FARMER PARTICIPATION IN BRAZILIAN SUGAR CANE RESEARCH

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Abstract

This research is concerned with the contribution which farmer participation, as a complementary approach to agricultural research in Brazil, can make to the improvement of disadvantaged farmers' socio-economic conditions through the solution of their technological problems. This notion is embodied in the concepts of Farming Systems Research and Farmer Participatory Research, which provide the broad theoretical framework within which this investigation was developed.

The context in which the research was carried out was Brazilian sugar cane growing regions, with a specific focus on the practice of farmer participation within the 'Three Year' Plan for Diffusion of Technology for Sugar Cane Agro-industry's Resource-poor Farmers (*Plano Trienal*). Material for this investigation derives from two sources: direct involvement since the pilot project original phase of the *Plano Trienal* over a period of six years and a period of fieldwork undertaken in 1988. During the latter, data were collected by means of questionnaires, interviews, participant observation and informal discussions in the States of São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, Pernambuco, Paraíba and Rio Grande do Norte.

The dynamics of sugar cane agriculture is analysed within the overall sugar cane agro-industry as a particular sector of Brazilian agriculture. The concepts of Farming Systems Research and Farming Participatory

Research are then set within this general frame of reference. Subsequently, the policies advocated by research and extension services is situated within the wider context of the Brazilian sugar cane agro-industry. Specific attention is then given to the failure of 'conservative modernisation' policies adopted by those services.

Within this broad framework the formation and development of the *Plano Trienal* is described and analysed. The performance of the Plan's selected projects is then investigated through a comparative study, with particular attention given to the types of approaches employed, both, participatory and persuasive. In this perspective, combined statistical and qualitative methods are employed, based on variables (such as technology, approach, farm, farmer and technician) with specific reference to four economic indicators: productivity, assets, adoption and technological problems. Finally, the role of Farmer Participation is critically analysed referring to Farmer Participatory Research as a crucial component of the agricultural research process.

The research findings point to the central importance of farmer's indigenous knowledge and scientific knowledge based upon 'mutual respect', and grounded in experience, for the processes of participatory research. In these processes, the relationship established between farmer and technician was found to be a fundamental aspect of research practice in which great weight is placed upon the farmer's role not as an object but as the 'subject' of agricultural research. This research demonstrates that the projects which embraced this approach achieved a higher level of technology adoption, a greater number of technological solutions and a greater increase in productivity and farmers' assets. The main policy implication of the thesis is that farmer participation, as a complementary approach to agricultural research methods, can contribute significantly to modifying the socio-economic situation of disadvantaged farmers.

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Introduction

A large proportion of the writing on the issue of agricultural research is dedicated to the all-important discussion of the value of the technician (researcher and extension worker), method and technology. This is expressed in the role the technician plays in rural areas and the consequences for his relationship with the farmer in order to 'deliver' absolute and unquestionable of the research results. In the same literature, less concern appears to be expressed about the very socio-cultural and historical insertion of the technician as an actor involved at a personal and professional level in the society of which he is a part. That is, less attention is paid to the way in which the technician can or should deal with the interaction between those socio-economic, political and cultural factors/forces which contribute to determine his very role as technician and the results of his own professional activities upon the socio-economic, political and cultural context in which such activities are developed. The scientific and social context in which the technician is developed, appear to demand of him a degree of neutral objectivity which, in the cause of science, subjugates all factors which have contributed to make him what he is -a technician- to a level of controllable variables; and ones which can not be allowed to impinge on the research activity as a whole (agricultural research and rural extension). That is, it would appear that such a scientific context attempts to impose on the abstract role of the scientist certain supra-human attributes which contradict both the scientist's human condition and the context within which he works. However, as Becker points out:

"I propose to argue that it is not possible (to do research that is uncontaminated by personal and political sympathies) and, therefore, that the question is not whether we should take sides, since we inevitably will, but rather whose side we are on".

(In Filstead, 1970: 15)

Believing in this committed agricultural researcher, I began to imagine that the main consequence of scientific neutrality was the view that the researcher had of the farmer, in relation to his research: the 'object'. This, in my view, was impeding farmer participation in the research process, with negative consequences in the adoption of technologies generated by the research. In this context, I began to study these points, and the fact that I was directly involved and worked in a research institution, helped me a great deal. It would seem to me intellectually dishonest not to declare my own personal and political commitment to the *COOPLAN* [1] and *Plano Trienal's* [2] disadvantaged farmers. In the former I learned to be influenced (by personal and political sympathies) and in the latter I carried out this research. This, requires not only 'a personal and political' commitment but a commitment to the need for penetratingly critical levels of investigation if it is to produce results, which, however painful, contribute to a deeper understanding of farmer's socio-economic reality and to the elaboration of the means to transform it.

The posture adopted by the committed researcher implies that the nature of his commitment and the history of his involvement with those subjects who form the universe of the research, should themselves constitute a research item. Thus, the researcher's reasons for engaging in that particular research with that specific subject group and the path which he became involved are important elements in a research report.

Therefore, I propose to present these preliminary considerations, as an introductory section of this thesis, in two sections dealing with:

1. My rediscovery of the two issues which are of fundamental importance for an understanding of this thesis - Farmer Participation and Agricultural Research -, due to direct involvement with the COOPLAN's peasants and my subsequent commitment to disadvantaged farmers of the *Plano Trienal*, which forms the universe of the research project;

2. The methods and techniques utilised during the course of research;

1. The Issue, the Rediscovery and Commitment

Throughout my experience in the sugar-cane sector, which began in 1971 with the governmental extension service, working with medium and large - scale farmers, progressing to a close relationship with the sugar cane industry (*usina*), then returning to the government initiative in an institution of colonisation and agrarian reform (*Instituto Nacional de Colonização e Reforma Agraria* -INCRA), it was only in 1977 that I had the opportunity to know better the poor, the miserable, the unprotected small sugar-cane tenant farmer (*camponês da cana*) [3]. This took place during work with small-scale farmers, tenants and members of the COOPLAN. In the knowledge that this class of cane farmers was being marginalised by COOPLAN the cooperative, which had no tradition in rural extension work (the few existing technicians developed jobs in essentially rural credit), created a department of rural extension with enormous resources ('auric' phase of the IAA) [4], whose greatest responsibility would be to prevent the proletarianisation of landless sugar-cane small farmers. Behind this 'unexpected' policy, however, was a real concern for votes. In other words, one wing of top management wanted to take over power that had been held by a family oligarchy for more than twenty years. This Cooperative was dominated by large-scale farmers and defended the interests of this category. As a result of this project, after two years these *camponeses da cana* , took over the cooperative in 1979, only to lose it shortly afterwards in a coup (backed up by government officials), which also lead to the firing of the whole technical team.

During that experience, from 1971 to 1977, dealing with the private and governmental initiative in the sugar cane sectors, working with the medium and large scale farmer, I noted that although sugar-cane research was comparable with that of developed countries and a national service of rural extension existed which was not too backward, the technology generated and diffused by these institutions was not solving the problems of small farmers.

At the time, and due to my social academic upbringing, I thought that this unfortunate situation was the fault of small and medium scale farmers themselves rather than the technicians. These farmers, especially the small-scale farmers, were poor, ignorant and unprepared for technological innovation. They were, within this context, concerned with their survival, disregarding the means and the ends. Large-scale farmers were doing well and this did not apply to them. As for us technicians, the implication was that we should have better training in communication methods (rural extension). As for the scientist, little could be altered, since he was on the right track towards technical 'excellence'. In other words, we had an 'ignorant' clientele who needed to be trained and a few technicians who needed to receive complementary information on modern techniques of persuasion, so that the 'ignorant' peasant could better 'participate' in the whole process of agricultural research, in order to solve his technological problems.

From 1977, after my involvement with COOPLAN, I abandoned the posture of neutrality and endeavoured to defend the interests of those with whom I was working. I rediscovered the significance of farmer participation and developed a new vision of what agricultural research should be. The initial challenge remains, namely, that farmer's technological problems are not being addressed. Nevertheless, a search for causes takes on new directions, since agricultural research did not permit the farmer's active participation in the process.

In pursuit of practical answers to this problem, and working in a sugar-cane research institution (1979) with a team that was totally committed to the cause of disadvantaged farmers, a pilot-project was started with small -scale farmers through their representative agencies, cooperatives and unions. This took place during the same year and initially, without the knowledge of higher management officials, culminating in the *Plano Trienal*, from which the projects that served as study units of this research, were selected.

2. Methods and Techniques

Two distinct types of research, quantitative and qualitative studies were carried out. Both methods have been criticised down the years and advantages and weaknesses can found in both. "It is now widely recognised that no single research paradigm can answer all the questions which arise in social research" (Neumann,1987:161). Quantitative and qualitative studies have been seen as complementary to each other. As a result of this critical combination, an integrated approach to social science research methodology has gained acceptance as having the potential to provide generalisable findings. The research carried out in this thesis follows this methodology.

The quantitative study was of an explanatory type in which the design could be classified as quasi-experimental of the Treatment Nonequivalent Control Group with Pre-test and Post-test type (Cook and Campbell, 1979:124). The technology, the farm and the approach were the planned variables, whereas the farmer and technician represent the circumstantial [5]. Within the research design, one type of approach, the Participation, functioned as treatment and the other, the Persuasion, as control.

The collection of information was carried out through questionnaires, interviews, participant observation and informal contacts. The Post-test observations were assessed though a survey during the fieldwork in the Brazilian states of São Paulo, Rio de Janeiro, Minas Gerais, Espírito Santo, Pernambuco, Paraíba and Rio Grande do Norte, involving 209 farmers and 23 technicians, during the period June to November 1988. At the same time, the archival record of the projects - initial diagnosis and participant observations - and the retroactive questions in the post-test questionnaires, served as pre-test observations. Non-parametric statistical methods were used to analyse the results of the data collected . A combination of case study and survey (of the quantitative study) represented the qualitative research format (Forcese and Richer, 1973:107), in which the descriptive method served as an instrument of analysis.

Notes:

1. Credit Cooperative of Sugar-Cane Growers from the State of Pernambuco (*Cooperativa de Credito dos Plantadores de Cana do Estado de Pernambuco* - COOPLAN).

2. The 'Three Year' Plan for Diffusion of Technology for Sugar Cane Agro-industry's Resource-Poor Farmers-1984/86. *Plano Trienal* means 'three year' plan.

3. Term used among sugar-cane farmers to identify small scale sugar-cane planters and their families with the following characteristics: coming form, in the majority of the cases, the outskirts of the urban cities who worked with non-specialised work-force (builders, servants, cleaners, door-to-door shoeblacks, barbers, ex-civil servants, etc.), whose ancestors emigrated from the rural to the urban zone, with no tradition in sugar-cane growing and newly settled in areas of agrarian reform.

4. During the 1970s, and more specifically around 1976, the export fund, due to the rise in the price of sugar, reached record levels. This fund was set up by discounts taken from each packet of sugar that was produced and each ton of crushed sugar-cane and it was destined to assist, among other things, socially and technologically (research and technical assistance) the farmer and the factory owner of sugar cane, sugar and alcohol.

5. Variables non-controlled that are influenced or conditioned by persons or things, depending on circumstances. In the case of this study, the circumstances are the farmers and technicians' behaviour, opinions, emotions, attitudes which lack of consistency.

Chapter I - The Brazilian Sugar Cane Sector: An Overview

1. Agriculture

This sector is an important source of employment and export earnings. It employs 30 per cent of the total labour force and is responsible for 38.5 per cent of exports (including semi-processed products). Brazil occupies second place among the major world's exporters of agricultural products.

Brazilian agriculture and cattle-raising still reflect the practices and traditions of the past as far as production is concerned. Most of the land is still exploited extensively. The main agricultural products are coffee, sugar cane, oranges, bananas, manioc, soybeans, cocoa, cotton and tobacco, as illustrated in the table below.

Table 1.1 Main Agricultural Products in Brazil -1986

Products	Area (hectare)	Quantity (ton)
Coffee	2,591,481	2,082,811
Sugar Cane	3,951,842	239,178,319
Oranges	30,853	4,782,230
Bananas	430,624	505,150
Manioc	2,051,539	25,620,600
Soyabeans	9,181,587	13,330,225
Cocoa	655,502	458,754
Tobacco	279,364	386,827

Source: Fundação Instituto Brasileiro de Geografia e Estatística-IBGE,1988

Brazil is the leading producer of coffee, accounting for 25 per cent of global output and 19 per cent of world exports. Coffee has been grown successfully since the beginning of the nineteenth century and, after being the mainstay of the economy for a long period of time, is still one of the leading export earners. Coffee is produced on the "red soils" of São Paulo, Paraná, Minas Gerais and Espírito Santo at altitudes of 1,700 metres above sea level and with favourable weather conditions, the coffee trees are once again producing large harvests. The 1980 harvest amounted to 21.2 million bags. Brazil is the second largest consumer of coffee in the world, after the United States. At present, instant coffee constitutes 10 per cent of the total coffee exported.

Brazil is the second major producer of cocoa in the world. Some 610,000 hectares are planted with cocoa; most is grown in the state of Bahia and although only ten per cent is consumed in Brazil, domestic consumption has increased considerably from 19,440 tonnes in 1974 to 36,000 in 1979. Cocoa production in 1980 was 228,000 tonnes. Climatic and soil conditions are ideal for growing cocoa.

A little over 20 years ago, soybean was not produced on a commercial scale in Brazil , and even in 1965 total production was no more than 500,000 metric tons. By 1975, it had become Brazil's largest export in value, and with a production of 11 million tons in 1976 Brazil had caught up with China, the second largest producer in the world, and became a serious competitor of the United States (which produces more than four times as much) in world markets. In 1977 Brazil became the world's second largest producer of soybean accounting for 19.9 per cent of the world's production. Brazil in 1982 produced 12.8 million tons of soybean. The crop has been concentrated in the South, where Paraná, Santa Catarina and Rio Grande do Sul are the main producing areas.

Sugar cane was Brazil's first important crop and Brazil is currently the world's second largest producer. It was first planted in the South in 1532 and later grown on a large scale in the Northeast. Today more than half comes from the Southeast and the rest from the Northeast. The area under cultivation in 1984 for the production of sugar and alcohol was 3,867,200 hectares and in the 1983/1984 harvest , the production of sugar, reached 9.2 million metric tons. The National Sugar and Alcohol Institute (*Instituto do Açúcar e do Alcool* -IAA) oversees the Brazilian sugar industry. Brazil's exports of sugar are not permitted to exceed the quota allocated under the International Sugar Agreement, to which Brazil is a signatory. Brazil's own sugar consumption, however, is high - 50.91 kilograms per person in 1980 - and the government's programme of manufacturing fuel alcohol from sugar cane easily absorbs the balance of the sugar-cane crop.

Brazil's wide climatic range enables it to produce almost every kind of fruit, from the tropical varieties in the North (including Brazil nuts, cashew nuts and avocados) to the enormous output of citrus fruits and grapes grown partly for export in the more temperate South. Brazil grows 20 per cent of the world's production of cashew nuts, and it is the world's largest producer and exporter of oranges, exporting 90 per cent as orange juice.

Brazil is also one of the leading livestock producers in the world; its pedigree Shorthorns, Hereford, Aberdeen Angus and Friesian cattle amounting in all to 109.6 million head, constitute the fourth largest herd in the world. Most of the meat produced in Brazil is for domestic consumption although some is exported. According to a study by the Ministry of Agriculture, half of the Brazilian herd is beef cattle, fifteen per cent is dairy cattle and the rest is used for other purposes. While production of beef has exceeded the increase in population, dairy production has not. While cattle-rearing takes place throughout Brazil, pig-rearing is concentrated in the South . In 1980 pig production totalled 705,300 tonnes, an increase of 15.5 per cent over 1979. More than half the national flock of sheep is found in the South. Sheep are raised in parts of the Northeast, where goats are reared principally . Poultry production on a large scale is found throughout the country, and Brazil is rapidly becoming one of the largest producers, with exports totalling 169,000 tons in 1980.

Fishing has always been important, particularly in the Northeast where there are plenty of fish and shell fish of high commercial value. At the mouth of the Amazon river the world's largest shrimp bank is to be found. Tuna is found along the entire coast of Brazil. Production of seafood is now increasing at the rate of seven per cent a year and exports are growing at an even faster pace. Brazil's 4,599 miles coastline has an offshore fishing limit of 200 miles. In 1979 the total catch was 806,320 tons.

Brazil's timber reserves are the third largest in the world. Three-quarters of the timber is found in the Amazon region, where 400 marketable types of hardwood grow. Hardwoods also predominate in the Atlantic coastal zone and only the southern States of Paraná, Santa Catarina and Rio

Grande do Sul produce the soft wood known as Paraná pine, used in the construction, pulp and paper industries. The country's aim is to become self-sufficient in pulp and paper. Eucalyptus is becoming an important source of new material for manufacturing industries. Exports of wood in 1980 amounted to 897,931 tonnes, worth US $ 386 million.

Five million agricultural properties in Brazil differ principally in size and use. Landownership is highly concentrated. To understand the land ownership system in Brazil, it is necessary to study areas where agricultural production is undertaken, that is to say, the units of production. This concept is not restricted to the formal aspect of the legal ownership of land, since it encompasses areas exploited under the system of sharecropping, rented land and land under squatter tenure.

Owing to the enormous number of variables to be considered, one could come to an infinite number of types of unit of production. For this reason, the system of classification proposed by Molina (1976) will be adopted. This considers significant variables such as the organization of rural labour and the relations of the farmer with the land and the market. According to the author, four basic types of production unit can be found: The Peasant Farm Unit (*Unidade Camponesa*), the Family Farm Enterprise (*Empresa Familiar*), the Capitalist Farm Enterprise (*Empresa Agrícola Capitalista*) and the Latifundio (*Latifúndio*).

The Peasant Farm Unit consists of small producers, with some control over the land, though precarious:

"these are small landowners(*pequenos proprietários*),sharecroppers (*parceiros*),small renters(*pequenos arrendatários*), squatters (*posseiros*), colonisers(*colonos*),smallcontractors(*pequenos empreiteiros*), resident wage-earners (*pequenos assalariados residentes*), with the right to utilise some land (single or shared planting), aggregate and others in various combinations".

(Queiroz,1973:23).

This social group which grows a variety of agricultural products (*Policultores*) constitutes the Brazilian Peasant class and lives either in direct relationship to the latifundia or in areas of settlement in small units. It is similar to the small farmer class of the colonial period (*sitiante*). It produces almost everything that is necessary for the family and sells the surplus directly in local markets or to intermediaries. The area of this unit of production (which will be defined next) is predominantly small and/or minifundiae. The family is a productive unit and a large proportion of its income comes from the plot of land worked by the family. The fusion of the domestic economy with the mercantile economy is its main and essential characteristic, which gives it a *sui generis* character according to Galeski (1972).

The Peasant Farm Unit can transform itself into a Family Farm Enterprise to the extent it can specialise increasingly in production areas predominantly for the market, buying articles of consumption and production in the towns and using technology for farming. Market activity prevails over production for domestic use. The Family Farm Enterprise is essentially based on work in the family. The existence of a workforce from outside does not alter its character since the main work is in the family. The small family producers reside in the area of their unit of production. However, depending on the type of production, they can reside in the nearest town or village, which is so in the case of family producers of sugar cane. They do not need to remain near the area of production, as this form of cultivation does not require great supervision. The family goes to the land only for work which they have to do and at harvest time makes use of seasonal labour (*volantes*) to assist in cutting and loading. These enterprises can dedicate themselves to export production or the internal market. Such is the case with horticultural farms, the rearing of small animals, the production of cocoa, sugar cane, cotton and soybean. The technology is industrial, making use of machinery and modern techniques which enables a thorough exploitation of the most productive land. The area of the Family Enterprise comes close to the rural module (*módulo rural*) established by INCRA. In the exploitation of sugar cane, they extend to wider areas, the opposite occurring in the case of horticulture.

The Capitalist Farming Enterprise is firmly established in the country, exploiting the large-scale monocrop cultivation of coffee, sugar-cane, cotton, wheat, soybean, rice and , cocoa as well as the large beef-cattle units, according Guimarães (1968). It emerged out of the capitalization of agricultural production and the change in social relations of production of the old latifundiae that had been sub-divided. It is comparable to the case of the old *Engenhos*, which, following the consolidation of national and foreign capital and the strengthening of sugar mills (*Usinas*), were transformed into mere producers of sugar-cane and their owners (the former *Senhores de Engenhos*) into sugar-cane suppliers, the so called *fornecedores de cana*. Wage-earning labour has replaced family labour. Production is mechanised, making use of modern inputs, highly specialised and entirely geared to the internal and external markets (Guimarães,1968). It tends increasingly to employ an entirely wage-earning workforce, with the elimination of resident labourers. Production for home consumption is tending to disappear. It is characterised by extensive methods and the search for economies of scale which allow the achievement of greater economic efficiency and greater productivity. Fertile areas in the capitalist enterprises are fully cultivated for which it is necessary to resort to the adoption of sophisticated technology and the use of rural credit. A classic example is the large-scale producers of sugar-cane. Capitalist entrepreneurs do not normally reside in the area of production. Besides these, there are large capitalist tenants who cultivate the lands of others with the same characteristics as the landowing producers.

The Latifundia cover a large area of land, units of colonisation that remain until today, geared to the external market, producing sugar cane, cotton, cocoa, beef cattle, among other products.

"Its dimensions exceeded and, yet nowadays to this day, exceed the average conditions needed for resorting to capital. That is why large areas of cultivable land are not exploited or cultivated. At best, these areas are rented out or shared and paid for in money or in kind".

(Burke and Molina, 1979:5)

The exploitation of the land is extensive, in general with routine agriculture and cattle-rearing on a primitive level. The technology used involves little mechanisation and far fewer modern methods. Responsibility for cultivation almost always lies in the hands of third parties, whether administrative and/or non qualified technicians (*práticos-agrícolas*).

From this socio-economic classification of the Brazilian landownership structure, the latifundia and minifundia can be considered as distorting structures. These constitute the four categories of rural property classified in the Register of Rural Property, instituted by Law No. 4504 of 30 November 1964 (the Land Statute): *Minifúndios*, Rural Enterprise, *Latifúndio* by type of land -use and of size. For this classification, the concept of a 'rural module' is fundamental. This is defined as the foremost objective of establishing a unit of measurement that expresses the relationship between size, the geographic location of rural properties and the form and conditions of their economic exploitation. It corresponds to the area of family property understood as:

"the rural property, directly and personally exploited by the farmer and his family, which absorbs all their work effort, guaranteeing them subsistence and social and economic progress,(...) and in some instances working with the help of outside labour".

(article 4, insertion II of Law No. 4504)

In a wider sense, however:

- A *minifúndio* will be every rural property that has an agricultural area inferior to the module established by the respective region and type of cultivation;

- A rural enterprise will be the property that constitutes an undertaking of an individual or corporate body, public or private, which exploits it economically and rationally inside the conditions of economic return of the region in which it is situated. It must be exploited at a rate of fifty per cent or more of its cultivable area, not exceeding in size, six hundred times the average module or six hundred times the average size of rural properties in the respective typical zone;

- The latifundia, when it exceeds the dimensions accepted as the maximum for a rural enterprise, or, not exceeding them but having an area equal or superior to the size of the module, will be left unexploited in relation to the physical, economic and social possibilities of the environment with speculative ends, in a way that prevents its classification as a rural enterprise. These structures were known and registered in data initially collected by the National Institute of Colonisation and Agrarian Reform (INCRA) in 1976 which confirms the high incidence of land concentration. It can be seen that of 3,383,683 properties registered by INCRA in 1976, 75.8 per cent were *minifúndios* and 22 per cent exploitative "latifúndios" (see table 1.2).

In terms of surface area, these totals are distributed as follows: 13.53 per cent at the total stated area is covered by *minifúndios* (75.8 per cent of properties), while *latifúndios* constitute 74.48 per cent of the total stated area (315,821,902.4 hectares). Expressed in terms of numbers, the *minifúndio* which represents 75.8 per cent of registered rural properties, that is 2,564,864 properties out of 3,383,683 in the country, takes up only 13.53 per cent of the total stated area which represents 42,726,212.7 hectares out of the 315,821,902.4 which constitutes the total area of farmland Brazil.

Conversely, it can be seen that the *latifúndio*, constituting 22 per cent of registered rural properties, or 743,031 of the 3, 383,683 properties in the country, occupies 74.48 per cent of the total area, that is 249,884,271.7 hectares out of a total of 315,821,902.4 hectares.

Table 1.2 Brazilian Land Ownership Structure: Areas and Percentages per Stratum

STRUCTURE

	Properties	%	Areas (Hectares	%
Minifundio	2,564,864	75.8	42,726,212.7	13.53
Latifundio	223	0.6	14,665,819.6	0.46
Exploitation *latifundio*	743,808	21.4	235,218,452.0	74,02
Rural Enterprise	75,788	2.2	23,211,418.0	11.99
BRAZIL	3,383,683	100,0	315,821,902.4	100.0

Source: Institutio Nacional de Colonização e Reforma Agrária-INCRA, 1976

Most latifundia originated during the colonial period and since then have been associated with sugar, coffee, cocoa and especially with pasture formation. Originally, the sugar and coffee plantations depended on slave labour. Since then however, other systems have subsequently emerged. Today, the workforce on the sugar cane plantations may have small cropping plots which are worked on a sharecropping (*meação*) basis with the landlord, or the right to farm a small plot for personal use in return for providing labour in the cane fields. As the scale of production has increased, wage labour has become more common. On the coffee farms, the workers are typically paid both a wage for caring for a number of coffee bushes, and also provided with a plot for subsistence crops. In the cocoa area, where demand for labour varies with the season, considerable use is made of temporary or casual labour. On the cattle ranches, the cowboys were traditionally paid with a share of the herd, but more recently they too have become wage labourers.

