become more efficient, especially in the process of seeking funds on behalf of the farmers.

Promotion of small-scale, cassava-based farmer organizations is an attractive proposal for cassava producers, who rapidly started building their organizations. The first task attempted by these groups was to try to improve their commercialization schemes, and the initial success achieved indicates that there is potential for consolidating their organizations through a strong institutional commitment. The cassava agroindustries that were able to operate during the project contributed to create additional employment opportunities, open alternative markets, stimulate local industry, raise farmer incomes, and encourage overall community development. Demonstrating these results will greatly facilitate the adoption of similar organizational methodologies by other farmer groups in Ceara and other regions of Northeast Brazil.

► **Improved welfare**

Direct and indirect beneficiaries of the project—including landless people in rural communities where the dry cassava agroindustries were established—received additional opportunities for increasing net incomes derived from project activities. These opportunities were represented by the better prices paid by the agroindustries for the roots, the employment opportunities generated by the processing of the product, and the share of the annual profits earned by the groups in the commercialization of the dry cassava. Overall the main benefit for farmers was the fact that they are now able to rationalize the decision regarding the final destination of their cassava production, choosing the more profitable outlet at the time of harvest, as opposed to the situation before the project when the only option was to produce farinha, with subsequent lowering of prices being common.

The experience and operational capacity acquired by local agencies will permit them to assume totally the coordination of future activities aimed at consolidating the results obtained during the last three years. This observation is based on the following facts:

- Potential for cassava production in the region (soils, climate)
- Climatic conditions appropriate for drying cassava chips
- Farmers' cultural tradition with regard to cassava processing
- Local agency commitment to cassava development work
- Great potential demand for dry cassava in the region

Despite these significant advances, there are some constraints that need to be addressed in order to consolidate and expand the cassava-based development activities to a commercial scale. These limitations are related to:

- The need to define and validate the organizational structure adopted during the pilot project for local agencies and farmer groups as legal components of the prevailing institutional framework
- The income-generating potential of the project is located at the level of the producer, who is motivated to expand the area planted to cassava and adopt improved technology; however, the principal gains in income come from the cost reductions derived from yield-increasing technology--an activity pursued only partially during the project. Moreover, the very long growing period required by the crop (15-18 months) requires an approach with a longer time horizon.
- Development of a market alternative for the farmers in Ceara--i.e., through the production of dry cassava chips for animal feeding--was initiated, but its consolidation will depend upon whether the product can be offered at prices that are competitive with alternative products and in sufficient quantities to meet increasing demand. At the same time, research activities must be initiated to identify additional cassava-based products and markets that could contribute to transforming cassava production into a more profitable, less risky activity.

Given the foregoing, it is recommended that a second phase of this project be executed, with the purpose of consolidating the activities and results obtained during the pilot project. This second commercial-level phase should emphasize actions aimed at:

- Strengthening local agency and farmer groups' organizational and operational capacities
- Consolidating marketing channels for dry cassava and identifying additional market opportunities for the crop
- Designing sustainable cassava production systems

At the same time, operational strategies should be aimed at transferring full control and administration of the project to local agencies within the short term (6 months) and total withdrawal of foreign donor-sponsored financial support for project activities in an intermediate term (3 years).

ANNEX 1

ACRONYMS

INSTITUTIONS

BIRD	International Bank for Reconstruction and Development
BNB	Bank of Northeast Brazil
CCC	Ceara State Cassava Committee
CIAT	International Center of Tropical Agriculture
CNPMF	National Research Center for Cassava and Fruits
EMATERCE	Ceara State Technical Assistance and Rural Extension Agency
EPACE	Ceara State Agricultural Research Agency
EMBRATER	Federal Technical Assistance and Rural Extension Agency
EMBRAPA	Federal Agricultural Research Agency
LBA	Brazilian League of Assistance
PAPP	Program of Support for Small Farmers - SUDENE
RCCs	Regional Cassava Committees
SEARA	Ceara State Secretariat of Agriculture and Land Reform
SIC	Ceara State Secretariat of Industry and Commerce