The occupational structure of the agricultural workforce has thus changed as a result of policies encouraging modern inputs (fertilizers, crop protection and mechanisation, among others) with the aim of modernizing the cultivation of sugar cane, coffee, soybean, wheat and others. Basically there has been a relative decrease of family manpower and an increase in the paid labour as shown in the table below.

Table 1.3 Composition and Evolution of the Rural Workforce, Brazil, 1970 and 1980

	% in Total		Rate of Increase (% per year)
Category	1970	1980	1970/80
Family	81,1	71,1	0.83
Permanent	6.3	9.5	6,51
Temporary	12.7	19.4	6.63
Total	100.0	100.0	2.16

Source: Martine and Garcia, 1987:110

As is well pointed out by Silva (1982:30), the fertilisers and crop protectors, to the extent they increase the productivity of the soil, increase the demand for unqualified labour at harvest time. Mechanization extended to different activities accentuates the seasonal nature of hired labour. Thus, modernisation increases the demands for and decreases the period of occupation of unqualified labour. As a result, the most economical solution for the landowner who is modernising is the growing substitution of the permanent worker by the itinerant one with the consequent seasonal variation in the employment of rural workers. Thus the figure of the *bóia fria* has arisen with the whole gamut of social problems that it entails.

Small farms have various origins. They are generally associated with the raising of crops by family groups (and normally occur in areas of high population density) but are also associated in the northern Amazonian frontier regions where migrant workers have carved out small plots from the forest (as happened in Maranhão initially). According to Guimarães (1968), the origins of the small farmer class lie in the free white population of the colony which belonged neither to the landowning class nor the slaves. They produced for their own subsistence, selling any surplus on the internal market. They often did not have legal tenure of the land nor slaves. They would work the soil with the whole family with their own hands and with precarious tools. In the colonial period, small production developed substantially in the South, where there was no great exploitation of a commercial nature as in the Northeast. Beside the *Sesmarias* there was also a large quantity of small farms which expanded and consolidated subsistence agriculture in the region. In the South, small farm expansion was stimulated by schemes of European colonisation in the nineteenth century. Government colonisation programmes over the past 20 years have played a similar role. In recent years, smallholdings have appeared around the great cities in response to the demand for horticultural products. These are known as *cinturões verdes* (green belts). The old coffee areas in São Paulo, for example, gave way to small units with varied production.

Properties between 20 and 100 hectares in size are generally market gardens in addition to producing cash crops such as coffee, cotton and tobacco and are used for pasture as a subsidiary activity. Larger farms of 100 - 1,000 hectares often have up to 55 per cent of their area in pasture and are engaged in stock rearing and dairying as well as cash crops such as coffee, cotton, cocoa and wheat.

About two-thirds of the farms are worked by the owner, particularly the small units. Rented farms make up slightly less than one-fifth of the total, some rented for cash and some in which payment is made in kind. Share-cropping is used in around 7 per cent of landholdings and is associated with the cultivation of temporary crops, such as: beans, rice, manioc, maize among others. Sharecropping whereby the crop is divided equally between landowner and tenant is the most common form, but other variations exist in which the landowner receives one-third or one-fourth of production.

The techniques of cultivation are still broadly traditional and primitive, as mentioned before, although this is changing fast in the Central and Southern regions, where modern agricultural techniques are used. At their simplest, they take the form of the *roça* system, based essentially upon the inherent fertility of the soil using the *coivara* system (whereby the vegetation is burned after it has been cut) and a minimum of equipment, principally the hoe, to cultivate it. When the fertility of the soil begins to decline, the plot is abandoned and planting is undertaken on another one.

This technique is simply slash - and - burn , but where it is practiced within the confines of a farm, it represents a system of land rotation and it is also used to clear land on pasture farms, where a cash crop is grown. The system may be refined by some use of the plough and the ploughing in of plant remains, producing a combination of land rotation, fertiliser use and some crop rotation.

Plantation systems have in the past been associated with monoculture, and little thought has been given to soil conservation. Increasingly, however, there have been improvements with the introduction of the plough, chemical fertilisers and modern soil conservation practices.

In the Northeast there is a marked difference between the coast and the interior, reflecting the physical and historical contrast. The narrow fertile coastal strip called the *zona da mata* (literally, forest zone) approximately one hundred kilometers wide and running parallel to the littoral from Paraíba to Bahia has been almost entirely monopolised by sugar cane plantations, although cocoa has became an important crop in southern Bahia. Compared with the South and Southeastern regions, there is a less developed agriculture, farm work still being mainly carried out manually or through animal draft. This is also due to the limiting factor of the uneven topography.

Many features of colonial organisations remain in the area. Sugar-growing *latifúndios* continue to be the primary units in the countryside and the social structure and organisation of work relations still bear many similarities to those of the colonial period. Moreover, on the coast, the production of sugar and cocoa is carried out in a physical environment very well suited to meeting the demands of foreign markets.

On the other hand, in the less favoured in land areas, the *sertão* there is small-scale cultivation, basically of a subsistence nature. The *sertão* is an extensive semi-arid interior which covers approximately half of the total Northeast. It has few scattered humid areas and suffers from erratic rainfall, but also from periodic drought. Those periods have been affected people and livestock. The *sertão* was occupied by men in search of land for stock raising and for three hundred years it was very thinly populated. The stimulation of cotton production in the last half of the 19th century resulted in migrants arriving from other sub-regions. Landowners contracted out land to sharecroppers to grow cotton and had with them an exploitative relationship. As Mitchell (1981) says:

"these contracts have been always very harsh, favouring the landowner at the expense of the worker and his family, who have to grow subsistence crops for their own survival".

(Mitchell, 1981: 3)

In the Southeast, cultivation spread further inland and is the most technically advanced in Brazil. This region is largely mechanised with capital-intensive farming. Owing to favourable climate and soil and internal as well as external demand, this region developed a great variety of agricultural activities. Besides sugar cane plantations (seventy per cent of Brazilian sugar cane production), coffee can be found in a large part of the land while more limited areas are farming subsistence and *roça* cultivation (in the *Serra do Mar*). Foreign and spontaneous settlement is located in part of Espírito Santo and the Rio Doce Valley. Around the cities market gardening is gaining importance in the economy of the region.

The division of the old coffee farms into small plots is today responsible for the variety of farming in the region. Pastoralism is varied with improved stock rearing in the north and west and dairying in the Paraíba valley and southern and central Minas Gerais for the urban market.

In the South, two basic elements co-exist: pasturage, on the grassland developed in the early colonial period and small-scale cultivation, associated with the influence of European immigrants. The production of cattle and sheep has been joined more recently by large-scale production of rice, soybean and wheat.

In the Mid -West, an area of active colonisation, pasture is the prevailing activity but coffee and cereals are cultivated in small areas. Soybeans are being planted on a large scale after having been introduced in the region of the *Cerrados* (a kind of woodland Savanna which is unsuitable for crop without fertiliser - sandy soils of low fertility).

The region of intensive agriculture, where the greatest potential for mechanised areas in the country is located (the central plateau - *cerrados*), to which the rural frontier expanded (after 1978). These large agricultural investments form industrial enterprises which have encouraged by tax incentive schemes from government. Sudam (Superintendency for the Development of the Amazonas), for example, a government organisation to promote the development of the Amazon region used a tax rebate scheme, in which companies were allowed to deduct up to 50 per cent of the income tax payable on all their operations throughout Brazil. It is for this reason that it is possible to explain the existence of a countless number of abandoned agricultural projects. The so-called new sugar-cane areas geared mainly to the production of alcohol were established in this region (*cerrados*) after

1979.

The main agricultural activities in the Amazon region are vegetable extraction associated with subsistence culture, where the process of *roça* (planting in partially cleared forest) is used. In limited areas near the rivers, commercial agriculture and pasturing predominate, in addition to food crops, tobacco, jute and black pepper.

1.1 Agricultural Performance: National and Regional

In the 1970's, Brazilian agriculture was marked by considerable changes in the process of its development, among which the following can be briefly described:

I - The incorporation of new areas into agricultural production, while having remained the main source of the growth of agricultural production, lost ground in relation to the increase in productivity of land and labour. According to the Brazilian Institute of Geography and Statistics (IBGE), the man-land ratio increased from 2.17 in the period between 1970 to 1975 to 3.5 between 1975 and 1980; yields increased by 1.53 p.a. per cent on average in the first period to 1.78 p.a. per cent in the second; and, in general, the growth rate in production went from 4.76 per cent between 1970 and 1975 on average to 6.01 per cent between 1975 and 1960. This occurred due to significant changes in the technology of production. However, these were adopted in an irregular way among cultures,regions and types of agricultural producer. Another contributing factor was the rise in transport costs for every unit produced and the relative difficulty of attracting capital for such undertakings (given their relatively low profitability) which demanded from the government a policy of higher tax incentives and credit subsidies. The current tendency is one of concern for investment in new technology in already occupied areas and the reduction of idle areas, as witnessed in the process of incorporation of the savannah grasslands *cerrados* , the recovery of exhausted soils and the more intense cultivation of irrigable fertile valleys (*várzeas*);

II-The inter-sectoral relations, between production and industrial branches (producers of chemicals for agriculture, producers of agricultural equipment and processors of products and agricultural raw materials) became more complex in this period. This new articulation is the result of an intense programme of import substitution in the chemical and mechanical sectors and the creation of stimuli for the incorporation of new techniques of agricultural production. The generation and implementation of the modernisation programmes of productive techniques was based on investments in research into cattle-rearing and in the training of personnel in agrarian sciences, in the widening of public services in rural extension and technical assistance, as well as in the setting up of a rural credit policy undertaken at subsidised rates (depending on the degree of agricultural exploitation and the region, this interest rate varied between none and forty per cent of the commercial interest rate (sixty per cent). At the marketing level, this interaction was reflected in the increase in demand for infrastructural services and services for the storing and drying of grains, as well as services of financial mediation, insurance and transport;

III-The aggregate growth of agricultural production has been expanding at an annual rate of 5 per cent, not an unnoteworthy result in international terms and almost twice as high as the rate of population growth. In the meantime, this aggregate performance masks disparities between the rates of growth in production of the main crops, according to their final destination. The sectors with the most dynamic performance were those related to export, namely cotton, coffee, peanuts, tobacco, soybean, orange and cocoa - and the internal generation of alternative sources of energy - alcohol - principally using sugar cane. The participation of export cultivation in the harvest area rose from 31.4 per cent in 1970 to 37.8 per cent in 1982. Its relative participation in the value of agricultural production rose from 35.6 per cent to 56.1 per cent in the same period. The aggregate value of the production of soya, oranges and sugar cane grew more than 12 per cent a year between 1970 and 1982, while the aggregate value of the production of basic foods - rice, corn, wheat, beans, manioc and potatoes - grew less than 2 per cent a year, below the average rate of population growth of 2.5 per cent over the 1970s.

Finally, the rise in costs of modern inputs into agriculture (fertilisers, pesticides and herbicides, agricultural machinery and equipment for example), and the problems caused by the underutilisation of chemical products have been forcing a redirection of research with the purpose of determining alternative technological solutions.

In view of the above, it can be seen that the whole agricultural policy of the country has been geared towards modernisation, which has on the one hand favoured the most developed agricultural regions, while on the other being responsible for impoverishment in others which were already less developed. As the main objective of modernisation is economic growth (the increase in production and productivity-accumulation of capital), investment has been concentrated in the most developed agricultural regions, where there is a predominance of large, wealthier producers specialising in production of cash crops. In other words, in regions where cattle-rearing, cash crop and reforestation predominated, the entry of capital took place without major difficulties, favouring economic growth.

In their turn, less developed agricultural regions, where there was a predominance of small producers with subsistence farms, remained marginalised in this process. The agricultural,agrarian and historic-cultural realities of the disadvantaged farmers, did not allow them to embark on this road. Thus, "small producers are being thrust into a position in which their work is being incorporated into undertakings the profit of which is being re-invested in favour of the large landowner" (Silva,1982: 37).

According to the same author (1982), the difficulty of capital in transforming Brazilian agriculture is centred particularly on four points:

a. "on the key role which is assumed by the ownership of land;
b. in the persistence (and multiplication) of small production (small landowners, squatters, patterns and tenants);
c. in the high degree of exploitation which exists, whether at the level of family labour or a wage-earning workforce;
d. in the fact that, however great the means and resources involved, the instruments of agricultural policy have not achieved great progress except in the case of some special crops and privileged regions".

(Silva, 1982:33)

Some of the conclusions of the Capital Formation Project (the USAID/OSO agreement in which various universities took part) show modifications in the properties of the Southern and Southeastern regions after 1970:

" (...) The size of large farms has increased substantially; (...) The rate of adoption of new technologies was directly related to the size of the property; (...) There was a rapid adoption of biological technology and, especially, of chemical fertilizers, this process of adoption significantly increased the operation costs.; (...)There has been a dramatic increase in the use of rural credit in recent years; all the increases in the supply of credit were channelled through formal credit institutions;(...); real negative rates of interest generally prevailed and substantially distorted the transfer of income to the users of credit. A small number of farmers absorbed most of the increases in credit supply;(...); the greatest beneficiaries of these incentives were to found on the large farms, resulting in an increase in the disparities of the income levels of properties".

(Translated from the Final Report in Silva, 1982, p.29)

1.2 The Sugar Cane Agro-Industry

Although cultivated since colonial times, it is only in the last five decades that sugar cane production has expanded more markedly. The different types of sugar cane, known throughout the world are of various origins: the *nobres* (*Saccharum officinarum L.*) - a type of cane that was high in sugar content but at the same time susceptible to diseases and pests - or tropical canes come from Oceania, particularly New Guinea, while the 'Indian', 'Javanese' and 'Chinese' varieties originate from the Asian Continent.

The first reference to solid sugar ('Kandi') appeared in the year 500 B.C., after sugar-cane had spread from India to Persia. From Persia it was taken to Arabia and Egypt and from these to all the regions near the Mediterranean

Sea and to neighbouring isles. It then went to the islands of Madeira, Cape Verde and the Canaries in the Atlantic Ocean. After that, it was transported to Central America, initially to the island of Santo Domingo, by Christopher Columbus. It reached Brazil at the beginning of the sixteenth century, introduced by Martin Afonso de Souza, Governor General of the colony of Brazil coming from the island of Madeira in 1532. It was introduced in the Capitania of São Vicente, today the state of São Paulo, where it adapted very well making possible the setting up of the first primitive sugar mill (*engenho*) in Brazil: São Jorge dos Erasmos. Soon after, in 1535, sugar-cane was taken to Pernambuco by Duarte Coelho Pereira, the head of the *capitania* in Pernambuco, where it also led to the setting up of a *engenho* in 1540, called Nossa Senhora da Ajuda. There a rapid development of the sugar industry took place and this *engenho* became the country's main producer of sugar. It was only in 1954 that São Paulo state managed to surpass it.

Brazil in the sixteenth and seventeenth centuries had in sugar cane its main source of wealth. The farming, industrialisation and sale of sugar made important progress. In 1624 at the end of the first period of Portuguese colonisation, the country had 400 mills, annually producing 75,000 tonnes of sugar. At the end of the seventeenth century, the sugar industry underwent a serious crisis, caused by the race for gold and precious stones in Minas Gerais and aggravated by competition in the market due to production in the Antilles. But a century later, with the decline of mining, there was a recovery in the mills and the nineteenth century saw the beginning of the modernisation of the industry, with the introduction of steam engines in Pernambuco in 1815.

By the turn of the century the structure of Brazilian sugar manufacturing had been established, despite having suffered the consequences of the abolition of slavery in 1888. The imperial government tried to adjust the sugar-cane economy to the tendencies prevailing in the countries at the vanguard of this type of production. Thus, in 1885, there emerged protective measures for what were known as the Central *Engenho*, specialised in making sugar and able to grind the canes of associate labourers and other located in the surrounding area. An imbalance thus appeared between the rapid improvement of manufacture, contrasted with stagnation in methods of cane cultivation. To meet its raw material needs, the central *Engenho* was obliged to start cane production. This represents the appearance of the mechanised mill (*Usina*), allying industrial activity to the agricultural.

"The *usina* gave rise to a new economic cycle, enabling a marked improvement in brands, as well as a higher industrial revenue occurring from the efficiency in the extraction of the sugar".

(De Carli, 1972:6)

Under the pressure of adverse factors , Brazilian sugar began to give way on world markets to competing items: not only cane sugar but also beet sugar whose manufacture developed markedly in Europe over the course of the nineteenth century. Confined to the internal market, the sugar economy was, despite everything, expanding its production, albeit in an irregular manner. The higher demand for the product arose as a result not only of the increase in population but also of a arise in the purchasing power of sectors of the population, especially in urban areas. As a result, problems between industrialists and farmers arose in relation the process of marketing harvests, creating difficulties for the farmers in getting prices compatible with their production costs.

Concern was evident at sugar meetings such as the one held in Recife in 1928, called by the state governments. Out of the debates in this meeting, concerned the 'General Protection Plan for Sugar, *Aguardente* and alcohol', geared to putting in order the cane economy on a co-operative basis with the aim of confronting existing maladjustments which were making themselves felt as factors destabilising control in the market. As a consequence of measures taken at this meeting there was an excess of production and the fall in prices proved to be great and steep. Bad times were approaching for the sugar economy.

At the start of the second decade of the twentieth century, the difficulties for marketing sugar grew worse. The serious crisis of 1929-1930 showed the need to control production and balance it in relation to consumption. The debates that ensued led to the idea of official intervention in the sugar market but this did not succeed at the time. It reappeared principally after the subsequent crisis of the second world war. 1931 showed that the sugar economy would only overcome the difficulties that were faced on the basis of a programme that would, without delay, restore the market , disturbed by over-supply . The protection of the sugar economy, based on limiting production, also had to take into consideration the national dimension to the problem. In effect, the existence in the country of various cane-growing areas, could have led to the emergence of divergences and even economic clashes between regions, with the possibility of serious setbacks for those least prepared for competition.

Hence the imperative of following an economic policy in the sugar-cane sector from the national point of view, with a broad view of the country's highest interests.

The government started its intervention in the sugar economy in February 1931, through Decree No. 19717, making obligatory the acquisition of alcohol by importers of petrol at a rate of five per cent. The measure came into force on the first of July 1931, with the objective of finding a market for the alcohol manufactured in the country. By opening a secure market able to absorb the production of alcohol, its growth of output was stimulated. A series of other official measures, including new decrees, envisaged more precise working of the recently- started policy and were introduced later in 1931 in a show of ongoing official interest in the sugar-cane economy.

The isolated measures showed themselves to be inadequate for dealing with the crisis of the sugar economy. The situation led the government in December 1931 to set up the Commission for the Protection of Sugar Production, made up of representatives of the federal government and of producer states.The Commission had as its final objective the accompanying of the evolution of the sugar economy, preserving an internal balance between production and consumption, through exportation and suggesting to the government the measures necessary for its efficient functioning.

The initial hostilities of some producers were overcome as the benefits of the new sugar-cane policy made themselves felt. The government understood that state intervention in the sugar-cane economy had to be perfected and that the norms relating to the protection of sugar and alcohol production had to be consolidated. It was therefore decided to form one body, the Commission for the Protection of Sugar and the Commission for the Study of Motor-Alcohol. On the 1st of June 1933, the Institute for Sugar and Alcohol (IAA) was born.

The IAA is a body of direct administration, autarchic and subordinate to the Ministry of Trade and Industry, designed to stabilize the sugar market, increasing, production and consumption of national motor alcohol. Its guidelines are:

-To guarantee the stability of the sugar market, establishing the maximum and minimum prices of sugar cane, sugar and alcohol as well as the prices of their derivatives;

-To control the sugar and alcohol production of the whole country to prevent clandestine manufacture;

-To facilitate absorption of excesses of raw materials in the manufacture of alcohol;

-To help sugar cane mills in setting up adequate equipment for the production of alcohol and the installation of autonomous distilleries (sugar cane mills which produces only alcohol);

-To fix limits to the production of sugar cane, sugar and alcohol;

-To regulate buying and selling transactions of sugar cane between the sugar cane farmers and the country's industrial production units.

Although not explicitly stated in its objectives, the IAA also had the task of protecting by means of a large financial subsidy the deficit of the Northeast's agroindustry, preventing its complete collapse. Without this support, it would have been incapable of competing either internally with the industry of the Southeast region or on the international market.

It is necessary to point out that the sector of the sugar-cane agroindustry is normally divided into two great regions (the South-East and the North-East) showing marked differences at the regional level in relation to: agrarian structure, edapho-climatic condition, technological level , management aspects, production performances and social reality. The table below attempts to show these differences.

Table 1.4 Description of Sugar Cane Agroindustry Regions

REGIONS / CHARACTERISTICS	NORTH-EAST	SOUTH-EAST
Agrarian Structure	Peasant Farm Unit and Exploitation *Latifúndios* with predominance of tenants.	Capitalist Farm Enterprise
Edapho-Climatic Conditions	Hilly Topography Excessive Rainfall and Drought. Poor soils	Plain topography Normal Rainfall periods. Rich soils
Technological Level	Low with predominance of hoe and animal draft	High utilisation of inputs and mechanisation
Management Aspects	*Senhor de Engenho* From the colonial period	Entrepreneur
Social Reality	Widespread poverty	Reasonable life conditions
Agricultural yields	40 tonnes/ha	80tonnes/ha
Industrial Performance	80kg/tonnes of sugar cane	105 kg/tonnes sugar cane

Source: Instituto do Açúcar e do Alcóol, 1987

After World War II, sugar cane cultivation experienced an enormous expansion in Brazil, regaining its position on the world market. Today, sugar cane occupies a prominent position in the Brazilian economy, favoured by the oil crisis of the 70s and is used for the production of both sugar and alcohol. In recent years there has been an enormous increase in the area planted to cane by traditional factories (*usinas*), as well as in the expansion of manufacturing for new areas, with the installation of autonomous distilleries, which produce only alcohol. According to the statistics of the Institute for Sugar and Alcohol (IAA), the area cultivated with sugar cane destined for the production of sugar and alcohol in 1985 was 4.17 million hectares. Of these, 16.1 per cent was destined towards the production of sugar for export, 36.7 per cent to the internal consumption of sugar and 47.2 per cent to the production of ethanol. This area also represents an expansion of 7.7 per cent in relation to 1984, as opposed to a growth of 3.9 per cent in that year in relation to 1983. In addition, it constitutes 9 per cent of the total cultivated area in Brazil. In the harvest of 1985/1986 the quantity of cane crushed for the production of sugar and alcohol reached over 224 million tonnes, 10.7 per cent above the previous harvest.

Roughly 60 per cent of this production was undertaken by 'large producers' (sugar cane farmers with properties of over 1,000 hectares) and the rest by small and medium-sized planters of sugar-cane. The total of sugar-cane farmers in the country is around 45,000 and the large property owners represent only 10 per cent of this share. Over 40 per cent of sugar-cane farmers in Brazil own properties of less than 20 hectares, located for the most part in the states of Pernambuco and Rio de Janeiro. By region, the

Southeast accounted for almost 73 per cent (163.5 million tonnes) of the cane gathered, the rest (a little over 27 per cent or 60.9 million tonnes) coming from the North/ Northeast.

As for distribution according to the type of industrial unit, factories processed 166 million tonnes (74 per cent), 49 million in the North/Northeast and 117 million in the Southeast. Autonomous distilleries, accounted for the remaining 26 per cent (58.4 million tonnes, of which 12.3 million was in the North/Northeast and 46.1 million in the Southeast).

With respect to the production of sugar from the same harvest, 7.82 million tonnes were produced (12 per cent less than in the previous harvest), 4.62 million in the Southeast and 3.20 million in the North/Northeast. São Paulo is the main producer of note with 3.43 million tonnes, or 43.7 per cent of the total production. As regards the destination of this production, 70 per cent was for the internal market and the rest for export, which generated US$ 362.9 million in revenue for the country.

The production of alcohol for the same period was 11.82 billion litres (28 per cent more than in the previous harvest). The Southeast was responsible for 9.8 billion litres, that is 83 per cent of national production.

Three hundred and ninety industrial units operated in this harvest (23 more than in the previous one), with the following distribution: 30 factories which only produced sugar, 165 which produced sugar and alcohol in adjoining distilleries and 1955 units which only produced alcohol. Of this total, 121 units (31 per cent) were in the North and Northeast region and 269 in the Southeast, including in that figure five units which processed other raw material (manioc or wood) for the production of alcohol. The largest number of units is located in the state of São Paulo (148 units and distilleries, or 38 per cent of the national total).

Apart from demerera sugar - for the most part exported - two other types of crystal sugar are produced in Brazil ('superior' and 'special') directly for internal consumption as well as the so-called 'standard' crystal sugar used as a raw material by refineries. The alcohol industry emerged in Brazil as a natural consequence of sugar production, since alcohol is a by-product which may be obtained from residual molasses in the manufacture of sugar. With the objective of encouraging the ultilisation of alcohol for fuel purposes, Decree No. 19,717, of February 20, 1931 stipulated that ethanol should be mixed with imported petrol to a minimum ratio of 5 per cent.

From that date to the inception of the National Alcohol Program - PROALCOOL (late in 1975), with the basic objective of increasing the national production of alcohol for fuel and chemical industry purposes, alcohol was used as a fuel mixed with petrol, at rates which varied according to the availability of sugarcane surpluses. However, the utilisation of alcohol as a partial or total substitute for petroleum derivatives dates back to World War I (1914/18). In 1927, a fuel called USGA, consisting of 80 per cent ethanol and 20 per cent ether was produced on a commercial scale by the Serra Grande sugar mill, in Alagoas.

In that same year, another ethyl alcohol-based fuel (*azulina*) consisting of 85 per cent ethanol, 10 per cent ether and 5 per cent petrol, was produced in Recife-Pernambuco. However, the low prices prevailing for petroleum at that time, discouraged the large scale utilisation of alcohol as a fuel in the country. Difficulties relating to the supply of petroleum derivatives during World War II temporarily increased the demand for fuel alcohol. Between 1942 and 1946, alcohol was used as a substitute for 42 per cent of the petrol consumed by the automobile fleet in the Northeastern region. In the 50s, with the extraordinary expansion in petroleum production by Persian Gulf countries, prices were stabilised at such low levels that alcohol was not competitive with either petrol or other derivates. When oil prices increased four-fold after the 1973 war in the Middle East, attention was once again given to the utilisation of alcohol as a renewable source of energy. In 1974, the Aerospatial Technical Centre (CTA) started conducting on the technological development of engines using straight alcohol or alcohol blends as fuel.

The PROALCOOL programme was developing a wide range of integrated activities in the areas of agricultural raw material production, alcohol production, distribution, utilisation, research and technological development. Subsequently, the national automobile industry also contributed to the area of research. In 1980, vehicles run on straight alcohol were launched and, thus, the joint efforts of the government and private initiative have been providing significant technological improvements in these vehicles, with reflections on their performance and durability. In 1984, out of 677,533 passenger cars sold in Brazil, 95 per cent ran on alcohol. On the other hand, if one takes into account heavy diesel and petrol vehicles, trucks and tractors, this percentage declines to 84 per cent.

Different types of alcohol are produced in Brazil: ethyl anhydrous, alcohol fuel, is destined for mixing with petrol for use in cars; the ethyl hydrate fuel alcohol which is used in alcohol motors; and the industrial hydrate, consumed partly by the alcochemical industry in place of petrol to get ethanol and partly by drinks, pharmaceutical and other industries.

In the early seventies, the sugarcane economy presented problems of a structural nature, resulting from low agricultural and industrial yields, with a high number of small sugar mills, pointing to the need for some plants which were clearly uneconomical to be absorbed. In addition to being obsolete, the industrial milling complex had exhausted its capacity, and this resulted in prolonged grinding periods, with great losses caused by the low yields obtained. There was also a high fragmentation of agricultural quotas and the establishment of unproductive minifundia. Sugarcane varieties (mainly in the Northern-Northeastern region) showed signs of degeneration, contributing to low productivity rates. As a consequence of the high agricultural costs prevailing in the North-Northeast (where purchasing power is reduced) the price of sugar in that region was fixed at a higher level than that of the Southeast.

At this time, reliable estimates indicated that the world sugar production growth rate would be lower than the increase in consumption, and this would give rise to a market desequilibrium situation which would favour producers and increases in quotas. A programme aimed at correcting distortions in the sugar-cane sector was then established, to be developed as sugar exports increased - in volume as well as in prices. Under this programme, the Sugar and Alcohol Institute gave priority to stimulating the refitting of the sugar-cane industrial complex, with a view to increasing the profitability of enterprises through the following programmes:

I-providing financial resources for the fusion, incorporation and relocation of mills, with a view to concentrating small and medium-size industrial units and moving those mills situated in inadequate areas to regions of higher potential or pioneer regions;

II-providing financial resources for the rationalisation of the agroindustry in such a manner as to permit the admission of modern equipment and the development of new techniques for solving problems relating to industrial productivity and operational quality, by correcting bottlenecks in the milling sector.

Units with a production capacity lower than 18,000 tonnes of sugar were considered small, and from a total of 249 about 148 fitted into this category, representing 59.4 per cent of the Brazilian sugarcane industrial complex in 1983/1984. The small comparative difference in percentages relating to the group of small enterprises in the North/Northeast and in the Southeast - 64.9 per cent and 55.9 per cent - is noted.

In 1984 there were 206 sugar mills in the country, of which only 37 were below the 18,000 tonnes capacity range; that is an average of 17.9 per cent, of which 9.2 per cent were in the North-Northeast and 8,7 per cent in the Southeast. About 43 sugar mills closed which were considered uneconomical. The quotas (the quantity of production authorised by the government) were transferred to sugar mills which were more efficient and capable of economics of scale gains. Problems of a social nature such as unemployment, were created as a result of this.

The final result of the programme was an increase in sugar production capacity from 5.4 million metric tonnes in 1971/1972 to approximately 11.4 million metric tonnes as of 1978, which enabled Brazil to assume the leadership in world sugar production in 1984. In the 1985/1986 harvest season, as was shown above, 7.82 million metric tonnes were produced, and part of the installed grinding capacity was utilized for producing alcohol in distilleries attached to sugar mills.

As of 1974, before the establishment of the National Alcohol Programme, the Brazilian Government started to encourage the implementation and re-equipping of several distilleries attached to sugar mills, with the intention of creating an infrastructure which would provide greater security and stability to the sector. If expectations relating to the international sugar market were not confirmed (as actually was the case as of 1976), the mills would be sufficiently flexible to absorb any cane surplus that appeared from producing direct alcohol without operating with idle capacity. At the same time, other programmes aimed at improving financial assistance to the sector and rendering special services to sugarcane farmers (independent growers) - either directly or through their cooperatives - were developed with the objective of stimulating sugarcane cropping up to the desired levels.

Among the overall results of this vast program, the following are outstanding from the viewpoint of the Brazilian government (March 1986):

- In four years industrial production almost doubled. With the advent of the PROALCOOL programme in 1975, which coincided with a slight retraction in the international sugar market, installed capacity was utilised for producing direct alcohol. In this manner the production of sugar was contained.

-A tendency for improvement in industrial yields and in levels of efficiency of mills. Some mills in the state of São Paulo have reached the target of 100 kilogrammes of sugar per ton of sugarcane with significantly reduced operational costs.

-Increased agricultural yields through higher utilization of modern inputs and adequate machinery and equipment. However, in some regions of the country, yields in tons per hectare as well as in sugar per ton are still very low, showing that various measures need to be taken to correct this situation.

-Modification in the production scale of mills. The national sugarcane milling complex is composed of: 17.9 per cent small size enterprises (less than 18,000 tonnes of sugar); 64.3 per cent medium-size enterprises (from 18,000 to 60,000 tonnes of sugar); 17.8 per cent large enterprises (more than 60,000 tonnes of sugar) located in the Southeastern region (Pamplona,1984:9).

-Strengthening of the cooperative scheme in both areas (sugar cane producers and sugar-cane growers) with the aim not only of reducing individual operational costs, but also of obtaining a smoother overall operation cost, during harvest seasons and reducing social tensions generated mainly by unemployment .

-Raising the average production size of independent growers (suppliers) by adding to the agricultural funds of suppliers simultaneously with technological change. Before the programme, 93.6 per cent produced less than 3,000 tonnes of sugarcane p.a., which is recognized to be uneconomic. Statistics indicate that currently most suppliers are producing around 5,000 tonnes p.a., especially those located in states where sugarcane cropping has experienced considerable expansion.

As far as other products from the agroindustry (sugar-refining and alcohol production) are concerned, the generation of thermal and electrical energy should be mentioned. In the majority of sugar cane mills, the burning of bagasse produced by the milling of sugar cane is sufficient for producing all the steam and electrical energy necessary for the production process. The importance of using vinasse (a residue from the production of alcohol) in the farming of cane sugar in place of chemical fertilisers (which are mostly imported) should also be mentioned. This alternative, apart form reducing agricultural costs to the farmers, also acts as an import- reducing factor.

Nevertheless, behind this whole process of modernisation, induced by the main guidelines of the government of gradually spreading capitalism to the rural sector, transformations have taken place in the structure of sugar cane production with respect to specialist technology, the market and the profit motive. Small-scale sugar-cane farmers, in the poorest regions, under pressure from these trends, began to sub-divide their farms either into micro rural units or, in some cases, became landless, working on the land of the large farms, sugar cane mill farms or in the sugar cane mills themselves.

It is clear that small agriculture units were ignored or by-passed in this modernisation process, especially those producing only subsistence crops.

Chapter II - Agricultural Research: From Orthodox to Participatory Research

Introduction

Before the institutionalisation of research last century, technology had already been developing for millenia, leading to the natural evolution of the elements/materials and methods used in agriculture. The knowledge acquired by farmers from their practice was limited and the dissemination of new technologies was undertaken by word of mouth. The development of scientific investigation procedures and of the means of communication, led to the diffusion of ideas and methods with greater intensity through institutional research, bringing rapid growth in agricultural productivity.

This chapter will discuss the development of agricultural research and its attempt to create new technology and/or to adjust technology to the specific needs of a particular set of environmental conditions. The dynamics of methods and approaches utilized by agricultural research will be based on the concepts of 'farmer-object', 'farmer-involved' and 'farmer-subject' research approaches. These concepts theoretically correspond to the Orthodox, Systems and Participatory research, respectively.

The conventional method or Orthodox Agricultural Research consolidated by Herbert Lionberger (1960), Everett Rogers (1962) and Van den Ban (1963), views the farmer as a passive 'object of actions', and as an information receptacle. Research and extension services [1] are treated as separate sectors, each with its own specific tasks. Technology is, in this case, purely 'scientific'.

Farmer-involved research or Systems Agricultural Research, developed during the seventies, stands out as an intermediate approach between two extremes in which the farmer is involved to some degree. This could be considered a variety of participation, managed by technicians. Although it does not view research and extension as fully integrated, it does not accept monopolistic institutions, proposing instead a link organism between them. According to this view technology is scientific, but it does allow for a social component.

Farmer-subject research or Participatory Agricultural Research, on the other hand, adopted from 1980, deals with the farmer as the 'subject of actions'. He is an active individual within the research activity enjoying a strong degree of participation. There is no distinction between research and extension roles, which are fully integrated. Technology here, besides being scientific, is also socially and politically determined.

The 'diffusionist' view of Rogers (1962, 1971, 1983) is taken as a theoretical reference point for Orthodox Research, Farming Systems Research for Systems Research and Farmer Participatory Research for Participatory Research.

1. Orthodox Research

According to the perspective which sees science and research as the source of discovery and the basis of technological innovation, orthodox research develops its own scientific process of generating new knowledge, transforming new and existing knowledge into new technology. As soon as something new is produced and approved, research should seek something new. It is necessary for innovation to be continuous.

Another characteristic of this traditional research may be easily demonstrated historically. After only three generations of independence, the United States of America started to practice a technological innovation system in farming. In 1862 the Department of Agriculture and the Land-Grant system were created by Congress. Initially Land-Grant Colleges were institutions based on the teaching of farming only; they became responsible also for research in 1888 with the 'Hatch Act of Congress'. During those twenty years, no distinction was made between the generation of technology and its dissemination. Research and extension were one and the same.

In 1910, the research director of the Department of Agriculture questioned the use of 'Hatch' funds for diffusion of research results. He alleged that he was not against extension and that he would try to obtain more research resources. In 1914, Congress created the extension service and the former director of national research was made the first director of the extension service. This service was incorporated into the Land-Grant system. Research and extension were administratively separated as part of a bureaucratic strategy to acquire funds. With such separation, according to McDermott (1984), research assumes specific functions, such as:

a)"It must provide alternatives or possibilities of innovation either by generating them or by identifying them from alternatives generated by other entities, either domestic or international;

b) these must be tested. They can be screened on experimental stations. Those that pass this screen must be tested in the farming systems in which it is expected to perform and by the same criteria that are used by that system. Service to the farming industry is the only reason for a research

service;
c) a third function is to make minor adjustments in a promising technology, both to improve its fit into the system in which it is being tested and to fit it into other similar systems, so that it can be used over a wider ecological band;
d) research must also work with the innovation so that it can be integrated into the farming systems. In some cases this is not difficult. In other cases, it takes experimentation".

(McDermott, 1984:7)

With this in mind, research adopts a completely technocratic approach, which is validated when results are tested within the system and, experimental stations have no worries as to its feasibility in the farmers' system that it is aimed at. Solving farmers' concrete problems is not really the main worry. On the other hand, although he is concerned that the result of this research is adopted (d), the researcher hands the innovation to the extensionists to be forwarded to the farmer. The extensionists, because they did not take part in the technology-generation process, in most cases, diffuse the technologies according to their own perceptions. The farmers who decide to use them, may do so in ways different to those that researchers had in mind.

In this model, the focus of orthodox agricultural research with 'industrial research and development' characteristics, understands the process of generation, diffusion and adoption of technological innovations, as a strict theoretical model which was initially formulated in the fifties and sixties by American social scientists, with Rogers (1962) its principal exponent. The 'technology diffusion model' of Rogers and Shoemaker (1971) is a result, they claim, of a revision of former models. Although they try to correct a series of deficiencies pointed out by themselves and by others, a number of lacunae persist within the 'Rogerian' model.

The inadequacy of any theoretical model (Rogers and Shoemaker's model could not avoid this) involve two kinds of problems:

- "Every model is always a simplified representation of reality ... our mental representation of the universe only reflects certain aspects or perspectives of reality;
- the concepts, either explicit or implicit, used in model, are always liable to reinterpretation, not foreseen initially by the model's idealizor ".

(Bertalanffy, 1973:329)

On the other hand, every model is built with a specific objective in view, and is, in this way, used as a work 'tool'. A model can therefore be considered as absolutely satisfactory for a specific study and totally inadequate for another. It enables us to find all the intermediate degrees, according to its suitability for the subject, to the aim and focus of study or the empirical experience to a greater or minor extent . It should not be used as a bible or a system of strict laws to guide and justify actions with human beings. What happened with orthodox research is that it rigorously adopted the 'Rogerian' model of technological innovation transfer to the farmer. Its basic components and assumptions will now discussed.

1.1 The Innovation

An innovation is an idea, a practice or an object identified as new to individuals or groups. Innovations originate from farming research institutions and are relative to objects, social actions and abstract ideas. In general, they are classified as technical and social.

The novelty aspect of an innovation, according to Rogers and Shoemaker

(1971), is expressed in terms of knowledge, persuasion or decision to adopt. It happens at a specific moment when the individual who already has access to conceptual and eventually instrumental information, begins to develop an evaluation of this. In this analysis or evaluation important, if not decisive, elements enter the perception that the farmer has of possible obstacles and incentives to the adoption which are part of his situation.

Rogers (1983), developing the above model, explains the different levels of adoption, taking the following attributes as basic in an innovation: relative advantage - the degree to which an innovation is understood to be better than the practice, product or ideas which precede it and which it should dislocate or substitute; compatibility - the degree to which an innovation is perceived to be consistent with existing values and norms, with previous experiences and with the needs of the individual and of the system; complexity - the degree to which the innovation is perceived as relatively difficult to understand and use; experimentability - the degree to which the innovation can be experimented on a small scale or in stages. There are certain practices which should be used in one go or not at all, there is no middle way. In this case it is of little experimentability and may obstruct the decision to innovate; observability - the degree of visibility of an innovation's result, to other people, that is, to be easily observed , communicated and described.

According to this model, the farmer supposedly has to have an excellent knowledge of the innovation and to be persuaded to adopt it. An extensionist who is expert in persuasive techniques, will therefore be able to 'solve the problem'. One must agree that some innovations are easier to adopt than others. Those which are relatively simple and compatible with the farmer's previous experience are adopted faster than those which are complicated and totally unknown to him. The individual analyses and estimates conceptually or symbolically, the rationality, the relative advantages and applicability of the innovation. In reality, this activity is yet another function which occurs permanently, to a greater or lesser extent in all phases of a truly cognitive process. This traditional model does not consider innovations that originate with farmers. For example, in Kenya, the macadamia nut was introduced into the farming system by a farmer and only later encouraged by the government (Adams,1984).

This model does not take into consideration the specific cognitive and learning systems of potential innovators, the farmers. As to the learning process, taking into account the assimilation processes and the mental structures studied by Piaget (1978), one can say that, although the farmer, as any normal human being, is capable of performing abstract operations, he will find it enormously difficult to relate abstract to concepts, due to lack of exercise and stimulus. He is essentially rational, functioning mentally with concrete facts, objects, experience and practices.

1.2 The Generation of Innovation

Rogers (1983) defines the process as being the group of decisions and activities, which take place in the following stages:

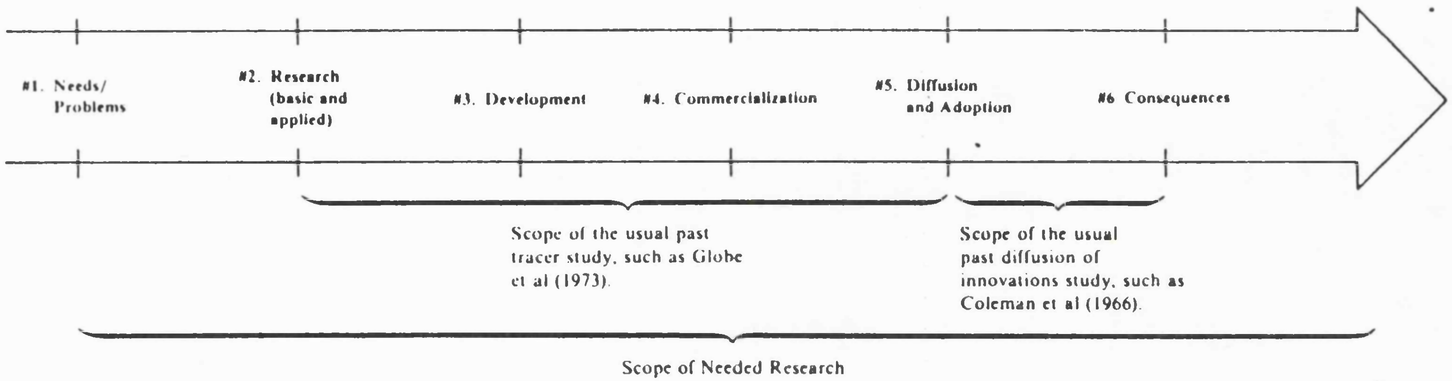


Figure 2.1 The innovation development process

Source: Rogers,1983:136

a. Recognizing a Problem or Need

The beginning of the process of technology generation is characterized by the identification of the problem or need. This motivates research and development activities to create an innovation which aims to solve the problem or need. In certain cases the problem can be perceived beforehand and scientists try to find solutions. In other cases, the problem may emerge from a social need, through a political process.

b. Basic and Applied Research

"Technology is a design for instrumental action that reduces the uncertainty in cause-effect relationships involved in achieving a desired outcome" (Rogers,1983:138). Technology is composed mainly of two components, hardware and software. The first being the instruments - products, equipment and so forth, and the latter consisting of knowledge, know-how, procedures and standards which form the basis for the instrumental. The majority of technological innovations are created by scientific research, although they could be the result of an interaction between scientific method and practical activity. The basis of knowledge for the elaboration of a technology derives from basic research. It is defined as an original investigation for the progress of scientific knowledge which should not necessarily have the specific purpose of practical applicability.

On the other hand, applied research consists of scientific investigation aimed at solving practical problems. Scientific knowledge is put to use in order to produce an innovation which will solve an identified problem or need. Applied researchers are clients of basic research. An invention should thus be the result of a sequence which begins with basic research, passes through applied research and goes on to the development of that same invention. Unlike innovation, which occurs when an idea is adopted or used, invention relates to the discovery or creation of a new idea. Rogers (1983) concludes, "one measure of the success of research is whether or not it leads to a patent, through which the federal government legally protects the rights of the inventor for a period of seventeen years" (1983:138).

c. Development

Development of an innovation is a process of adopting the new idea in order for it to attend to the needs of the potential adopter. This phase normally occurs between research and innovation. It is the final stage of the new idea before it is adopted.

d. Commercialization

In most cases, research activities result in innovations. The group of scientific results are packaged, ready to be adopted by the users. Because this packaging of research results is made by private enterprises,this stage is called commercialization. Thus, commercialization is the production, manufacturing, packaging, marketing, and distribution of a product that embodies an innovation. The author adds:

"two or more innovations are often packaged together in order to facilitate the diffusion because the several innovations have a functional interrelatedness, or at least they are so perceived by potential adopters. A technology cluster, also called an innovation package, consists of one or more distinguishable elements of technology that are perceived as being interrelated closely ".

(Rogers, 1983;143)

e. Diffusion and Adoption

This is the process of communicating an innovation through certain channels over a period of time among the members of a social system. The process may also occur among social systems where the adopters are not individuals but actual social systems, for example: small groups, communities or societies. Diffusion is a special kind of communication which deals with the diffusion of new ideas. At this stage it should be made clear which innovation should spread, how, when and to whom. There is normally a certain pressure to approve an innovation as quickly as possible, in order to diffuse it and to therefore solve the problem or need previously identified at the beginning of the process. Adoption, however, occurs when the farmer incorporates a new idea or innovation to his production system, adopting it as routine practice in his farming activities, because he is able to adopt it for a certain period, and then abandon it . In this case adoption may not occur fully.

f. Consequences

There are at least three classifications of consequences: desirable versus undesirable, direct versus indirect or anticipated versus non-anticipated. The author explains that these six phases are somewhat arbitrary and that they do not necessarily occur in the sequence shown here. Depending on certain innovations, may even exist at all. The final phase of the generation process of a technological innovation is the consequence of an innovation, that is, changes which occur in the individual or in the social system, as a result of rejection or adoption of an innovation. It is known, at this stage, whether the problem or need initially identified, has been solved or not. Sometimes innovation causes a problem or need of a different type, in which case, a new cycle is initiated.

The rigidity of the 'Rogerian' model is indicated by the phases described above. The innovation generation process starts in laboratories or offices. Identification of the need for something to research is the first step. It does not come about as a response to the farmer's needs but indeed as a result of the interests of researchers and technicians. One also clearly perceives from Rogers' comments that the value of innovation lies in its capacity to be patented by official agents, to the industrial model, and not its potential for solving the specific problems of farmers themselves. From this concept, the appearance of the idiom adopted in agriculture by the so-called Green Revolution [2] - the technological package - which was used as a support by conventional researchers. The generation of innovation is seen as a function of laboratories or research institutes. These operate as industrial organisations, which produce packages and put them on supermarket shelves at the disposal of the extensionist consumer and/or farmers.

1.3 The Diffusion of Innovation

Most studies that have tried to explain theoretically the process of diffusion of a technological innovation, are based on the so called linear communication model. This is defined as a process through which messages are transferred from the source to the receiver. This views human communication as occurring in only one direction - a unilinear view. There is only one type of diffusion agent, the individual. Diffusion would occur solely between the change agent and the potential adopter, in other words, between the technician and the farmer.

However, Rogers and Kincaid (1981) revolutionized every theory on the subject, at the beginning of the eighties, when they explained the existence of other types of diffusion through their communication model, called the 'convergence model'. Communication is defined as a process in which participants create and divide information amongst themselves, with the aim of creating a mutual understanding about a message which has been spread - a two way view. Based on this new model of communication, in which the message is reported to the new idea, there is a redefinition of diffusion. It is the novelty of the idea in the context of the message which gives a special character to diffusion. Finally, Rogers adds;

"diffusion is a kind of social change, defined as the process by which alteration occurs in the structure and function of a social system. When new ideas are invented, diffused, and are adopted or rejected, leading to certain consequences, social change occurs".

(Rogers, 1983:6)

Bourdenave (1980), however, with his 'dialogue broker model' had already proposed that communication, in the diffusion process, instead of being concerned only with the spread of technological innovation among rural people, could also become a means of transmitting information from the rural population to policymakers about the limitations found in the combination of the factors of production; land, labour and capital. A permanent dialogue could be developed, aiming at a wider view of the problem, including its social and educational aspects, among others.

Burke and Molina (1979) state that the diffusion of an innovation involves three processes or sub-processes: communication, learning and decision-making to innovate. The authors consider the cognitive focus of Piaget

(1978), contrary to the behaviourism of Skinner (1974), embraced by Rogers and his followers. Some considerations about the subjects should be discussed further.

According to Rogers, the four main elements of the diffusion of an innovation are: innovation, communication channels, period of time and social system. As the subject innovation has already been commented above on, only the other three elements will now be described.

a) Communication Channels

Essentially, the process of diffusion is the exchange of information, in which an individual communicates a new idea to one or more people. The whole process comprises: an innovation; an adoption unit - one individual or more - who have the knowledge or experience of the use of innovation; another unit, which may also be an individual or group, which has no knowledge of innovation; and a communication channel connecting both adoption units. The communication channel is the means through which messages pass on from one individual to another. The nature of the information exchange between individuals is what determines the conditions under which the source will or will not transmit the innovation to the receiver; this is the 'transfer effect'.

Mass media channels are good examples of quick and efficient means of transferring information to potential adopters on the existence of an innovation. On the other hand, inter-personal channels are more efficient, especially if the channel which links one or two individuals is close. The inter-personal channel is to do with face-to-face contact between two or more people.

b) Period of Time

The speed with which an innovation is adopted by members of a social system, is defined as the adoption rate. With representation along the Cartesian axes, of a number of individuals adopting the innovation, on a cumulative frequency over a period of time, this distribution is known as 'Rogers' S-shaped curve' (1983). The few individuals who adopt the innovation at first, in each time period, are the so called innovators. However, as soon as the diffusion curve starts to rise the number of followers also rises, thus leading to a decline in the adoption rate as the adopters decrease. Finally, the S-shaped curve reaches its asymptote, as the diffusion process ends.

The speed of adoption varies from one innovation to another. Some new ideas often spread rapidly into others, and the S-curve is quite steep. The adoption rate is normally measured by the amount of time needed for a percentage of individuals that belong to the social system to adopt an innovation. Innovations that are thought by individuals to possess great relative advantage and compatibility, should have a quicker rate of adoption.

c) Social System

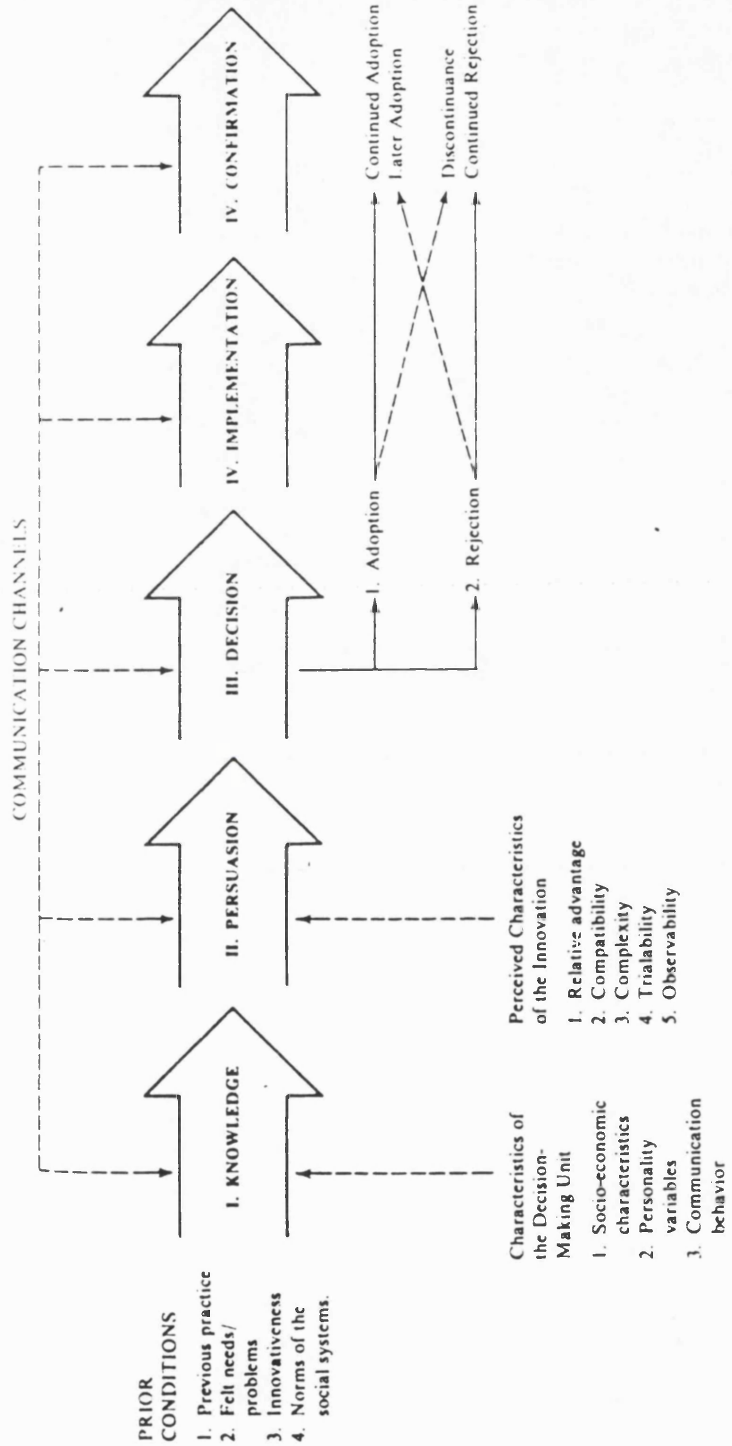
The diffusion of an innovation which occurs within a social system is affected by its structure. It can aid or prevent the diffusion. The development of the linear model of communication adopted by Rogers during the sixties, to the convergence model in 1981, represented only a small evolution in the dynamics of communication. He still considers the source as being the main communication component, when he states that the nature of information exchange between the source and the receiver is in fact, the conveying of that information. There is no room in his model, for a 'dynamic communication dialogue', as Paulo Freire (1979) calls it, in which information is recreated in the interaction process between source and receiver. There is joint participation of the person or persons - source and receiver - in this process.

1.4 The Adoption of Innovation

The decision-making process of innovation is a process in which an individual or individuals, when acknowledging an innovation for the first time, evaluates the new idea, makes a decision about it, adopting or rejecting it, in order to implement it and finally confirms the decision whether they incorporate the innovation into practice. This behaviour is essentially a way of dealing with the uncertainty that an innovation involves, in judging whether the new idea will bring better results than existing techniques. It is the novelty of the innovation associated with its uncertainty, that offers the distinctive aspect of innovation decision-making compared with other decision-making process.

Rogers (1983) proposes a model of innovation-decision process in five stages, according to Figure 2.2:

Figure 2.2 The innovation-decision process



Source: Rogers,1983: 162

a) Knowledge

It begins when an individual learns of the existence of the innovation and acquires some knowledge of its functions. According to Rogers, there are three types of question that one normally develops when faced with an innovation: 'What is the innovation?', 'How does it work?' and 'Why does it work?'. The first of these questions would be the software information and is inserted in the actual innovation. It helps to reduce the uncertainty of a problem's solution or the attention in dealing with the individual's needs. The second is the information required for its use. The user should understand how it works. The more complex it is, the more doubts it will generate regarding its operation. And last of all, is the fundamental knowledge, which consists of the technical and scientific principles of innovation. They are more appropriate for formal schooling and general education. The farmer is placed mainly in the first two, while the technician is obviously in the third.

Keith (1968), White (1968), Shingi and Mody (1976), studying the farmers' knowledge of agricultural innovations, characterize the 'earlier knowers' of an innovation, which are classed as having better education and higher social status. They are more in touch with mass communication and interpersonal channels. They are also more in touch with the technician, maintain a greater degree of social activity and are more cosmopolitan than the opposite 'later knowers'.

b) Persuasion

At this stage the individual forms a positive or negative attitude towards the innovation. The individual becomes psychologically involved with the innovation. He seeks more information about the new idea, what are its advantages and disadvantages. The important thing in this phase is to know where he seeks the information, what message he receives and how he interprets this information. It is particularly during this stage that the individual is motivated to look for information on innovation, in order to reduce the uncertainty of the innovation's consequences.

c) Decision

The decision stage occurs while the individual is engaged in the activities that lead him to choose whether to adopt or reject the innovation. Adoption is the decision to make full use of an innovation as the best possible solution to one's needs or problem. Rejection is the decision not to adopt an innovation.

It is common for the individual to test the innovation before making the decision in order to diminish its uncertainty. In some cases the decision may consist of an initial phase in which he tests it, then deciding to adopt or reject. Therefore, the process may go in the direction of adoption or rejection. Nevertheless, each stage in the decision-making process to innovate is a potential rejection point. The individual may reject the innovation whilst it is still in its acknowledgement phase, for example, as he may decide to reject the innovation even after having previously decided to adopt it. Besides being discontinuous, the process, in some cases, may also have its order altered.

Eveland (1979), classified rejection into two types: active rejection and passive rejection. The first is when the actual individual, taking into consideration the validity of the innovation-having even passed the testing phase-decides not to adopt it. Passive rejection, also called nonadoption, is that in which the individual never really thought the innovation to be useful.

d) Implementation

Up to now, the process of the decision to innovate has been mental. In implementation, the innovation is put into use. When implementation begins, the individual wishes to know how to obtain the innovation, how to use it, what operational problems he might encounter and how to solve them. It is a phase with certain information characteristics, in which the extension worker assumes his role of technical assistant to the farmer, enabling him to operate the innovation.

This period varies according to the nature of the innovation. It normally, ends when the adopter institutionalises and regularises the innovation as part of the production system. This ending is also known as routinisation or institutionalisation. The innovation then ceases to possess a differential quality and the new idea disappears.

e) Confirmation

This is the stage in which the individual tries to consolidate the decision that he has already taken to innovate. He may, however, still change his mind if confronted with conflicting information. The confirmation stage is continuous following the decision to adopt or reject for an indefinite period of time. During the entire stage, the individual tries to abandon the state of dissonance [3], or, in some cases to reduce it.

In the case of innovative behaviour, a dissonance reduction may occur:

i. when the individual becomes aware of his felt needs or problem and seeks information on how the innovation will meet his needs;

ii. when the individual acknowledges the idea and has a favourable attitude towards it, but does not, however, adopt it;

iii. when the individual, after having decided to adopt and after the implementation of the innovation, obtains new information that convinces him not to adopt it.

The extensionist has a relevant role in this particular stage, giving assistance to the farmers through complementary information. It is possible that the high rate of discontinuity (the decision to reject after adoption) of many innovations explains why technicians assume that the process ends in the adoption. The point made here, with regard to these phases of the decision-making process to innovate, concerns the position that Rogers (1962) outlines for the extension worker. He considers the extensionist to be an expert and a keeper of information who is always willing to provide information that will lead the farmer to adopt the innovation. The technician is constantly supplying a prompt answer to the question, as though it automatically contained a solution in itself. The extension worker is the 'doctor', information is the 'medicine' and the farmer is the 'patient'.

1.5 The Adopter

Not all individuals within the same social system adopt the same innovation at the same particular time. In the same way that, amongst themselves, different degrees of innovativeness exist. Rogers (1983) described the different categories of adopters, based on innovativeness, as follows:

a) Innovators

Innovators are almost obsessed with innovation, some researchers have stated. They are avid for new ideas. Judging by their characteristics, they cannot be considered members of a local social system; they are cosmopolitan. They have control over substantial financial resources to absorb the possible impact of an undesirable innovation and the ability to understand and apply complex techniques. They are capable of assuming a high degree of uncertainty of an innovation up to adoption.

In spite of not being respected by the other members of the social system, the innovator plays an important part in the diffusion process of an innovation. He is the initial introducer of the new idea to the system which could have a multiplier effect. They are considered risk-takers.

b. Early Adopters

While innovators are cosmopolitan, early adopters are the natives. They enjoy a greater degree of leadership in the system than the innovators. They act as counsellors to potential innovators. The early adopter is considered the final litmus test before the adoption of a new idea. In other words, all attention is focused as him, on the assumption that others will follow his example.

c. Early Majority

They adopt the innovation before the average member of the system. They frequently interact within the system, and yet they do not undertake leadership functions most of the time. They adopt the innovation deliberately. although their decision-making time is relatively long.

d) Late Majority

The late majority adopt an innovation after other members of the social system. They adopt it as an economic necessity and as a response to group pressure. They convince themselves of the need for innovation due, mainly, to the weight of the system's standards. In other words, this pressure is the prime factor in the decision to adopt. Due to lack of resources, they must eliminate any doubts about the new idea, so that they feel they are taking no risk in its adoption. They are considered sceptical.

e) Laggards

They are the last ones to adopt an innovation within a social system. They do not perform any kind of leadership role. They live isolated within the system and their point of reference is the past. The decisions they take are based on previous generations' procedures and they interact initially together with other individuals with traditional values. Normally, when a laggard adopts an innovation, it has already been replaced by another one which will already be brought into use by other innovators. They are superstitious and oppose change and technicians. Their resources are limited, they dread uncertainty and their economic precautions make them overcautious in the decision process. These are the so-called traditionalists.

Rogers (1983) summarized the adopter's characteristics according to socioeconomic status, personality variables and communication behaviour. The comparison between earlier adopters and later adopter, is as follows:

a) socioeconomic characteristics - there is no age difference and early adopters have studied longer and are, therefore, more literate, possessing higher social status. They have a greater degree of upward social mobility, they own larger-sized units, have a greater business sense, they are more in favour of rural credit and have more specialised operations.

b) personality variables - earlier adopters are more emphatic, less dogmatic, they are more capable of dealing with the abstract, they possess greater objectivity, are more intelligent, they are in favour of change and more capable of dealing with risk and uncertainty. They have a favourable attitude towards science and education, they are not as fatalistic, have a greater degree of motivation and aspiration for education and occupation among others.

c)communication behaviour - earlier adopters enjoy greater social participation and are more integrated in the social system, they are more cosmopolitan and are more in contact with the 'change agent', they are more exposed to mass media communication channels, they are more avid for information about innovation, they have more knowledge on innovation, and a greater degree of leadership.

This typology which Rogers establishes for the farmers in relation to the process of adoption is a rigid classification, in which they are labelled in order to make the extensionists' work easier. He, in turn, knowing the classification, will define a specific strategy for each one. He does not infer a dynamic relationship or a mutual learning in which farmers and extensionists, who are involved in the same process, together search for a solution to each problem.

1.6 Orthodox Action

For many years, practically until the early seventies, orthodox research tried to put into practice its results through this classical, centralised model of diffusion. This is based on the generating source, where researchers are found, the research and development institution, which disseminates the innovation or group of innovations as a uniform package for the potential adopter, who accepts or rejects the innovation. This classical approach reached its peak of popularity and success in agricultural extension services with Ryan and Gross's (1943) investigation of diffusion of hybrid-seed corn. Based on the 'centre-periphery model' it assumes that innovations should come from a centralised source and be spread to its users. It believed in the success of research results, the certainty that the innovation would be adopted by its users via an efficient agricultural extension service. The operationalisation of the model was done through two separate governmental institutions. One of them, the research body, would generate the innovation as a technological package and hand it over to the other, the extension service, for the diffusion of this package.

A good example of a model where extension and research are separated, is the United States (Rogers et al,1982a), with its agricultural extension model composed basically of:

a) a sub-system of research which integrates the experimental stations, and the Agricultural Department which is responsible for research activity;

b) another formed by extension workers, at national level, who work with the farmers and the local rural population;

c) the nationwide extension specialists, who form the link between the change agents and the farm researchers. Researchers and extension specialists were located at the agricultural universities (Rogers, 1983).

Developing countries adopted the American model, with some variations. For example, in the case of Brazil, research was not nationally integrated.

Each state developed its own research under the state-level agricultural offices, and these, in turn, were under the Ministry of Agriculture at national level. Where the specialist-extensionists would perform the same duties, however, they were bound to the extension service. The universities would support both services, either through basic research results, or by training researchers and extensionists when requested or through formal agreements. The agricultural diffusion model in Brazil is therefore centralised. The decision on what to divulge, how to divulge it and to whom, remains in the hands of a small number of technical experts near the top of an officially-controlled diffusion system.

This began to be questioned by Schon (1971), who stated that the centralised model of diffusion bore no relation to reality. His decentralised model denied the relevance of linear or one-way communication, i.e. comparable to the decentralised diffusion model followed by Rogers' (1983) own model of convergent communication. Figure 2.3 summarises the differences between the two diffusion models.

Figure 2.3 Characteristics of Centralized and Decentralized Diffusion model

Characteristics of Diffusion Systems	Centralized Diffusion Systems	Decentralized Diffusion Systems
1. The degree of centralization in decision making and power.	Overall control of decisions by national government administrators and technical subject-matter experts	Wide sharing of power and control among the members of the diffusion system; client control by local community officials/leaders.
2. Direction of diffusion.	Top-down diffusion from experts to local users of innovations.	Peer diffusion of innovations through horizontal networks.
3. Sources of innovations.	Innovations come from formal R&D conducted by technical experts.	Innovations come from local experimentation by nonexperts, who often are users.
4. Who decides which innovations to diffuse?	Decisions about which innovations should be diffused are made by top administrators and technical subject-matter experts.	Local units decide which innovations should diffuse on the basis of their informal evaluations of the innovations.
5. How important are clients' needs in driving the diffusion process?	An innovation-centered approach; technology-push, emphasizing needs created by the availability of the innovation.	A problem-centered approach; technology-pull, created by locally perceived needs and problems.
6. Amount of re-invention?	A low degree of local adaptation and re-invention of the innovations as they diffuse among adopters.	A high degree of local adaptation and re-invention of the innovations as they diffuse among adopters.

Source: Rogers,1983: 336

Rogers later admitted candidly:

"During the late 1970's I gradually became aware of diffusion systems that did not operate at all like the relatively centralized diffusion systems that I had described in my previous books. Instead of coming out of formal R&D systems, innovations often bubbled up from the operational levels of a system, with the inventing done by certain users ".

(Rogers,1983:334)

In spite of continuing with psychological conceptions of behaviourism in which he sees the farmer as 'user' and/or 'client' and the technician as 'change agent', Rogers continues to play a role in this field. Apart from being one of the leading theoreticians of the conservative phase, he is noted also for having developed a new approach in which researchers and extensionists begin to have concern for the farmer as subject of the action, when pointing out:

" ... then the new ideas spread horizontally via peer networks, with a high degree of re-invention occurring as the innovations are modified by users to fit their particular conditions. Such decentralized diffusion systems usually are not run by a small set of technical experts. Instead, decision making in the diffusion system is widely shared with adopters making many decisions. In many cases, adopters served as their own change agents " .

(Rogers, 1983:334)

1.7 Conclusion

This model considers the, generation, diffusion and adoption of technology, separated processes of learning comparable to 'stimulus-answer-reinforcement' and the concept of 'behavioural conditioning'[4]. The model is based on an intuitive and empiricist concept of the learning process in which all emphasis is directed to what is taught, who teaches and how to teach, without worrying seriously about how to learn. It considers the farmer as an object of all actions. It imagines that the extensionist's knowledge should simply be transferred to the farmers minds, where the knowledge will accumulate as more information is fed in. Eventually, this information can be used when the need arises, or even to be re-transmitted to other members of their social system. The extensionist is conceived as someone who is active, more experienced, who holds greater knowledge and authority, who transmits information to someone who is passive, less experienced, with less knowledge and authority, namely the farmer.

In conclusion, the consequence of this model in practice has been the non-incorporation into the farmers' production system of a significant mass of technological innovations generated by the research institutions and disseminated by extension services. This is especially true in relation to small-and medium-scale farmers, especially those in the less developed countries. To attenuate these consequences a new approach developed: Farming Systems Research.

2. Systems Research

Early on in this orthodox period there was a concern for rural poverty in developing countries. The need for agricultural research which attended to the requirements and aspirations of farmers with limited resources began to be highlighted. Shaner et al. (1982) criticised the classical research approach described above as 'top down'. In most cases, farmers rejected proposed innovations because they were of no use or were too risky, or due to a lack of resources or even markets. In short, technologies were not adopted because researchers were not aware of, or did not take into consideration, the small farmers' needs and requirements. The main criticism of traditional research, and those engaged in the systems approach (Norman, 1980; Shaner, Philipp, Schmeehl, 1982; Byerlee et al., 1982; Collinson,1984; Hildebrand, 1986), maintained that research, extension and other programmes should specifically take these farmers' situations into account. From this basic premise, Farming Systems Research and Development (FSR & D) or simply Farming Systems Research (FSR) was created.

FSR proposes the integration of this new research and the development of technology from a systems point of view, in order to disseminate it, integrated to the extension services. This approach proposes providing the means to deal with the close interaction of the many on-farm activities, that characterize subsistence farming. The growth of interest in farming systems research, which placed the farmer at the controls of the technological process, grew out of a recognition that "the Green Revolution had brought most benefit to those who supplied the farmer, rather than the farmer or labourer himself" (Redclift, 1984:110). Also, Gilbert et al.(1980) emphasized that the approach to the Green Revolution, had only concentrated on income-generation, thus increasing differentials between small and large- scale farmers, causing rural unemployment.

Apart from those criticisms already mentioned, the orthodox phase was characterised by a number of shortcomings as follows:

a) *farm management economics* which had been successful in Europe and North America, had not benefitted underprivileged farmers of LDCs;

b) the non existence of proposals for small-scale farmers owing to the failure of the researchers to perceive that when they combined land, labour and capital, they were in fact behaving in an economically rational manner;

c) the failure of the orthodox school to appreciate that risk, uncertainty and therefore caution (mainly due to slender material, financial and natural resources) were variables which determined resource-poor farmers' behaviour in accordance with their situations;

e) proposed innovations by research and extension were simply not being adopted or, in some cases only partially adopted, or, adopted in a modified form.

Thus, the systems approach to agricultural research, was created under the mistaken assumption that statistical and operational research methods, using computers, could alone offer data which would guarantee the adoption of technological innovation, through mathematical models and complex systems, aimed at increased productivity as a prerequisite for the improvement of rural living standards. In addition, its creators were inspired by the Farm Management approach, mentioned above, which

"is concerned with how the individual farmer can so organise the factors of production - land, labour, and capital - on his farm, so adapt practice to his particular environment, and so dispose of his product, as to yield him the largest net return, while still maintaining the integrity of his land and equipment".

(Clayton, 1983: 110)

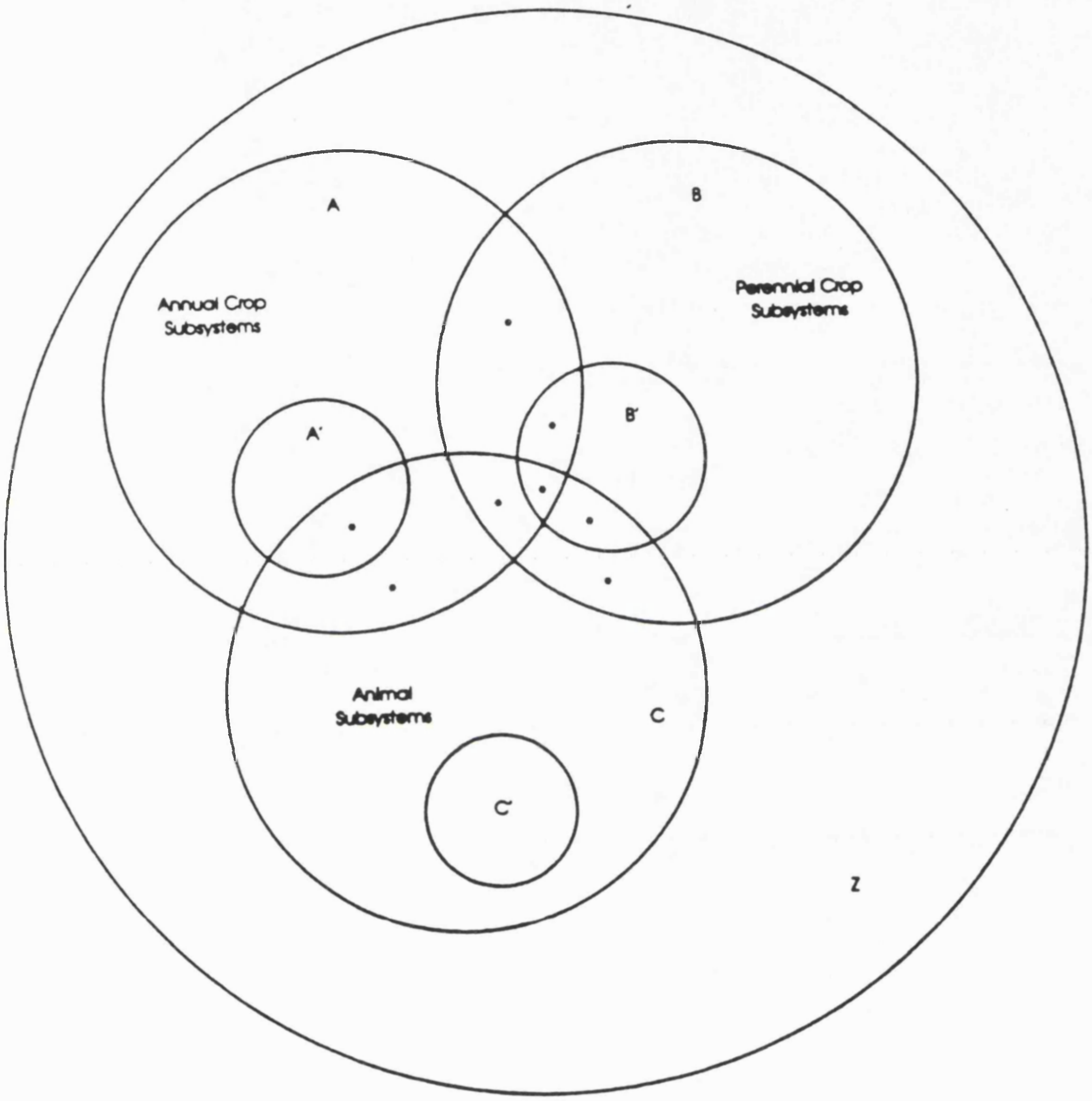
2.1 Systems

Systems ideas emerged from operational research, developed during the Second World War, and were then applied to the industrial area. Computing made numerical applications more feasible. Therefore, complex flows, receiving algebraic or analytic treatment, without the use of conventional numerical methods, began to be practicable. Economic planners began to apply macro-models, meteorologists started working systems theory for weather forecasting, engineers for the construction of great motorways and road traffic studies, and doctors started to develop systemic models to study the human body. From the use of this theory emerged new sciences such as, genetic engineering, biotechnology and artificial intelligence. "Any substantial manufacturing company runs optimizing models of plant throughput, cash flow, and distribution system. Even world systems have been attempted" (Simmonds, 1985:19).

Initially, the systems ideas also penetrated developed countries' agriculture. An agriculture which is based on enterprise, whole-farm and production-unit models emerges, for maximizing/optimizing farming exploitation. "When the physical, biological and economic data are good (as they commonly are) such models are generally agreed to be potent aids to efficiency" (Simmonds,1985;19). The systems of animal and plant growth, the system of epidemics and the system of production, are some examples of the invasion of the systems model within agricultural research. There are several authors who speak of systems theory and its application to farming, such as Dalton (1975), Dent and Anderson (1971) and, Spedding (1979).

The comprehension of any system starts off from a qualitative enumeration of the components and its interactions for a quantitative description of states and flows. It is only when the latter is clear that one attempts to represent the system through a model or synthesis. Depending on the investigator's interest, the system may be divided into sub-systems, which is the major context of FSR. Figure 2.4 illustrates a farming system.

Figure 2.4 An agricultural system



Source: Simmonds,1985 :20

In this perspective, the farming system is defined by Shaner et al., (1982), as

" a unique and reasonably stable arrangement of farming enterprises that the household manages according to well-defined practices in response to the physical, biological, and socioeconomic environments and in accordance with the household's goals, preferences and resources "[5] .

(Shanner et al., 1982:16)

These combined factors, are responsible for output and for production methods. The farming system is part of a large system, for instance, a local community. From the farming system, in turn, one is able to extract a sub-system, the cropping system. "The goal of FSR is to improve the aggregate production of the small farmer and his family's welfare" (Redclift, 1984:110).

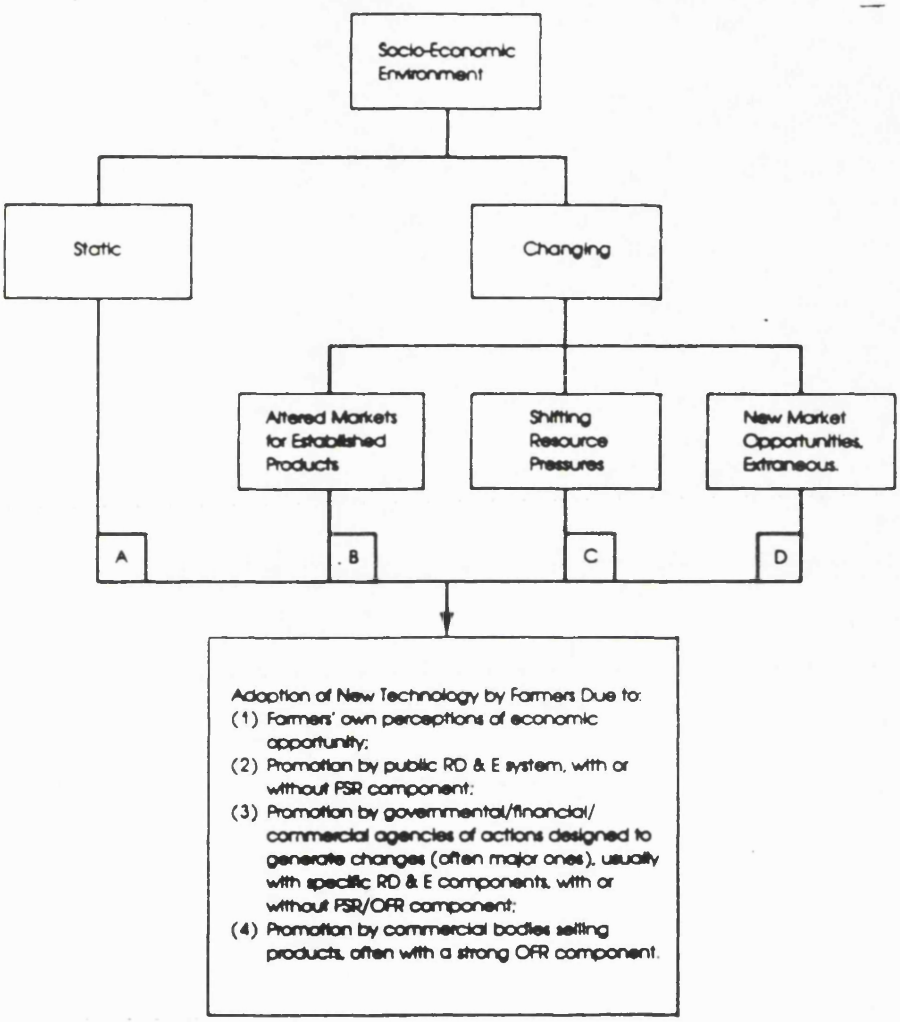
2.2 Technological Change

2.2.1 Innovation and Change

It is commonly assumed by proponents of FSR that farming systems are permanently stable and only change when disturbed by an outside force. Therefore, if that stability always existed, it was always punctuated by changes. This would include for instance, the small-scale farmers' method of working the land in developing countries, in most cases, in their grandfathers' moulds. Nevertheless, this apparent stability has been altered by the pressures of internal food demand (large indigenous populations of the LDCs with limited resources). Consequently, changes are constantly occurring, in both the long and short term. Thus, the main concern of FSR followers is to promote stability of the system through socially desirable changes.

According to the systemic view, there are several causes and technological change agents in the agriculture. Figure 2.5 presents four causes and agents (Simonds, 1985).

Figure 2.5. Causes and agents of technological changes



Source: Simmonds, 1985: 9

In A, the author considers the existence of a static cause, or non-change, which actually represents an abstraction, as there are not many situations where there is no pressure on farming. In D, all new opportunities deriving from the opening of outside markets are stated. The most important causes for FSR, stresses Simmonds, are B and C. B reflects the increasing need for food supplies by the burgeoning population, and C, the ever-growing pressures of these population on the land and other limited resources. At the end of the figure there is a list of the four change agents. These may be considered either endogenous to the farming community - farmer's perceptions - or exogenous, such as research and development, public institutions and governmental and commercial bodies.

2.2.2 The Farmer's Decision to Innovate

The notion of how a farmer decides to adopt an innovation is summarized by Simmonds (1985), in figure 3.6, in a general schema which may be applied to any source of innovation and to any operation scale of the farmer. In this case, what is relevant is the small-scale farmer in the context of FSR. The farmer tends to adopt whatever innovation presents the least acquisition cost. Taking as an example a new variety of crop, it will be generally accepted and rapidly adopted, if it is similar to the already existing one, but improved, in some aspects, such as maturity and yield. New varieties will be rejected if they do not meet farmers' needs. They will also be rejected if they do not respond to other characteristics such as storage conditions or market preferences like sizes of fruit or colour of grain.

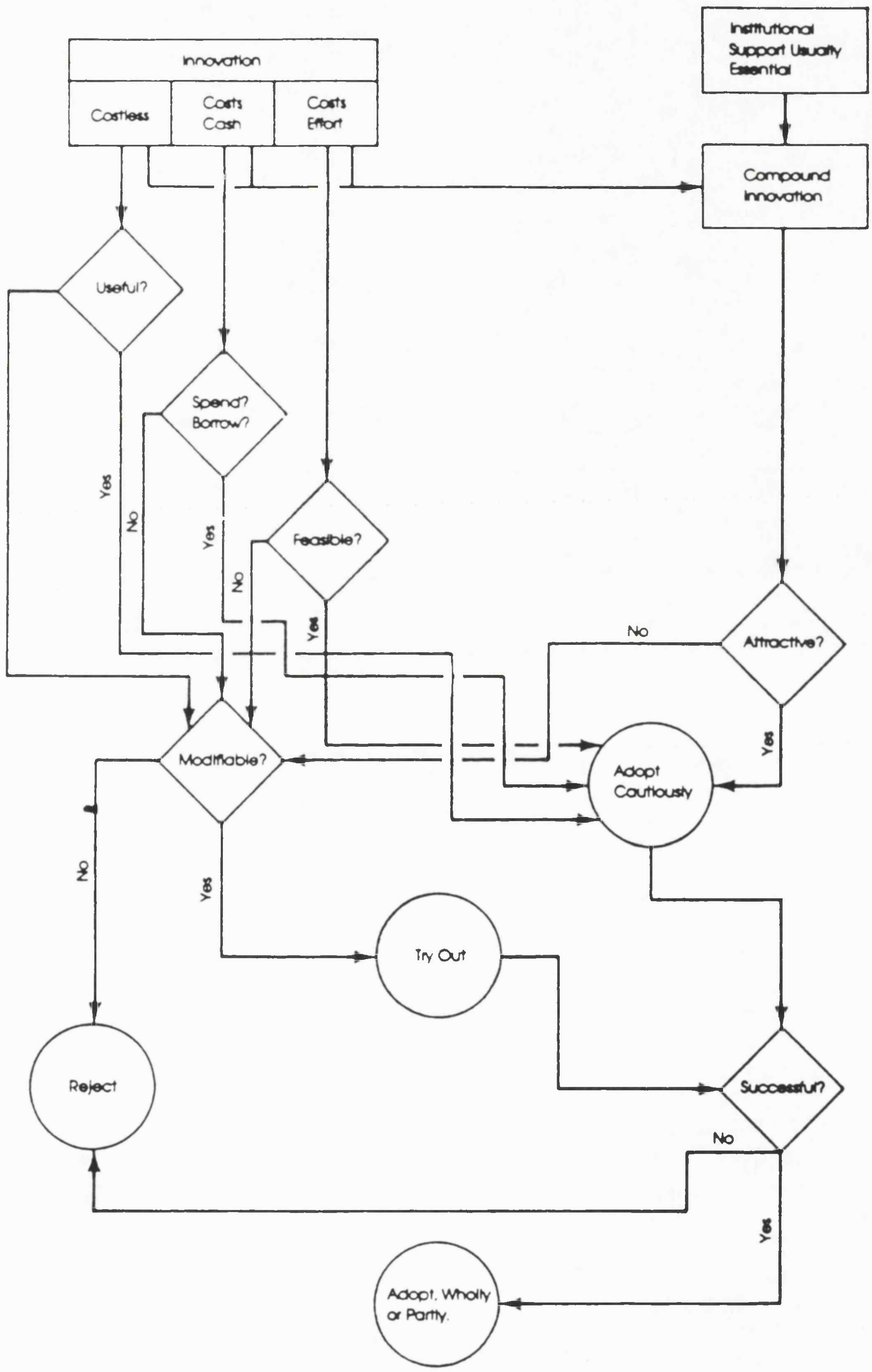
The farmer tends to adopt whatever innovation requires least expenditure in operational cost and capital. As an example of the first, we amy cite the acquisition of moderns inputs - fertilizers, herbicides, insecticides and fungicides. In the second instance, we may include the building of fences, silos, roads, dams, the acquisition of machinery. Expenditure on operational costs has to be made on a short term basis and, is subject to farmers' cash supply and discount rate. In relation to modern inputs, especially fertilizers, one should consider the fact that its level of adoption may be partial, in other words, in smaller quantities than those recommended, unlike the other items of capital expenditure that have to be adopted in their totality. In addition the acquisition of machinery and equipment requires additional maintenance expenses. Besides, modern inputs are not available all of the time to the community and in the acquisition of these inputs, if it is necessary to resort to rural credit, the risk component is always taken into consideration by the farmer. In short, technologies that imply great expense, tend to be rejected. Redclift points out that:

" ... the principles behind farming systems research are simple. First, every attempt is made to economize on the use of non-farm inputs, such as paid labour, chemical fertilizers and seeds. Second, every attempt is made to maximize the use of what small farmers have relatively abundantly, such as family labour and organic fertilizers ".

(Redclift,1984:111)

The farmer tends to adopt the innovation that requires the least labour, as well. The planting of two crops of short cycle in rotation (6), besides being more economical than a long cycle crop, requires less manpower from the farmer and his family. Simmonds (1985) comments that, a hard-working farmer is not always a profit maximizer. Technologies that require great labour demands, manpower and work animals, tend to be rejected. According to the systems school of thought, governmental institutions have an important role to play in the technological change process. These institutions should be concerned with the setting up of infrastructures of communication, of material supplies, of marketing, of research and extension, of rural credit of distribution and/or sale of modern inputs, of storage, and so forth in order to support innovation aspects technical, economical and social, what Simmonds (1985) calls 'compound innovation'. Lastly, state the followers of systemic research, to be successful an innovation should consider the economic circumstances of the farmer or else change them, so that the innovation may be accepted.

Figure 2.6 Farmer's decisions on innovation



Source: Simmonds, 1985:17

2.3 Farming Systems Research in General

The first activities of FSR were developed in the Guatemalan Institute of Agricultural Science and Technology (ICTA) and in some of the International Agricultural Research Centres (IARCs), especially the International Maize and Wheat Improvement Centre (CIMMYT) in Mexico, and the International Rice Research Institute (IRRI) in the Philippines. They were responsible for defining the methodological aspects of FSR in the light of field experience, of which a major example was the East Africa Programme of CIMMYT whose director was M.P. Collinson. Another experience was that of D.W. Norman at Ahmadu Bello University, Nigeria. These experiences formed the theoretical and practical basis of FSR as a new approach in agricultural research. According to Clayton (1983), Collinson and Norman were inspired by Farm Management Research (FMR), but adapted for the small farmer.

FMR appeared to be based on the economic theory of perfect competition/perfect knowledge models, for the large-scale commercial farmers of developed countries. It tries to present to the farmer the most efficient way of practicing farm-management. Focusing on the optimization of the allocation of resources, within the typical farm business model, its initial objectives were to identify hazards in the use of resources and in the diversification of agricultural exploitation and indicate, from this, forms of overcoming these deficiencies, taking into consideration the farmer's aims, his income and constraints.

FMR clients in the developed countries, "are farmers, would-be farmers and their professional advisers or input suppliers, and, to a lesser extent, those concerned with agricultural policy" (Clayton, 1983:112). FMR has suffered some alteration in order to introduce it to LDCs farming, where it is used by agricultural planners, policy-makers, agricultural training programmes at colleges and universities, agricultural projects and sector planners. This transfer, was, perhaps, what inspired FSR pioneers.

FSR started to occupy its own space due to the unsatisfactory results of orthodox agricultural research with disadvantaged farmers in LDCs. Research into technology adoption revealed why small farmers did not adopt certain technical recommendations, showing that it was due to the fact that these were not consistent with the farmers' situations (Clayton,1983). They were inappropriate to their circumstances, objectives and preferences. An agricultural research approach had to be created suited to the reality of the small farmer. Under this flag, FSR was born. It proposed, among other things, to help improve the relevance of national research and extension services (Collinson, 1982 in Clayton,1983:138) under the premise, "that effective research on agricultural technology starts and finishes with the farmer; that integration of the perceptions of biological scientists and social scientists is an essential element in such research " (CIMMYT,1980 in Clayton,1983:138).

Making extension and research services more relevant, signifies making them more accessible to small-scale farmers, which implies knowing their circumstances and knowing the farming system they operate. "The FSR approach seeks to understand the farming system and how the system as a whole, comprises both present management and potential management improvements" (Collinson, 1979 in Clayton,1983:138). Understanding the small farmer, signifies:

"appreciating why he does what he does and the way he does it, (including) the way in which (he) weighs rainfall, soils, markets and available production techniques and then allocates his resources to provide reliable food supplies and a cash income ".

(Collinson, 1979 in Clayton, 1983:138)

Although Collinson (in Clayton,1983: 138) affirms that FSR, on certain occasions, resorts to the FMR method, Clayton (1983) states several significant differences between the two approaches. FSR is a multi-disciplinary methodology, involving agricultural economists and applied scientists working as a team, in addition to the existence of a certain degree of farmer participation. FMR and FSR differ, in their conceptualisation, of the process of the farmer's decision-making process. According to CIMMYT's document, Planning Technologies Appropriate to Farmer's: Concepts and Procedures (1980), FSR believes that the farmers should make decisions concerning the allocation of resources and the adoption of technologies, because they are rational and try to improve their farming activities within the following context:

"Farmers reject technologies not because they are conservative or ignorant but because they rationally weigh the changes in incomes and risks associated with these given technologies under their natural and economic circumstances - and correctly decide for themselves the technology which does not pay. Our task then is how to incorporate knowledge of farmers' circumstances into the design of technologies so that they are consistent with farmer circumstances ".

(CIMMYT, 1980 in Clayton 1983:193)

FSR differs from classical farming research in its holistic aspect. This means that it, "treats concepts and procedures for planning technologies for a single crop within the farmers total cropping system" (CIMMYT, 1980 in

Clayton,1983: 139). In addition to this, the technologies of the single crops sometimes result from decisions taken in farming systems as a whole. Its planning therefore, requires a knowledge of the interactions in the farming system which interfere potentially in these products. As one can see, this approach contrasts with the single commodity or single resource orientation which directed orthodox farming research, while FSR considers the farm resource allocation in the multi-product context.

In order to achieve a better understanding of what will be discussed next here, comment should be made on some of the terms used when dealing with FSR. Taking into consideration the work involved in FSR in the wider sense, Simmonds (1985) points out the main elements: a) FSR sensu stricto, b) On-farm research with a farming systems perspective (OFR/FSP) and c) New Farming Systems Development (NFSD).

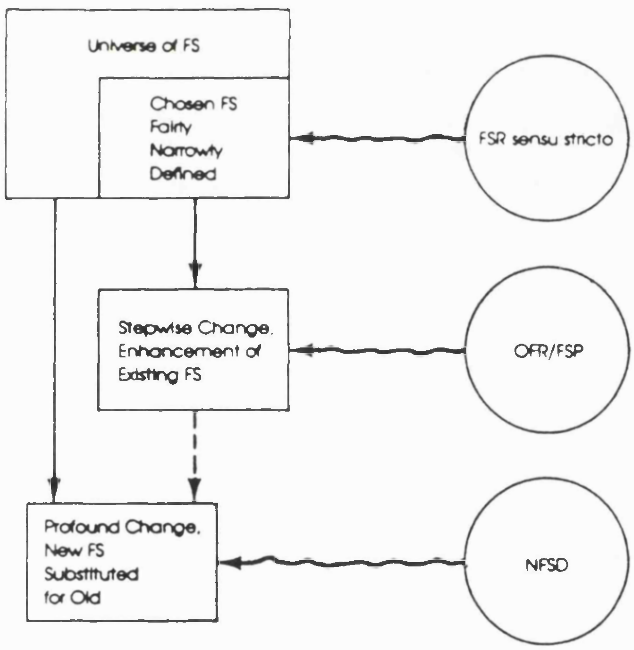
What he calls FSR sensu stricto, relates to pure research in farming systems just as they existed, with its descriptions, analysis, classifications and understandings. It relates to the agricultural, economic and social contexts of the system being studied, and is essentially an academic approach.

OFR/FSP, makes use of the previous material to help define on-farm research, much needed for the understanding of the practical reality of farmers. This reference point of the FSR-sensu stricto is what the author calls a farming systems perspective (FSP). It is the type of agricultural research that believes that changes should be adapted to the circumstances of the user and that research carried out in experimental stations will not always serve their needs. Changes should be progressive and evolutionary -

never revolutionary (Byerlee et al, 1982).

NFSD stands in contrast to OFR/FSP because it tries to promote a radical change in the system. It envisages a revolution to construct an entirely new system. This is oriented research and may be found in some OFR. OFR/FSP tries to adapt new technologies to the socio-economic realities of small-scale farmers. NFSD does exactly the opposite; it adapts the economics to the technology, and normally requires governmental intervention. The figure below illustrates the elements described above.

Figure 2.7 The elements of FSR Work



Source: Simmonds, 1985: 11

Other terminologies often used in FSR literature are 'upstream' and 'downstream'. 'Upstream' that is, "originating in the research station and encompassing the farmer; downstream that is, originating on the farmer's field and encompassing the research station" (Redclift, 1984:112). The theoretical aspects defined by those engaged in FSR, emphasize the downstream approach, which is aimed at the small-scale farmer and respects their characteristics. These are listed below bearing in mind the socio-economic aspects mentioned by Collinson (1984):

a) They are poor;

b) They do not have access to rural credit;

c) They are conscious of environmental uncertainties and of their scarce resources, both natural and financial;

d) They are aware of their family responsibilities;

e) They avoid risks

f) They are frequently the victims of cyclical labour shortages and under-employment;

g) They may have opportunities for complementary off-farm employment;

h) They are economically rational, but not necessarily profit-maximizing because:

i. They have their own utility scales;

ii. They live in countries with the sort of social infrastructures of markets, supplies and communications which are inadequate;

iii. They have distinctive values and priorities or programmes of their own.

2.4 The Art of Farming Systems Research

One common point among the several approaches that deal with FSR concerns the selection of uniform procedures for carrying out research and the implementation of technological changes. FSR's researchers investigate the individual circumstances of disadvantaged farmers while attempting to reach a large number of farmers. The field teams that carry out on-farm research are supported by specialists in physical, biological and social sciences, extensionists and other professionals involved in agricultural production. They should develop their activities at the farm level instead of the experimental stations, in contrast to the classical model.

FSR interdisciplinary teams develop their actions jointly by studying the physical conditions (rainfall, temperatures, and land forms), biological conditions (production potential and pest and diseases problems) and socio-economic conditions (the size and nature of landholdings, farmer and community customs, markets, and local services) of the farming system.

The farming system is conceived as a complex organization of soil, water sources, crops, livestock, labour and other factors, in the same environment, which the farmers manage, according to their capacities, preferences and techniques. The rural family manages these resources, with the aim of producing of crops, livestock, and nonagricultural commodities, in some cases, to obtain extra off-farm income.

Farms are classified by FSR according to (a) their main features, within a given farming system, (that is , grazing system, permanent cultivation on rainfed land, or irrigated farming) and (b) the environment (agroclimatic zone, soils, and terrain). Researchers also take into consideration: the area, the needs of the study and the available information. FSR studies the interdependency of the factors under the farmers' control, and their relation to the physical, biological and socio-economic conditions of farming. FSR identifies, generates, adapts, tests and promotes technologies, with the aim of optimizing the use of these factors.

Shaner et al. (1982), summarize FSR as being an approach to agricultural research with the following combination of characteristics:

a) Farmer-based: FSR teams focus on the farmer's conditions and try to integrate them in the research activities;

b) Problem solving: FSR teams choose the problem to be researched with the intention of leading the research to serve local requirements and define national policies according to the farmers' needs;

c) Comprehensive: FSR teams, when considering farming activities as a whole (consumption and production), are trying to improve the income and the general well-being of the farmers. They identify the possibility of environmental changes and they appraise the likely results of their actions, respecting the interests of the farmers and society;

d) Interdisciplinary: FSR teams, which consist of researchers and extensionists, with different backgrounds in the physical and social sciences. They interact with the farmers in the identification of problems and opportunities, trying to find appropriate solutions;

e) Complementary: FSR teams can utilize results already obtained by other researchers, in the solution of new research problems;

f) Interactive: FSR teams make use of research results to improve their knowledge of the system and the actual approach to FSR, besides planning new research;

g) Dynamic: the initial changes in the farmers' conditions and their positive results, motivate the FSR teams towards new and more significant changes;

h) Responsibility towards society: FSR teams, prioritise the public interest in general, especially that related more directly to farmers.

What really characterizes FSR is the combination of these factors and the identification of the circumstances of the farmers before initiating the actual research. They consider these circumstances also during its implementation, in order to make use of this knowledge in the evaluation of their research results. To be specific, the basic idea of FSR, is to increase the productivity of the farming systems by means of the generation of technologies aimed at specific groups of farmers and at the development of insight into which technologies fit, where they fit and why. This is developed through scientific methods, which generate hypotheses that are tested under the field conditions of the farmer.

The implementation of the FSR process is developed by its teams through the following steps:

a) the selection of areas and groups of farmers with similar characteristics as the target of research activities:

b) identification and prioritization of problems and opportunities, in order to elaborate hypotheses for alternative solutions;

c) planning and experiments, studies and procedures for data collection;

d) experiments in the field conditions of the farmers, making use of research results, aiming to identify or generate improved technologies that relate to the circumstances of the farmers;

e) the coordination of on-farm experiments and the primary product studies and discipline - oriented research;

f) the dissemination of the results to farmers initially involved in the target area and others;

g) concern with alternatives for improving agricultural policies in order to assist farmers, the targeted farmers, and those who farm under similar circumstances.

With regard to implementation, what makes FSR different from conventional research, is that it tries to integrate social science into the research and development process (Dillon, 1978). Also, it takes note of the interactions that occur within the farm as a whole, measuring results according to the farmers' own objectives. In contrast, orthodox research divides the problems of the farm into subject areas in order to study them separately and evaluates these results by comparing them with the standard within each field or subject area.

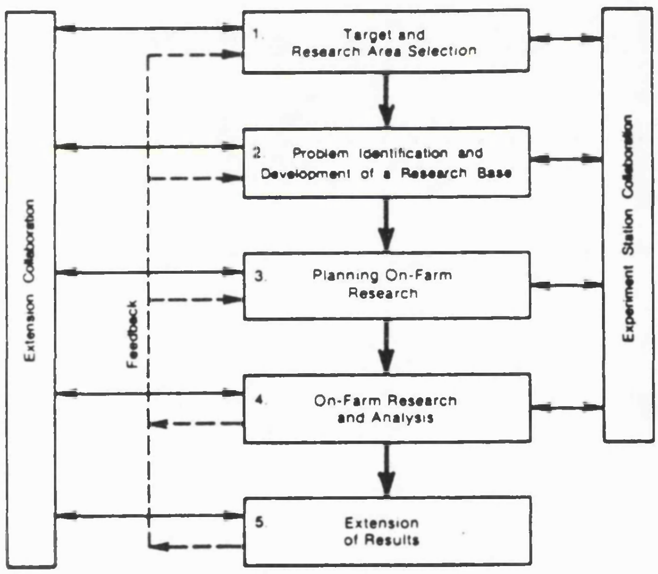
In an attempt to summarize what has been said about FSR, one can define it as being an approach which views the farm as a system, trying to focus on the relationships of interdependence between the various components of agricultural activity that are in the hands of the members of the farm household, and how these elements interact with the independent factors outside of the household's control.

2.4.1 Activities

The approach taken by FSR, depends on its administrators and researchers and on the agricultural and livestock product sought by the research institution, and whether it is national or international in scope. The physical, biological and socio-economic characteristics of the target areas and groups, also have influence on the type of FSR approach. The great majority of approaches operate within existing conditions or, at the most, propose modest changes.

In spite of this diversity, one can point out the main activities: target and research area selection, problem identification and development of a research base, planning on-farm research, on-farm research and analysis, and extension of results. These are outlined in figure 2.8.

Figure 2.8 The activities of FSR



Source: Shaner et al., 1982:28

In practice, these activities may or may not occur in this sequence. The interactive character of FSR leads, in most cases to an activity that often overlaps with other activities, in an attempt to improve results. The experimental station acts by giving technical support and collaborating in the four initial activities, while extension, interacts within each activity. The last two activities feed back in to the rest.

1) Target and Research Area Selection

Taking into consideration regional and national policies such as the better use of resources, raising the income of poor farmers and greater domestic food production, FSR teams help decision-makers in the selection of target areas and target groups of farmers. These considerations determine the identification of problems and opportunities which will support research actives.

Among these areas, one is chosen and subdivided according to its uniform characteristics, so that the area of research which will represent all other sub-areas may be chosen. Simmonds and others have named this research area the "recommendation domain" or "target farming system". The recommendation domain "is the farming system narrowly enough defined so that any recommendations that arise from on-farm research work may reasonably be expected to apply, in large part at least, to all the constituent farms of the domain " (Simmonds, 1985:34).

In relation to the target group farmers, the team selects them taking into consideration the environmental and production patterns and farming practices, which should be compatible. Farmers should explore a specific crop or livestock, or undertake a mixed cultivation of crops and livestock. In practice, FSR teams identify farmers who work under similar conditions attempting to assist them by giving them the same technical advice (Byerlee et al., 1980). This is why environmental conditions are primary in the definition of approach.

2) Problem Identification and Development of a Research Base

After the definition of the research area, the FSR teams then study, in more detail, the farming systems and the characteristics of the area, aiming to act immediately or define new research themes and experiments. Information about farmers is obtained through surveys, reviews of secondary information, direct observation and discussions with members of farm households. They identify the problems and opportunities and classify them according to the degree of importance of their solutions in the short and long term, to the society and with the availability of appropriate technologies or potentially appropriate ones.

3) Planning On-Farm Research

The process of planning and research design is accomplished taking into consideration the following: definition of priorities through identification of problems and opportunities; the forming of hypotheses: the use of existing research results; the identification of regional, national or international agents, with the potential to help if necessary; and, whether the farmers' environment should be changed and, if so, how and to what extent this change is possible.

Given these procedures, the team analyses current farming practices and environmental conditions in order to consider them for the research programme proposal. They analyse alternative cropping and livestock patterns, management practices, the number and types of experiments, and the level at which to set nonexperimental variables (Shaner et al., 1982). Thus, the FSR team works with the farmers at field level and offers the necessary knowledge of the farmers' circumstances in order to plan and implement appropriate experiments. Meanwhile, farmers take part in research experiments and test their results. The researchers also design record-keeping systems, special studies, climatic monitoring, and surveys. These back-up activities, help to improve understanding of the research area, to implement on-farm experiments, measure progress and evaluate the results. Before concluding the research plan, a preliminary appraisal is carried out, of the possible impact on farmers and the environment which the proposed changes may bring.

4) On-Farm Research and Analysis

FSR programmes are directed at on-farm research, emphasizing, its development based on the farmers' field conditions. During this phase, three types of experiments are conducted, which Shaner (1982) calls biological production experiments: researcher-managed trial, farmer-managed tests and superimposed trials. Researchers develop new technologies on farmer's conditions trying to maintain all experimental actions and variables under their control; this is the scientific approach. The second type of experiment focuses on the researchers' learning, in relation to the way in which the farmers react to the suggested innovations, as they adopt them. The third one involves simple experiments carried out by the farmers on their conditions, under the researchers' management. While carrying out this experimental stage, the teams act in conjunction with the extensionists, contacting farmers, marking out places to apply the experiments, identifying the resources and co-ordinating the activities with the experimental stations. Deals are made between farmers and their representatives, researchers and extensionists, in order to define the responsibilities relating to expenses involved in the setting up of experiments, how crops will be distributed and the assumption of possible loss. During this phase, the teams develop studies and special surveys, register the farmers' practices and the results of their experiments, monitor local conditions, sample yields and analyse the results.

An analysis of experiments takes into consideration not only the biological performance of the crop or the animal, but also the resources necessary for their productivity, the economic feasibility and the socio-economic acceptance by society. The results of these analyses supply the necessary guidelines for the teams to select the technologies to be spread, to identify field-level production problems and to collaborate in formulating government policies.

5) Extension of Results

This activity concerns making research results as accessible as possible. To do this, experiments are set up in several places. These help to define specific conditions for the applicability of results more widely within the target area. Before the dissemination of results, pilot projects are developed in the target area in order to test the technologies under a variety of conditions in which they will be diffused. Based on these results, technologies may suffer adjustments, as well as improvements on ground-work or on farming policies. The extension service participates in all FSR activities, forming part and parcel of its teams. They are familiar with the technologies used, and know how to apply them. This contrasts dramatically with orthodox research, which is totally divorced from extension activities.

In conclusion, the collaborative aspects of FSR and feedback are fundamental features. The experimental station offers the means of obtaining scientific knowledge about the target and research area; it helps field teams to identify farmers' problems; it helps FSR teams with their experiments and knowledge of the research process; also offering the necessary infrastructural support (for example, housing, office, storage and training). Extension, in its turn, helps FSR teams to better understand the characteristics of the research area and, most of all, the target group farmers. They help identify problems by introducing the teams to the individual farmers and local leaders, selecting the farmers who will form the target groups, they help the team design experiments based on farming realities, collaborating in the conduct of the experiments as well as undertaking the role of communicating research results, not only directly with the farmers but also with their class organizations, such as co-operatives and unions.

Figure 3.8 also illustrates the feedback of activities 4) and 5) to 1), 2), 3). As the teams analyse studies and experiments and evaluate the technologies that have been given, they need to gain insights within the target and research areas and on farmers' problems and opportunities. This information will then be used in the selection of new areas, redefinition of areas and sub-areas of research, improving research design as well as planning and altering the approaches to on-farm research and analysis. According to the principles of FSR researchers, extensionists, farmers and all those involved in this production, work (with greater efficiency) in an integrated fashion.

2.4.2 Strategies

In order to decide which strategies to use in FSR, it is important to consider aspects such as how much change to attempt, how soon to attempt change, where the ideas for change originate and what type of research to consider. The action proposal should be discussed beforehand with household members to assess whether they are in favour of change. If so, the research team needs to find out whether it is capable of dealing with the complexities of the farm as a whole, whether the government would be able to respond to changes and whether it is possible to improve the farm's infrastructure without radical change. Sometimes, when farmers do not want changes, the work is carried out to improve the efficiency of the practices already developed by them. This could also happen for other reasons, such as the need for immediate results, aiming to stimulate the interest of the households and researchers or to obtain financial support from governmental agents.

It is necessary to consider the type of farming system in question, what Harrington (1980) calls 'farming systems in the large' and 'farming systems in the small'. It considers the subsistence crops where improvement probabilities are high. Followers of the 'farming systems in the small' consider not only the requirements of the actual crops, but also how they fit into the farmers' system. On the other hand, researchers of 'farming systems in the large', only work on a particular part of the system, after having selected those which offer the best chances for improvement.

When considering how soon to attempt change, some researchers hold back diffusion of research results until studies on farmers' conditions are complete. They justify this delay alleging that it provides a greater understanding of the farmers' realities, a greater efficiency of their research results, a greater volume of base-line data to evaluate the efficiency of their programmes and better conditions to elaborate future programmes of research and development.

Other researchers, however, and mainly those who work with cropping systems are in favour of the introduction of short-term changes, using on-farm experiments. These help them to acquire the knowledge of how farmers and environment respond to changes, besides identifying themes for new researches and improvements. Cropping systems research, with similar procedures to those of FSR, focuses on "crops and cropping patterns, alternative management practices in different environments and interactions between crops, between crops and other enterprises, and between the household and environmental factors beyond the household's control " (Shaner et al., 1982:17).

The position of the followers of immediate change is well grounded when they state that, as delay reduces benefits to present-day farmers and these costs being greater than the costs of misdirected action, this approach allows for a greater return on research funds than long-term procedures. When taking into consideration the fact that research institutions all over the world deal with scarce human and material resources, Collinson (1979) reinforces this argument when he states that low cost/rapid coverage approaches seem to be an essential starting point for a 'bread and butter' contribution from the profession.

With regard to the type of research, the discussion which arises is relative to the integration of the 'upstream' - "partly basic, broadly general, and supportive" - and 'downstream'- "site specific, primarily adaptive, and useful without long delay for target groups " (TAC,1978; Gilbert et al., 1980; Harrington, 1980 in Shaner et al.,1983:37), which have already been mentioned above.

Gilbert et al., (1980) suggest a combination of the two programmes. This would be determined by the availability of innovations that can be easily and rapidly integrated into existing farming systems. Wherever the group of technologies is great, the downstream programme can be effective, whereas where basic research is more general the upstream approach is necessary and should allow a better method of organizing research. "At the minimum, a two-way flow of information is needed from farm level to research institute and back again in the form of appropriate technologies" (Shaner et al., 1982:37). International research programmes have proved more efficient when they resort to the upstream approach, while the downstream shows similar performance in the programmes of national level and engaged in the former.

Finally, the decision whether to prioritise farmers' welfare or their levels of production will influence the type of research chosen. Depending on farming policies, increased productivity may be the most important requirement to satisfy national interests, to the detriment of farmers' welfare, despite the fact that FSR should, ideally, lay greater emphasis on social aspects of the farmers' situation. For example, the establishment of PROALCOOL in Brazil encouraged the increased production of sugar cane, at the expense of staple food production.

2.4.4 Implementation and Evaluation

Implementation

When making a decision on FSR as a research approach of national interest, two main aspects, according to Shaner et al (1982), should be taken into consideration by decision-makers; national development goals and small farmers' needs. In most cases, research priorities are not established in accordance with national policies. Research programmes are often in the interest of the researcher and therefore not part of a wider development programme. Research programme leaders are concerned with their current research, the consequence of this procedure being that it is difficulty to disseminate the results of this research. This situation also has a another characteristic, namely that researchers and extension services are isolated from each other.

In relation to the small farmers, there have been questions raised among policy makers in developing countries, as to whether research institutions are in fact developing technical solutions to solve their problems. Research in the experimental stations and the emphasis given to commodity programmes, has not contributed to increasing the productive capacity of small farmers. In most cases, small farmers do not have any say in research programmes and have an even smaller chance of testing their results at field level. As a consequence of this, new technologies are not relevant to the small farmer's conditions.

Some of these statements can be understood in terms of LDCs' historical concern with directing research and extension programmes towards commercial farmers who produce commodities for export. In doing so, these institutions ignore all subsistence producers. It may be asked, however, whether governmental policy should direct itself to increasing food production and improving the welfare of the poor. FSR has emerged as a possible strategy.

FSR followers suggest opportunities for the application of their concepts when farming productivity is low. These concepts show why and how to select the technology appropriate to the farmer's situation, and where and how they can be applied to incorporate them into the farmer's system. Evidence shows that "technological improvements, both spontaneous and induced, can and have taken place with disastrous consequences" (Mitchell,1981:133). Sometimes, "how to use available technologies is more important than generating new technologies" (Shaner et al.,1982: 164).

Taking into consideration these points described above, the next step in the implementation of FSR is to define the kind of approach. There are two types; project or programme. The project approach can consist of one or more projects which incorporate FSR procedures. They do not demand major changes in institutional policies, organizational structures or the agenda. They demand, rather, modest endowments from the national budget, especially when they are being financed by international agencies. This explains why, when an institutional environment exists, which is neutral or opposes FSR, the project approach is recommended.

On the other hand, the programme approach requires a greater and wider institutional effort, implemented by the farming systems projects, in which FSR goals and activities are an integral part of national policies of agricultural research and development. The government should nominate an institution to coordinate all bodies involved nationally, in the implementation of the programmes. They demand significant changes in organizational structures, and financial resources will be taken from the country's annual budget. The programme approach is advisable whenever a general consensus is reached on FSR, backed by top-level governmental support.

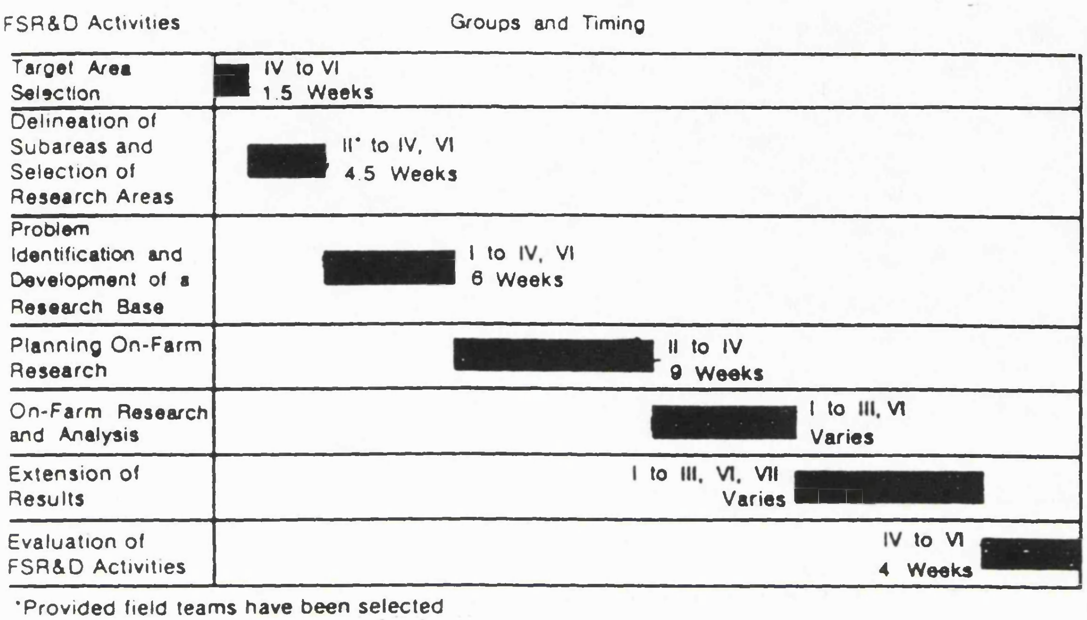
The decision about which approach to use, will depend on the country's particular situation. When decision-makers choose the farming systems approach as the main activity of their farming policies, it is appropriate to choose the programme approach. However, when they do not accept or are indifferent to this approach, as in the case of IAA-Planalsucar, the alternative is the project method. Once the kind of FSR approach is chosen, there are some aspects to be considered before the implementation process itself is initiated; these are, the time-scale, organizational flexibility, staff, costs and governmental support.

The necessary time-scale for generating and diffusing improved technologies will depend on the types of farm enterprise, the research team's knowledge of the area, the backlog of suitable agricultural technologies, the efficiency of the research and extension programmes, the level of team training, the period required to make the necessary changes, the government's support, and the identification of more advantageous technologies. However, although some experienced researchers are against it, in Shaner's view, FSR "is basically the rapid initiation of on-farmer experiments combined with adjustments in the programme's direction as results provide feedback " (Shaner et al., 1982:6). What FSR really needs, Shaner concludes, is enough time to adapt to farmers conditions and identify new opportunities to solve their problems.

FSR has great organisational flexibility. Depending on the approach defined, project or programme, FSR will adapt to all kinds of situations, either being developed by a semi-autonomous government corporation with great operational mobility and high budget, by the governmental research and non-governmental development agencies, by ministries responsible for research and development, or by being used in experimental stations that also deal with other research activities. FSR may also have specific objectives, as for example to act within a specific crop or livestock project in order to increase production.

As for staffing, depending on which type of FSR is adopted, the main groups are teams at the field level, as well as at regional and national levels. Figure 2.9 illustrates in sequence the involvement of those relative groups within FSR activities, including the evaluation phase, which will be discussed in the final item below.

Figure 2.9 The principal groups involved in FSR activities



Source: Shaner et al.,1982: 35

Regarding the target area, staff at national level are involved because this requires high-level decision-making. As the selection of the research area is a technical matter, it concerns technical staff. During the phase of problem identification, it is necessary to contact the farmers and discover their circumstances. Local and regional leaderships are involved. Planning on-farm research requires a strong technical back-up, therefore the field team and commodity and disciplinary specialists are present. Extensionists play an important role in the on-farm research, supervising farmer-managed tests. The extension service, among other organizations backed by the research teams, takes the responsibility for the extension of results. The regional and national teams participate in the final phase, the evaluation.

Staff should receive training on objectives, procedures and methods of

FSR. The objective of this training is mainly to brief the teams about on-farm techniques. They must learn to work with interdisciplinary teams and to deal with farmers, considering them both as a source of information and research partners. When analysing FSR costs, the variables, expenditures, rates of adoption and breadth of coverage, should be discussed. Even if one considers that the aim of FSR is to substitute only part of the activities of the experimental station, it tries to reduce the expenses of installations, materials and equipment, staff and action, in spite of increased fieldwork expenses.

Even considering that the FSR target group, in most cases, is different from that of general agricultural research, FSR proponents emphasize the high rate of adoption of technological innovations by small-scale farmers targeted by FSR. Even taking into account the fact that FSR's public is more specific than that of traditional research, FSR practitioners state that, depending on the target groups' level of representativeness, results may have wide applicability. The last aspect to be observed in the implementation of FSR is governmental support for the institutions involved. In most cases, FSR followers consider that the resources for the development of the normal research activities in LDC's are modest. The challenge is how to introduce a new approach without being able to count on government support.

Evaluation

Subject to availability of resources, of the situation' s requirements, of the appraisers, and financing institutions, FSR practitioners divide the evaluation of their projects and programmes into (a) built-in evaluations,

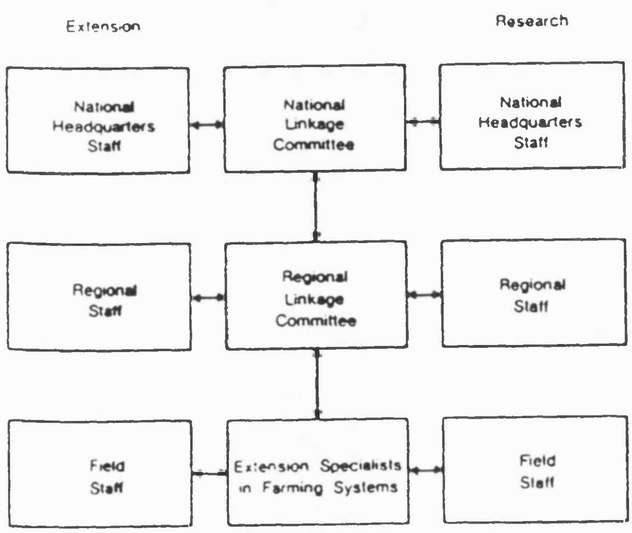
(b) special evaluations and (c) impact evaluations. The first is a periodic evaluation or monitoring of the results and problems one is faced with when implementing projects. It normally occurs after critical phases in order to increase the efficiency of implementation. This evaluation is part and parcel of the projects and acts as a link between those responsible for its management and those who assume financial activities. Special evaluations are made when the executors do not find solutions to certain problems, when changes in the scope of activities are necessary and whenever an event deserves special attention. In order to avoid bias in the evaluation, outside evaluation teams not involved in the project are often contracted. The last type of evaluation is conducted by the actual project teams, after their conclusion, and tries to identify or even measure the results of the project. These results form the basis of future projects and inform new policies.

2.5 Systems Action

While orthodox action only embraced the decentralized model of diffusion of technology at the beginning of the seventies, systemic action was born with it. The operationalisation of this model developed on the same pattern as orthodox action, in other words, through two distinct governmental institutions, research and extension, and yet it proposes an integrating structure between them. This is the great difference between the traditional research and functionalist approach, in relation to the process of bringing the research results to the farmers.

The integration between research and extension, is proposed through extension specialists on farming systems (ESFS). They form the link between the technologies generated by FSR researchers and the broader-scale diffusion of improved technologies through extension. Just like FSR staff, extension staff are equally organized in the field, at regional and national levels. FSR practitioners recommend that ESFSs become regular members of the FSR teams on all three levels, in order to allow full integration between research and extension. A proposal for this integration is suggested through the linkage committees (Benor and Harrison, 1977), illustrated in figure 2.10 below.

Figure 2.10 Linkages between research and extension in FSR



Source: Shanner et al. , 1982: 157

At national level, the linkage commitee comprises the heads of research and extension and senior ESFSs. The same regional staff members form the corresponding level, and ESFSs represents the link at a local level. As a practical example of this integration, one could quote the agreement concluded between the 'Instituto de Ciencia y Tecnología Agrícolas ' (ICTA), the Agricultural Science and Technology Institute and the " Dirección General de Servicios Agrícolas" (DIGESA), the General Directorate for Agricultural Services, in Guatemala (Letter of Agreement,1978). In this agreement the following aspects are noted:

" ... National development programs create the need for coordination and mutual support by those organizations holding complementary objectives;
Agricultural research, promotion, and training should be merged into a single effort leading to technologies that farmers will adopt;
DIGESA will convey to ICTA problems arising during technology transfer; and ICTA will provide DIGESA with technologies suitable for farmers' adoption;
To accomplish the above, both organizations will integrate their efforts and contribute resources to that effect;
Each organization will appoint a coordinator to represent its interests and to select projects in their mutual and individual interests ... "
(Translated by the Consortium for International Development; ICTA and DIGESA,1978)

The last aspect to be considered in systems action are the two activities responsible for its implementation; the multi-locational testing and pilot production programmes. During multi-locational testing, the technology developed in the research area is widely tested in the sub-areas within the target area, in the face of the target area, and even the sub-areas having some differentiation with regard to farmers' conditions. The results of multi-locational testing allow FSR teams, together with extension, to adapt and/or adjust technologies for the various conditions of the sub-areas. They are not research activities and their objective is to make research results more approachable. According to Zandstra et al. (1981), the Asian Cropping Systems Network is applying multi-locational testing in their member countries. Consequently, the pilot production programme proposes testing how the support institution functions and how the environment reacts whenever new technologies are introduced to the area on a large scale.

The representatives of support institutions, will form a committee which will approve the programme's implementation, based on the report of the multi-location test results. This will then be formalised through agreements where the responsibilities of the institutions will be specified. An extract from the 1976 memorandum of agreement between governmental and private institutions which participated in a pilot production programme in the Philippines exemplifies such an arrangement.

" This memorandum of Agreement entered into by and among the different government agencies and instrumentalities, represented by their respective regional Directors/Provincial Heads/Managers with full authority to do so:

1. IRRI-PCARR- The International Rice Research Institute - Philippines Council for Agriculture and Resources Research (Rainfed Rice Projects)
2. UPLB-NFSC - University of the Philippines at Los Baños- National Food and Agriculture Council (National Multiple Cropping Programme)
3. National Food and Agriculture Council
4. Bureau of Agricultural Extension
5. Bureau of Plant Industry -BPI
6. Department of Agrarian Reform - DAR
7. Bureau of Soils
8. National Grains Authority - NGA
9. Philippines National Bank - PNB
10. Rural Bank -RB - of Sta. Barbara
11. Agricultural Credit Administration - ACA ... "

(Haws and Dilag, 1980)

2.6 Conclusion

The systems approach believes that the first precondition for the improvement of living conditions in rural areas should be the optimisation of the use of factors of production through mathematical models and complex systems. This can, in turn, generate and incorporate new technologies into the production system. Although the approach takes into account the social aspect in the process of generation and diffusion of agricultural technologies, viewing the farmer as the technician's partner in transferring innovations to other farmers, it does not consider the farmer's indigenous knowledge.

It represented a significant advance, compared with orthodox research especially in relation to the adoption level of the generated and diffused technologies, among resource-poor farmers. However, it is still unsatisfactory regarding the efforts made by their followers and institutions responsible for its implementation. In order to go beyond the advance obtained with the systemic proposal, and trying to take account of the further constraints which affect disadvantaged farmers, the Farmer Participatory Research approach is suggested.

3. Participatory research

The growing idea of empowerment of disadvantaged groups brought out by the move towards participation in social science research, was one of the features which introduced participation into agricultural research. Participation is seen as:

"a strategy for the creation of opportunities to explore new, often open-ended directions with those who were traditionally the objects of developments ... is concerned therefore with the production of knowledge, new directions, new modes or organization rather than with the dissemination of more of the same".

(Oakley and Marsden, 1984: 13-14)

The worry that conventional research methods, both quantitative and 'neutral' tend to preserve inequalities, leads to the notion that one should respect peoples' capacity to produce and analyse their own knowledge. With this, the commitment and involvement of the researchers with the community took place, until it was recognized that research is an educational process for the researcher as well as for the community.

Participatory research was one of the most important themes adopted by the United Nations Research Institute for Social Development (UNRISD) for the 1980s (Pearse and Stiefel, 1979). It was also the theme of an international conference which took place in Yugoslavia in 1980 (Dubell et al., eds, 1981), where three parallel objectives of participation were identified: community involvement in social research; community action for development; and community education as part of mobilisation for development.

The proponents of community participation are concerned with specific issues. "Participation requires the direct, face-to-face involvement of citizens in social development and ultimate control over decisions that affect their own welfare" (Midgley et al., 1986:10). These basic premises raised other propositions and, as participation became popular in development, it raised difficult issues.

3.1 Participation and Development

Participation in development became the focus of attention of governments and NGOs, which sought to understand what had gone wrong as a result of having ignored the human factor. They also sought to understand how to transform the rural population from being the object of development to being the subject.

" ... I have to go back, and instead of taking the people as the object of my research I must try, on the contrary, to involve the people in a dialogue also as subjects, as researchers with me..." (Freire,1979:88) . This idea has its origins in Freire (1972) who views education in the sense of 'humanizing' (*humanização*) the person of the conscious action that he or she should take to 'transform the world'. By proposing consciousness-raising (*conscientização*) as a liberation strategy for the oppressed, his is considered a pioneering effort in the popularisation of participatory research.

Participation has therefore been understood in different ways within its own multi-dimensional nature. As Kalawole (1981) comments: " participation is perhaps the most ambiguous concept, which means different things to different people" (Kalawole, 1981:2). Development economists tend to define participation by the poor in terms of " equitable sharing of the benefits of projects". Others view participation as an instrument for enhancing the efficiency of projects or for cost-sharing. Participation is also seen as an end in itself, whereas other see it as a means to achieve external goals. Lucas and Lele (1978) see participation as an educational process for sensitizing people and for stimulating critical awareness. Pearse and Stiefel (1979) have defined it as 'sharing' or 'joining'. Cohen and Uphoff (1977) understand participation as being the active involvement of people in the decision making process. Oakley and Marsden (1984) say it "is regarded as empowering the poorer sections of the people to take independent, collective action in order to overcome their poverty and to improve this social status " (Oakley and Marsden, 1984). "...Participation is concerned with the distribution of power in society, for it is power which enables groups to determine which needs, and whose needs, will be met through the distribution of resources " (Curtis, quoted in Oakley and Marsden, 1984:25). The World Conference an Agrarian Reform and Rural Development (WCARRD, 1979) issued the following statement :

"Participation by the people in the institutions and systems which govern their lives is a basic human right and essential for re-alignment of political power in favour of disadvantaged groups. Rural development strategies can realise their full potential only through the motivation, active involvement and organisation at the grass-roots level of rural people ... ".

(WCARRD, 1979:13)

According to the World Bank's experience with development projects, community participation may be viewed as a process that serves one or more of the following objectives (Paul, 1987):

1. as an instrument of empowerment leading the people to an "equitable sharing of power and a higher level of political awareness and strengths".

2. to build up beneficiary capacity in relation to a project which can be responsible for the continuation of the project.

3. to contribute to increased project effectiveness, when the beneficiaries contribute to better project design and implementation.

4. cost-sharing by beneficiaries.

5. to improve project efficiency.

These objectives may overlap in practice and may vary in intensity, depending on the nature of the project and the characteristics of the people involved. So, the 'information can be shared' with people, they can be 'consulted' on key issues, they can have a 'decision making' role and they may be able to 'take the initiative' in terms of actions/decision pertaining to the project. Those four levels of intensity may be present or not, or may co-exist in a particular project or at a particular stage of the project.

" It is not surprising, for example, that in the initial stage when beneficiary groups are yet to be formed, a project agency starts with a low level of community participation intensity and gradually moves up the ladder".

(Paul,1987:5).

One can see from the literature that, in the majority of projects involving community participation, a specific process is involved using prescribed techniques and procedures. These are emphasised more by certain groups or organisations than others and vary from location to location in response to particular circumstances. Nevertheless, in general, whether local institutions are formally or informally organised, "the major task for community workers is to foster their consolidation and effective functioning in the long term" (Midgley et al.,1986:30).

"Community participation is said to be achieved when programmes which are desired and utilized by the community are effectively sustained by them after all external support has been phased out".

(Midgley et al., 1986:27).

A true process of participation in development, however, must be broadly-based whether it is under State control or developed by NGOs. Starting from the premise that the rural poor are incapable of initiating a process of rural development, most official programmes are authoritarian and hierarchical allowing very little participation by the people.

"The top down management techniques of the 'blue-print' approach are firmly eschewed in favour of dialogue, mutual consultation at all stages, self-reliance, collective action to solve group problems, democratic decision-making and local control over project activities".

(Hall in Midgley, 1986:103).

These working methods are more likely to be assumed by organizations which lie outside of direct government influence. Although the NGOs are criticized because they usually develop small-scale projects, they can begin to challenge the social structures which underlie poverty and exploitation. Those projects allow more participation leading the people to find their own course of action as they became aware of their condition.

The notion of community participation was popularized by the United Nations and other official bodies. It is being applied in the areas of health, education, housing, social work, urban and rural development. In agriculture, the introduction of poverty-oriented methods, such as the Kenyan Farmers Training Centres and The Taiwan Agriculture Extension Service represented a move towards co-operation, joint action and participatory decision-making. The development of FSR is also a clear recognition that research and extension needed to develop a more participatory approach in the design of agricultural systems to suit small farmers' needs.

3.2 Participatory Research in Agriculture

Although FSR has gone beyond research based on single crops to emphasize interdependence among biological, environmental, social and economic factors, some doubt has been expressed as to its relevance as an input to tropical agricultural research. The idea of replacing the introduction of single innovations by generating complete system packages, ready for large-scale adoption, did not succeed as expected. New techniques of planting were introduced into the real-life farming systems by interdisciplinary research teams run by agronomists and agricultural economists, neglecting the role that the farmers could play in the technology generation and dissemination process.

Apart from Maxwell's (1984) criticism of the inadequate articulation by FSR of the substantial resources that need to accompany the farming systems' dynamics as well as its inadequate articulation, within a broader policy framework, Davidson (1987), Biggs and Gibbon (1986) have also criticized FSR as a separate model to that of orthodox research. Overriding importance has been attached to large, expatriate-led FSR programmes, instead of developing more modest efforts through small programmes or projects, taking full advantage of local institutions and their scientists (Biggs,1984).

In the methodological field, Chambers and Jiggins (1986) make the following criticisms: multidisciplinary collaboration has been problematic, mainly because natural scientists do not see FSR as social science innovation; the accumulation of data while attempting to broaden the systems studied; FSR's main concern is not with the resource-poor farmer; FSR is still dominated by the transfer-of-technology approach; scientists are not adequately prepared for face-to-face dialogue with farmers; the researchers determine the design, content, conduct and evaluation of on-farm trials. They also criticise the reductionist aspect of farming research, which identifies interactions between a restricted number of controlled variables, and leads to the researchers' wish to totally control field experiments.

Still in relation to the implementation of FSR, Biggs and Gibbon (1986) criticize efforts to refine concepts and the definition of the sequence of FSR stages as a distinct variation on traditional research. At the same time, the authors recognize that FSR's latest experiences have adopted a more flexible approach. In relation to FSR's methodology, Farrington (1988) also points out the inadequacy of certain techniques and of FSR's own approach, as a consequence of biases in the training of technicians based on the transfer-of-technology approach. Chambers and Ghildyal (1985), Chambers and Jiggins (1986), Rhoades and Booth (1982), Gupta (1986a) among others unanimously state that "scientists' attitudes and approaches to farmers do not always convey the mutual respect and interested curiosity conducive to learning from farmers ITK" [7] (Farrington and Martin, 1988:19).

Considering all the criticisms made up to now on the systems approach, Farrington and Martin (1988) are correct when they oppose Chambers and Jiggins' views on FSR, when applying the scientific method. The authors state that " they appear to equate the application of reductionist scientific methods with a transfer-of-technology approach, though, in fact, the two are not necessarily connected" (Farrington and Martin,1988:20). They generalize the terminology of transfer-of-technology to mean a top-down approach of promoting exogenous technologies, divorced from the farmers' realities. This certainly happens in orthodox research and conventional FSR but it cannot be generalized. In many cases, for example, in the Strategic Projects of the case study reported in this thesis, such a transfer came to meet the needs of potential adopters. This demonstrates that the transfer-of-technology approach does not always operate in such a limited way, of solely promoting inappropriate technologies.

Another aspect to consider is who should control the on-farm trials. Chambers and Jiggins (1986), criticize the scientists' domination in the FSR approach and suggest that farmers should be in command, as in Farmer Participatory Research (FPR). On the other hand, Farrington and Martin (1988), seem to favour the researchers ruling in stating that:

"The phase 'on-farm trials' is frequently used to describe the testing under a range of agro-ecological conditions of certain components of the technology portfolio derived from the accumulated body of scientific knowledge. It is inevitable that scientists will dominate the trials, and in this context it is important to stress that such trials are unlikely to incorporate the full range of farmers' management practices and preferences or constraints ".

(Farrington and Martin, 1988:20)

However, they do suggest that:

"in trials designed to address specific problems faced by farmers, farmer/researcher interaction should be designed to broaden the range of options at the farmer's disposal and to speed up the rate of change achievable solely through application of ITK".

(Farrington and Martin,1988:20)

The notion of either side exercising total control may be questioned. During fieldwork in Brazil for this thesis, it was observed that there may be a greater or lesser contribution, either from the scientist or from the farmer, depending on the context. For example, if the problem, which they both identify requires more information from official knowledge (Long, 1985b and 1987) or better still from scientific knowledge, the main participation will be that of the researcher. On the other hand, if the solution requires a significant volume of information relating to local knowledge, in other words, the farmer's indigenous technical knowledge (ITK), he will be the protagonist with the greatest deal of information. Each case should be considered within its context, emphasizing of course the integration of the actors - farmers and scientists. The initial tendency, which is normal in the researcher, is to dominate so long as he/she possesses scientific knowledge. On the other hand, the farmer is inhibited from affirming his/her position because he/she considers that 'the doctor knows best', to paraphrase a small farmer from Northeastern Brazil. However, this is simply a question of developing participation in practice and of understanding the process as an exchange of experiences and knowledge, a mutually educational process.

"It is necessary to acknowledge that agricultural techniques are not unknown to country folk. Their daily task is none other than to face the land, look after it, cultivate it, within the margins of their experience which, in turn, is built within their own culture ".

(Freire, 1979:51).

The key to success, to quote Richards (1986), is the quality of interaction between farmers and scientists. On the other hand, the same author (1986) points out the possibility of farming activities being isolated from their wider social context by FSR.

"I argue that narrow functionalist conceptions of 'farming systems' as agro-ecological entities, obscure important characteristics of the production process in resource-poor farming communities, and lead to badly flawed assessments of the potential for technical change" .

(Richards, 1986:2)

This has been, to some extent, confirmed in several participant observation studies in which the researchers took part in farming activities throughout a full agricultural cycle, leading Richards (1986) to dispute whether the farming systems actually exists at all. The results of some of this research show that certain agricultural practices or strategies, are adopted by the farmers as a cumulative result of a sequence of adaptations to a specific climate and personal contingencies. Crop mixtures could be an example. They are adaptive strategies that result from the farmer's ability to deal with his environment, to adjust himself and keep himself tuned (Watts,1983). Thus, these practices or strategies are not the result of a management input, but an outcome. They are not, therefore, "systems" as such. They are part agronomic, part biographical (the result of the relationship between man and environment).

Richards (1986) then asks what can be said of the farm. He queries whether it also may be considered a system, whose functioning can be foreseen only through mathematical estimates and computer use. According to conventional FSR, a farm is a discrete agricultural enterprise under the management of a single individual - the farmer - or a corporate unit - the family or the household. It is considered a small firm, which permits farming systems research to draw upon standard micro-economic analytical concepts.

Fieldwork in a Mende rice farming community - Mogbuama - in Sierra Leone (Richards, 1986) shows that assumptions raised above concerning the farm could be queried and opposed by the concept that "farms are complex seasonal agro-ecological units in which a number of discrete and managerial interests intersect at specific moments in time and then diverge again" (Richards, 1986:3).

New approaches are now being implemented, which take into account the wider social context in which the farm is inserted, within the broad pattern of farming activity. Participatory research, farmer consultative panels, rapid rural appraisal and problem-diagnostic surveys, are among the techniques which question FSR's conventional assumptions about inter-action, which are based on detailed, often slow and expensive studies of input-output.

FPR is thus a complementary approach to that of FSR which will help to narrow down and improve the quality of the relationship between farmer and researcher; democratize the technology development process; and consider also the issue of cost-effectiveness in the design, implementation and dissemination of technology. As a part of that process, Agricultural Knowledge Systems "would be made more dynamic, and (especially) community-level mechanisms for the implementation and enforcement of ITK strengthened" (Farrington and Martin, 1988:65).

3.3 Agricultural Knowledge Systems

According to Hurtuvise (1984) the word 'systems' is used for three different modelling purposes:

"i. for analytical purposes: system analytic concepts are applied to a complex phenomenon which seems difficult to analyse by conventional scientific analysis; such a phenomenon is then called a system;
ii. for design purposes; a system is created to perform some function;
iii. for simulation purposes; a system is created which closely resembles a complex phenomenon. This model is made to function and the results are compared to the outcome of the complex phenomenon. One can predict interventions in this manner ".

(Röling, 1988:186)

All three types of system can be defined as an arrangement of parts - elements, components, subsystems - which interact to achieve some common purpose (Fresco, 1986; Hurtibise,1984). The interaction of the parts is the most important aspects in any system, "the whole is more than the sum of its parts ", as Röling says (1988:188).

FSR employs analytical criteria (i) in an attempt to understand the complex 'farming' phenomenon, called the local farming system. It employs design criteria (ii) in an attempt to create a system that will be really useful for development. Consequently, investments are made, people are trained, existing research institutions are reorganized in order to improve interconnections among agricultural information systems (Röling,1988). It is also used for simulation purposes (iii) as it can predict interventions in farming in order to obtain an improved outcome from investment decisions. FSR can be considered, thus, a model created deliberately by specialists in the administration of agricultural research and by others, who seek agricultural development.

FPR does not claim to be a pre-determined model. It is an approach based essentially on natural agricultural knowledge systems rather than on 'designed' systems. An agricultural knowledge system is "a system of beliefs, cognitions, models, theories, concepts and other products of the mind in which the (vicarious) experience of a person or a group with respect to agricultural production is accumulated " (Röling, 1988:33). What is emphasized here is the cognitive system , its structure and the regulation that it imposes upon the environment.

Recently, those in the farming sector who are involved in the development process, especially those who dedicate themselves to working with disadvantaged farmers, have shown interest in studying farmers' knowledge, experience, and their ability to experiment. This has been virtually ignored both by orthodox agricultural research and by FSR's traditional approach (Chambers and Jiggins,1986). The idea is that knowledge should be considered an important resource in the efforts towards development.

This theme has been touched upon under different headings: agricultural knowledge systems (Röling, 1988); indigenous knowledge systems (Brokensha et al., 1980; Richards, 1985); local knowledge (Korten and Uphoff, 1981); rural people's knowledge (Chambers, 1983); the study of interfaces between local and official knowledge systems (Long, 1984 and 1985); indigenous technical knowledge (Howes and Chambers, 1979; Basant, 1988; Farrington and Martin, 1988; Tripp, 1989). The ITK concept appears as one of the most comprehensive examinations of the subject, although it still requires a more precise definition (Tripp, 1989).

Howes and Chambers (1979) established a comparison between ITK and formal science. Chambers adds that ITK can be contrasted with modern scientific knowledge . It has a limited capacity for breaking down data, for interpreting it and reorganizing it in different ways, compared to formal science. ITK is concrete, based on intuition and the evidence as it is directly perceived. Indigenous implies originating from and naturally produced in an area ... "Technical in ITK also has a healthy effect in emphasizing the practical nature of much of this knowledge " Chambers, 1983:83). Chambers prefers the term 'rural people's knowledge'. He explains: rural includes all farmers, large or small; people, in the sense that most of the knowledge is located in people themselves and very rarely in writing; knowledge refers to the whole system of knowledge "including concepts, beliefs and perceptions, the stock of knowledge, and the processes whereby it is acquired, augmented, stored and transmitted" (Chambers, 1983:83).

Farrington and Martin (1988), distinguish ITK as being objective and of wide validity. The problem is that familiarisation with any rural group is only achieved by socializing with it. It will not be widely found in books or taught all over the world. According to them, in spite of the vast literature studying cases that involve ITK, "no systematic attempt appears to have been made to investigate the circumstances conducive to development of strong ITK "(Farrington and Martin, 1988:25).

This would be an important guide to scientists as well as an indicator of which conditions could be altered in order to strengthen ITK. Although it does not explain or predict, ITK is potentially an important complement of formal scientific knowledge, especially because of its capacity for location-specific classification of aspects of the biophysical environment.

Besides the detailed knowledge of their environment, farmers often have complex strategies for dealing with it. Edwards (1987) reveals studies which took place in Botswana and Zambia that compare local soil classification with those obtained by laboratory analysis; Johnson (1972) demonstrate how soil conservation techniques in Nepal were developed based on the farmers' perception of risk; Richards (1985) describes the decisions that farmers in Sierra Leone make on the timing and type of burning for land preparation in relation to rainfall patterns; Brammer (1980) shows that farmers in Bangladesh developed methods for establishing rice in saline soils and for planting wheat in ridges during the dry season.

My personal experience in fieldwork with sugar-cane farmers has shown that most of them create a harvest calendar of all the different varieties planted in the different types of soil, which correspond to the calendar developed by the technicians. This calendar is based on the analysis of the maturation stage (sucrose contents), which is done initially in field conditions by the field refractometer [8] and confirmed, in most cases, afterwards in laboratory tests. The method that the farmer uses is based on the previous harvest calendar, on the type of soil and humidity content, topography, sugar-cane variety and, plant phenotype. In relation to this last factor, he observes the quantity of dead leaves and their distribution in the longitudinal direction of the plant.

The farmers' experience, developed throughout the years, should be considered of utmost importance in the development of research programmes. The rationale for such practices needs to be understood before changes are proposed, as Tripp says (1989). It would probably avoid resource investments in options that do not contribute effectively, or in from that have even been tested and rejected by the farmers.

Some limitations may however be identified. Swift (1979) points out that the transfer and use of information is liable to be affected, as it is passed on by word of mouth or by direct experience, and kept in the minds of those who practice it; differences within the groups' social functions will influence the type and extent of ITK developed by each group. Socio-economic stratification has its influence on rural societies, leading poorer farmers to innovate in some fields because of their poverty. Biggs and Clay

(1980) detail other limitations. On its own, ITK is limited as a means of promoting improvements since it depends on techniques, local raw materials and genetic resources. As for the informal system, genetic improvement remains limited by the non-existence of specific techniques. ITK's contribution to the solution of problems will vary according to the extent that its limitations are peculiar to the farming systems under examination. ITK's potential will also vary within and across communities, according to attitudes and individual values.

All of the impressive stock of farmer knowledge and experience could be used to improve current agricultural systems. Some of the cases showing their contribution to research successes that incorporate ITK are reported by Richards (1979) and; Scott and Gormley (1980). ITK should, thus, be seen as a dynamic experimentation process of enquiry which is complemented by a science-based development of technology, just as the FPR approach proposes.

3.4 Farmer Participatory Research

3.4.1 The Concept

FSR contributed to the emergence of FPR since it suggested, in its first formulations, the need to involve and learn from the farmers in the process of research. This is quite a controversial point for some FPR proponents, who maintain that their approach should differ from research that is done in conventional institutes, which perpetuates the *status quo* in the researcher-farmer relationship. Farrington and Martin (1988) point out that the main differences between FSR and FPR represent, to a certain extent, an extension of the divergences between the various approaches and institutions in the social sciences. Those institutions want their intentions and expectations to be fully satisfied, independent of community control, especially in agriculture, as the stock of technical knowledge accumulated by institutions is very wide. The IAA-Planalsucar experience is a good example where FPR demands that the existing institutions be open to accepting indigenous knowledge as legitimate.

The interest in FPR is based on the fact that LDC resource-poor farmers seem to have gained very little from the transfer-of-technology approach. "Learning from farmers is a piecemeal fragmented and iterative process requiring repeated interaction between researcher and farmer over an extended period" (Farrington and Martin, 1988:9). But it appears that farmers are better served by a more adequately technology, tailored to suit their realities, which addresses their particular characteristics. Different FPR approaches have been proposed. On the chart below (figure 2.11) are summarized the main features of four of those approaches suggested from: CYMMYT's on-farm experimentation Tripp (1982); Harwood (1979) on the basis of IRRI experience; Rhoades et al. (1985) derived from work at 'Centro Internacional de la Papa' (CIP) International Potato Centre; and, by Chambers and Ghildyal (1986).

Figure 2.11. The main features of FPR approaches

	Tripp	Harwood	Rhoades and Booth Rhoades, Batugal and Booth	Chambers and Ghil Chambers and Jiggi
Methodological issues				
Who decides on trial design/content?	researcher incorporating farmers's views on content	farmer and researcher jointly	farmer, technologist, extensionist (where possible) and social scientist, jointly	principally farmer w consultative inputs f researcher, if requir
Who manages the trial?	researcher manages the variables being tested, farmer manages the remainder	farmer and researcher jointly	farmer and researcher jointly	farmer
Who evaluates the trial?*	not indicated	researcher and farmer, in the light of farmer's goals	farmer has final judgement on appropriateness	farmer
What should characterise farmer/ researcher relations?	'honest curiosity' by researchers	farmer and researcher equal	farmer and researcher equal partners	ITK and farmer goal fundamentally important; 'reversals required if researche to learn from farmer researcher as consult
What should characterise the research process?	OFT as iterative multi-season process; time needed to gain farmer confidence, and test new hypotheses arising from trial results and his views of them	OFT as iterative multi-season process; farmer to decide whether/in what form he wishes to continue trial; important to test through inter-year climatic variations	flexibility needed: consult farmer through research process and change design where necessary. May be useful to conduct an experiment *before* a survey	farmer to dominate a decisions on researcl process. Apparently unstructured
Institutional issues				
What should be the interaction between OFR and more basic or commodity/factor oriented research?	ideas for OFR testing to be obtained in part from other components of research, and trial results to feed back to them	OFR teams should be based at the same stations as other research to facilitate interchanges. Unproductive to send 'basic' researchers to field for long periods.	'other research' to provide ideas as one component in 'constructive conflict' process of defining researchable problems. Station-based research should complement OFR	'other research' shoul have a purely referral role. No indication th it should provide idea for OFR testing or th OFR results can usefully be fed back ir it
What is the role of extentionists in OFR?	help identify sites; to help run trials which may eventually become demonstrations	may be brought in to assess trial and learn from successful ones	involved throughout research, especially in spreading technology among farmers	none defined
How far should OFR researchers monitor the agro-ecological and socio-economic environment with a view to introducing the technology elsewhere?	in detail, to facilitate dissemination	in detail, to facilitate dissemination	in detail, to facilitate dissemination and monitor consequences	not indicated

Source: Farrington and Martin, 1988: 10,11

One can point out, from the comparison of the four approaches that, with the exception of Chambers et al., all the other approaches focus on the relationship between on-farm research and other components of the research system. One can also observe that there are two opposing positions in relation to methodological aspects: Tripp places researchers as controllers of research actions while Chambers et al. defend the view focused on the farmers.

The institutionalised knowledge on which the scientist can draw certainly cannot be more specific than the knowledge produced by the evolutionary selection of methods and techniques used by the actual farmers, as a sub-set of what Norgaard (1984) terms 'Coevolutionary Agricultural Research'. This is why, generally, activies in FPR advocate the idea of an intimate relationship between farmers and researchers. A relationship in which the farmer carries out an important rôle in defining the research programme or project, in the sense that their own interests and priorities are guaranteed, rather than those of the researchers.

The identification of the problem does not occur simply through researchers' observations, not even assuming that farmers are capable of enumerating their main problems. That calls for a considerable amount of patience and comprehension from both farmers and researchers, a continuous dialogue that leads to mutual agreement about a research agenda, and not only the discovery of what farmers really want. It is what could be called 'mutual respect'. It requires, more than anything else, the clarity of thought to understand why and how a new technology will give a better performance than one which already exists.

3.4.2 Farmer participation

The range of initiatives in FPR has increased nowadays and they have been conducted by different agencies, such as the farming systems programmes of International Agricultural Research Centres, National Research Programmes and Non-Governmental Organizations (NGOs). Farrington and Martin (1988), in trying to review recent field experience, encountered three general difficulties. Firstly, there is a tendency to try to describe, within farmer involvement, what intention and logic lies behind the action. Secondly, although the importance of assessment is recognized, this, in general, has not been done in terms of efficiency of participatory methods in relation to amount of time and costs. Thirdly, several cases of studies involving innovatory participatory methods are taking place at the moment, but their experiences have not yet been evaluated. The experience is relatively new and there are various forms and degrees of interactions involved in the different study cases.

In the attempt to classify field experiences with farmer participation, Biggs (1987) suggests a typology of participation based on the degree of interaction, for the analysis of nine study cases, in different countries of on-farm client oriented research study (OFCOR) of the International Service for National Agricultural Research (ISNAR).

a) Contract

It does not actually represent participation in the true sense, but it is considered a link between farmers and researchers. The research institution hires or lends the land and the farmer services in order to diversify agro-ecological conditions for verification of technologies developed in the experimental station.

b) Consultative

Farmers are consulted by researchers at each stage of the research - diagnosis, design, technology development, testing, verification and diffusion. During this consultative process, researchers make all the decisions regarding the contents and conduct of the surveys and trials in order to, once again, call on the farmers to participate in the final evaluation.

c) Collaborative

The farmers are consulted on potential new technologies and on how to go about cost-effective, village-level research. It involves continuous interaction, individual or in groups. This and the previous mode of interaction are the most common, "being central to the work of IRRI, CIMMYT and many national programmes " (Biggs, quoted in Farrington and Martin, 1988:31).

d) Collegiate

In this category, the farmers are not only consulted, they are motivated by the researchers at an individual and community level to conduct informal research and development, strengthening the local capacity for such. Here, jobs done by the NGOs stand out. The case studies of IAA-Planalsucar could be placed in these categories, with greater focus on the last two.

3.4.3 Methodological Aspects

The actual research and development by and with resource-poor farmers, is a broad process, which requires understanding and interaction of all types and at all levels. "This includes social relationships, exchanges of ideas and information, linkages between people, and institutional dimensions" (Chambers et al.,eds,1989:43). It takes into consideration the interactions between researchers and farmers, extensionists and farmers, between women and men, between formal and local knowledge. It is not, therefore, limited to following 'stages' chronologically. Some experiences have actually tried this type of integration and, from that effort, certain modifications and methodological contributions have been proposed and have proven to be important for the improvement of research methods. Some techniques have been created, which others developed by FSR have been adopted and/or adapted in order to structure the integration between farmers and researchers, moving from formal questionnaires to more informal rapid rural appraisal (Chambers, 1981).

a) Diagnosis

In FPR, a greater emphasis is placed on the identification of the problem such as "putting oneself as much as possible into the farmers' shoes to understand how they view the problem in both technical and socio-cultural terms" (Rhoades, 1984:148). This work requires a great deal of time, understanding and patience from both sides, as it is based on continuous observation and individual or group discussions, to reach mutual agreement. In order to enable farmers to take on a more active rôle in the analysis and identification of priorities, a quick informal survey, described as a rural appraisal, diagnostic survey, informal survey, sondeo, joint trek, or group survey (Collison,1982; Mathema et al.,1986), has often been used. The objective "is to identify the range of farmer resources and physical environments, production priorities and practices in a specified study area, through interaction with farmers and local informants" (Farrington and Martin, 1988:33). In the meantime, this is the first stage of an interaction process, which permits the group to share some common ground. A clear understanding of the research agenda is established at this stage for both researchers and farmers.

Various other techniques have been used, such as: on-farm experiments, farmer field-days, farmer advisory boards, participant observation, chain of interviews, "scientists working with farmers in their fields in exchange for information" (Rhoades,1984; Rhoades et al., 1985), "the development of problem lists and encouraging farmers' experiments" (Bunch, 1982 and 1985), biographical analysis (Box, 1982 and 1987b), "community appraisal" (Lamug, 1987), "ranking of problems" (Engel, 1987), "use of various types of diagrams" (Conway, 1987), "maps drawn by extensionists" (Gupta, 1987), "field observations" (Lightfoot et al.,1987), "interactive research" (IDS Workshop,1987) and different group activities.

Regardless of the methods used, it is of prime importance that they start by exploring the indigenous technology and the experiments that the actual farmers have informally performed, that is, the ITK. It is also important to identify intra-household interactions, in order to explore "which groups in the community have particular responsibilities and access to the associated agro-ecological knowledge"(Farrington and Martin,1988:36). Having identified the problem, the search for solutions becomes a constant on-the -spot exchange (Rhodes,1984) between farmers and researchers which should strengthen a continuous interaction until a potential solution or a set of solutions is selected.

b) Experimentation

Ever since the FSR approach originated, the idea of on-farm experiments has been developed and adopted, although under conditions rigidly control led by research institutions. Nevertheless,

"the farmers' actual participation in the planning, execution and evaluation of research should be clearly distinguished from mere research in farmer's fields initiated and controlled completely by scientists".

(Harwood,1979:40)

FSR followers believe that farmers should perform a more active rôle in the management of on-farm programmes. Working results, in that sense, have proven that the leading rôle of farmers has turned out very well whenever the tests involve new varieties or new crops (Farrington and Martin,1988). This type of experiment involves activities which are all too familiar to farmers and are also inexpensive.

"In testing new varieties, the choice of non-experimental variables includes the consideration of interactions familiar to farmers, such as date of planting, seeding rate, or choice of intercrop, and the results are often less dependent on field to field variation than those of source crop management techniques".

(Tripp,1989:11)

The ideal level of farmer participation depends, therefore, on the on-farm research objectives. In order to find out even more about farmers' management practices and evaluation criteria, a few innovate field methods have been proposed. Farrington and Martin (1988) distinguish them "whether farmer and researcher work jointly on the same trial, or by separately, on different aspects of a trial, or even on different trials" (1988:42) as follows:

1. Farmer and researcher conduct trials jointly

i. Adaptation of standard techniques for greater farmer participation

The adaptation of standard research methods is considered important in the promotion of greater farmer participation (Okali and Knispscheer, 1985; Lightfoot,1987). Although objectives and design are generally established by researchers, there is a range of technology choice for farmers which definitely improves their understanding and feedback.

ii. Farmers design experiments with researchers

Although there have not been many experiences in this sense, the example of the fertiliser trials conducted at CIAT (Ashby, 1986 and 1987) is relevant. Involving different degrees of farmer participation, two experiments took place, designed to evaluate: how farmer/researcher relationship differences affect the management of on-farm trials, the agronomic results and evaluation by researchers and farmers; and farmer participation in defining criteria for testing technology under small farm conditions and for experimental designs. The test crops were beans in an extensive fallow farming system area, and potatoes in an intensive crop/livestock area.

2. Farmer and researcher interact, but do not conduct trials jointly

i. Farmers and researcher conduct their own experimentation

Farmers are provided with new inputs on methods which at the end of a short period of explanation on their use, they have the freedom to incorporate in their own farming system. Researchers promote the evaluation of the outcome, not only to verify its impact on productivity, but also, to understand "the criteria by which farmers assess technology and to gain insight into possible further changes that merit experimentation" (Farrington and Martin,1988:43).

ii. Farmers evaluate researcher-designed trials

Although this approach could well lead to a greater farmer participation in future experiments, it does limit him to participating only in the evaluation stage.

The case study, described in the fifth chapter, shows, with practical examples, some of the diagnosis and experimentation methods described above.

c) Evaluation of Research Results

As long as they have not been compelled or influenced by incentives such as credit and subsidized prices, as Tripp (1989) points out, the ultimate evaluation of the technology generation and dissemination process is the degree of adoption of innovations by farmers. However, this is a lengthy process and steps should be taken to anticipate what will be viable according to each situation in which research takes place.

FPR considers the farmers' evaluation as being not only the final phase of the research, which informs future investigations, but also as a process that takes place throughout the various research phases. As farmers participate in all research activities, they are able to discuss the feasibility of new techniques or the acceptability of new crop varieties, during the research process. This information can be compared and weighed against other existing research information, or even against some adaptations developed by the farmers themselves. Although the existence of some limitations in the farmers' contribution to evaluation is recognized, it is still considered a useful alternative to conventional research evaluation.

3.5 Participatory Action

FPR proposes a virtual revolution compared with orthodox and systemic action. The farmer is the main person responsible for disseminating research results. In fact, for those who have taken part in the generation process and the dissemination of technologies with farmers, this notion ceases to be revolutionary but rather a statement, in scientific language, of what has been taking place for years. It is a return to basic principles. In other words, long before having created any sort of organizational structure to disseminate the results of farming research, the farmer already did so, and has been doing so by word of mouth ever since farming has existed. Participatory approach only proposes organizing and stimulating this process.

Farrington and Martin (1988) quote the following successful examples of farmer-to-farmer dissemination: rice/groundnut rotation, Khon Kaen University, NE Thailand (Jintrawet et al.,1985); training in Leucaena management techniques, Eastern Visayas Farming Systems Research Project (Cornick et al., 1985) and Baudha-Bahunipati Family Welfare Project, Nepal (Arens and Nakarmi, 1987); village-level classes taught by farmers, World Neighbours-NGO (Bunch,1985); rice/fish, Ubon, NE Thailand (Sollows, notes of Canadian Universities Service Overseas); Bolivian farmers' textbook (Hatch, 1981); farmers' three-day conference, Bolivian Highlands, (Farrington and Martin, 1986); potato varieties propagation and distribution, N. Peru (Horton and Prain, 1987); soil and water techniques, Sahel (Reij et al.,1986); water-harvesting techniques, Oxfam and villagers in Yatenga, Upper Volta (Wright, 1985); farmer-to-farmer contact in Central America, Oxfam Project (Oxfam, late 1970s); feedback from farmers to researchers (Norman et al,., 1988): Ashby et al., 1987).

Farrington and Martin (1988) highlight two important considerations from all the evidence: NGOs and universities have been the greatest promoters of participatory dissemination, whose researchers have directly given the farmer initial stimulus. In contrast, the national research and extension services of LDCs have done very little in that sense.

The conventional approach to extension, strictly speaking, has hardly favoured farmer dissemination of technology. The persuasive position of the extension agents, in accordance with the training received, does not leave much room for the actual collaboration of farmers "in 'trying out' a range of technologies which may or may not meet farmers' evaluation criteria" (Farrington and Martin, 1988:56). Some of the progress in FSR and in extension work represents a move towards participation, narrowing this gap (Byerlee,1988). Some successes were achieved by incorporating extension agents into participatory trial management in Zambia (Kean, 1988), into informal diagnostic surveys in Honduras and Guatemala (Whyte and Bounton, 1983) and into the development of farming systems technologies in Khon Kaen, Thailand (Charoenwatana, quoted in Farrington and Martin,1988).

One could also quote some of the different functions taken on by extensionists, such as: facilitating input supply (Harwood, 1979) and as village-level catalysts, where the roles of researcher and extensionist merge (Fernandez, 1986; Raintree, 1978; Tan, 1986). Depending on the circumstances of the extension agencies' intervention, this new approach "sees the role of extension officers as facilitators, promoting interaction between farmers and encouraging farmer-to-farmer extension" (Smukupt, 1987 in Chambers et al.,eds, 1989:45).

As for the rôle of NGOs (co-operatives, unions, producer's organisations and charitable or religious-based organisations) one can safely say that they have been of great relevance in strengthening indigenous technology and disseminating research results on both an area and social group basis. This has been owing to their familiarity with local agro-ecological and socio-economic conditions, their facility in articulating farmers' interests and their broad 'facilitating' approach to rural development, and as Farrington and Martin (1988) pointed out, one should make reference also to the NGOs' link role with formal research in the design and diffusion of technology.

Recently, another type of participatory dissemination other than that done by farmers and their organizations, has been identified. Some research institutions are working with farmers in two ways: i) contacting them directly through collective events - field days for example- at their experimental stations. CIAT (Tropical Agriculture Research Centre-Bolivia) classifies them as 'direct users' (Thile et al., 1988) and IAA-Planalsucar as 'direct action' (Plano Trienal, 1983); ii) through the institutions that work on technology development and make use of the technologies developed by the research institution. CIAT calls them "intermediate users" (Thiele et al.,1988), and similarly IAA-Planalsucar, calls it 'indirect action'. Participants in the latter are producers organisations and other NGOs and area-based projects.

4. Closing comments

Conventional approaches to agricultural research and extension are deeply embedded in the transfer-of-technology mode, in a conventional compartmentalisation of research and extension. This approach involves scientists deciding on research priorities, generating, introducing, testing technology and passing it on to extension workers to transfer to farmers. It is hierarchical and centralised, standardised and simplified. 'Normal professionalism' and 'normal bureaucracy' [9] (Chambers, 1989), (when combined), in the international agricultural research centres, agricultural universities, and national agricultural research systems, demonstrate a substantial capacity to resist change.

It is important to remember that researchers have no monopoly on discovery, as Fernandes and Tandon (1983) pointed out. Research and development is not confined to the experimental station, laboratory or greenhouse. It also springs from the farmer's situation. Rural people and all those who work within the rural environment have valuable knowledge about rural society, experience and the ability to cope with their environment.

Throughout the years, many researchers, extensionists and development workers have tried to re-direct their objectives and activities in order to attend to farmers' concrete needs. Their efforts on the road from the station to farmer's field , making technology development more relevant to farmer's problems, can be summed up in five major trends (Fernandes and Tandon, 1983): decentralization of research structures, encouragement of personal and direct relations with local social groups; appreciation of the knowledge of the real environment; the improvement of the technical message, tailoring their experimental methods to local technical constraints; a new emphasis on objectives, based on production conditions, fashioning innovations to suit agrarian systems by closely linking research to development. The tendency of the conventional approaches has thus been reversed in this approach.

The term 'farmer participation' has become familiar to all those involved in development. However, the concept of 'participation' in rural development is viewed from a wide range of perspectives, with contrasting interpretations. The first time it came up in the FSR description was unremarkable, as it could be summed up by the use of farmers' information to define research priorities and to undertake research on farms (Uphoff et al.,1979; Norman 1980; Whyte,1981). As Kean (1988) points out, the term encompasses farmers' roles in both decision-making and implementation of research. Besides, farmer participation has been used as a parameter in the discussion of the advantages of FSR (Matlon et al., 1984), as a distinguishing goal and main fault of FSR (Oasa, 1985), as an alternative focus for FSR (Chambers and Jiggins, 1986), as a complementary approach to FSR (Biggs,1980; Richards, 1987), as a complement to client-oriented research and development (Farrington and Martin, 1988), or even as a crucial component of agricultural research methods or/and approaches.

Farmer participation embraces several major developments: incorporating farmers' views, handing decision-making to back to the farmers, farmer and researcher as equal partners, getting rid of paternalism; a democratic combination of local and formal knowledge, re-structuring current institutions, researchers and extensionists to facilitate farmers in determining their concrete needs and overcoming their problems. However, farmer participation is no panacea. Farmer participation signifies developing and maintaining a close interaction (with mutual respect) between those who participate in the action, that is, both the outsiders - scientists, extensionists or NGO workers - and the local, rural people.

Finally, the development of methods/approaches during the last four decades, from Rogers' persuasion to farmer participation, discussed about in this chapter, will enable the reader to understand the reasons which led Brazilian agricultural research in general, and specifically in sugar cane research, to take the centralised diffusionist method as its theoretical basis. Sugar-cane research, as an instrument of the modernisation of the sector, its relationship with rural extension, its policies and consequences for disadvantaged farmers will be the main subject of the next section.

Notes:

1. Extension is the term used to denominated training programmes for rural people. The agencies responsible for these programmes disseminate information to farmers and their families. Agricultural extension is related to agricultural production (economic growth) and rural extension, apart from that, also includes the rural families in their social context (development).

2. A post-war movement which appeared in developed countries, in the period 1966-1970 (Redclift, 1984). This movement maintained that the large-scale exploitation of positive genotype-environment interactions, in other words, the use of new varieties with special genetic characteristics - semi-dwarf, quick-maturing, among others - or the use of inputs - water, fertilizers and other chemicals - on their own or combined, could lead to a large increase in productivity and therefore an improvement in rural life-styles.

3. The change in human behaviour is partly motivated by an unstable situation or dissonance, by an uncomfortable state of mind that the individual tries to reduce or eliminate. He tries to reduce this situation through his knowledge, attitudes or actions.

4. These concepts, developed by Skinner (1974) -'Behaviourism'- and developed after laboratory studies on the behaviour of animals and training, were set out for human beings, leading to an ideal programmed training through mechanically coordinated progressive associations.

5. Farming is an activity performed by households on holdings that represent management units created for farming and livestock production, motivated by profit (Ruthenberg,1971).
The household is defined by Harwood (1979) as a social organization in which members normally live in the same environment, sharing their food. They may or may not constitute a family group. A family consists of two or more linearly related kinfolk, their spouses, and offspring, concludes the author.
Enterprises, on the other hand, are activities which are developed to produce an output that contributes to the total production or profitability of the farm family (Shaner et al. 1982). To FSR, these activities are: crops, livestock, processed products of improvements on the farm, non-

agricultural activities made on the farm, such as handicrafts and productive activities of the household members, which are not related to the farm itself.

6. The planting of one crop after the harvesting of the first, in the same area.

7. Indigenous Technical Knowledge

8. A instrument for determining the refractive index of a substance. In this case if is used to determine, under field conditions, the sucrose content of the sugar cane plant.

9. The term 'normal professionalism' is used to describe technicians' behaviour based on transfer-of-technology training in which they dominate all actions. In turn, 'normal bureaucracy' means the administrative procedures with a hierarchical and centralized, standardized and simplified approach.

Chapter III- Sugar Cane Research in Brazil: 'Conservative Modernisation'

1. The Logic of Research and Extension

Historically, Brazil has shown a greater willingness to use agricultural research and agricultural production to face balance of payments problems than to cope with nutritional or basic food supply problems. Thus, the government has been sensitive to the research needs of export crops but not to domestic food crops. Isolation in training and lack of participation in the international research community from those who research staple foods (dispersed and non industrialised products), aggravate the difficulties of finding contributions to solutions for their problems. Support for research into staple foods has not been significant or continuous and, consequently has been ineffective in practice. Rice, beans and maize have been studied by some research bodies, but have never been given a high priority and are among the most poorly understood crops in Brazil. On the other hand, coffee, cotton and sugar cane have been supported for a long time.

In fact, research on coffee began with the foundation of the Agricultural Research Institute of Campinas in São Paulo in 1887, which played an important role in research on the cotton plant at the beginning of the twentieth century and in sugar-cane, particularly after 1935. In 1927, the state government of São Paulo created another important research unit primarily devoted to plant and animal pathology, the Biological Institute of São Paulo. This Institute gave a particular emphasis to coffee. After 1930, research into sugar cane was intensified with the establishment of the

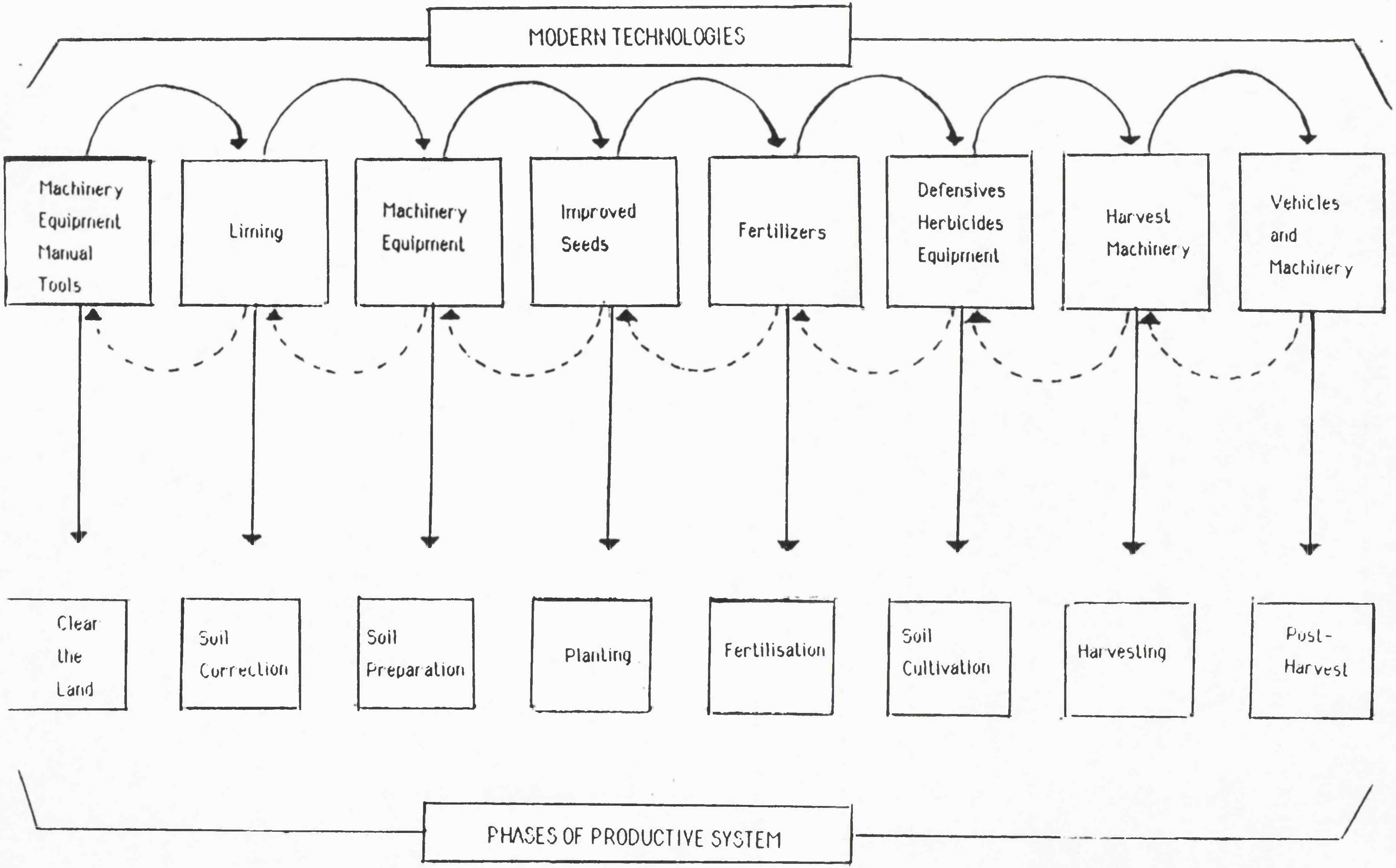
Campos Station (Rio de Janeiro) which, together with the Department of sugar cane at the Institute of Campinas, provided a substantial capacity for research. Since then, agricultural research agencies have adopted the characteristics of a caste system, according to Pastore et. al. (1976). Those who work with an export product enjoy all the best facilities, training of the highest quality, equipment and material facilities, interaction with local and world scientists, public support and professional prestige. But those who work on rice and beans are not the best qualified, recruitment and training will be local, at best, equipment and materials will be difficult to get, interaction will be limited. Their support and professional status is low. They are pariahs in the system. Economic forces during the 1960s and at the beginning of the 1970s, created a favourable atmosphere for profound change in the Brazilian research system. This system has undergone several changes, but still does not provide a research system capable of comprehensively handling agricultural problems.

In December 1972, the Brazilian Agricultural Research Company, Embrapa, was created with the aim of re-organising agricultural research in Brazil, in order to bring about its integration into the international production system. It was set up as a public corporation to coordinate and administer research on agriculture and animal husbandry. In accordance with the government act that created it, Embrapa acts like any public enterprise, open to receiving any kind of financial and human resources as well as selling its services to any type of client. Its main product is agricultural technology and its principal client is the government. It develops its research in accordance with government priorities in terms of products for export and internal consumption. Increasing agricultural productivity is its main objective. The initial task of Embrapa was to transform the general policy goals of the government into research programs geared to increasing the productivity of land and labour. Its second goal was to organise and improve the skill of the scientific and technical staff who carry out the research programs. National agricultural research became the responsibility of Embrapa with the exception of the cultivation of cocoa, sugar cane and coffee, investigations which are carried out respectively by the Executive Commission of Support for the Cultivation of Cocoa (Ceplac), the Institute of Sugar and Alcohol (IAA) and the Brazilian Coffee Institute (IBC).

The basic declared philosophy of Embrapa was that applied agricultural research ought to be guided by the 'concrete demands of society'. The carrying out of applied research with the aim of meeting immediate needs is the responsibility of institutes of technological research, while the universities take on basic research. In addition to these general principles, according to the guidelines which created the enterprise, five ideas orient its actions, according to Pastore et. al. (1976): a) the transfer of foreign technology to the agricultural sector is considered valid, though in many circumstances its importance is limited; b) due to the scarcity of human and financial resources for research activities, efforts ought to be concentrated on regional projects, which can help to overcome regional differences; c) agricultural research ought to have greater administrative flexibility, including the freedom to obtain outside resources, pay researchers a salary in accordance with the labour market and carry out a forceful training programme; d) a solid integration with the extension service and agricultural input industries, with a view to spreading knowledge throughout the country; e) knowledge of the institutions of international research ought to be adapted and diffused throughout the country. Agricultural research should strive to function by means of technological packages which can diminish the degree of risk for farmers.

The efforts of Embrapa, according to its official policy ought to concentrate on an integrative process of technology generation. This 'with the aim of technical and economic efficiency', would later be transferred to the farmers as an organic structure called 'technological packages' or a 'production system as per product'. So, the 'technological package' can be defined as the set of agronomic techniques, practices and procedures which, when articulated with each other, are indivisibly applied in farming or livestock, following the pattern established by research. In other words, according to Aguiar (1986) the technological package would be like an 'assembly line' (*linha de montagem*) where the use of a specific technology or component (improved seed, for example) requires the use of previous specific technologies or components (machinery and equipment for soil preparation, liming for soil correction) and leads to the adoption of specific technologies or further components (fertilisation and chemical protection). Thus, the success (or not) of the activity would be dependent on the complete use of the technological package. This is shown in the figure below, where each phase of production corresponds to a specific technology which is linked to one or more previous technologies (dotted lines) and one or more further technologies (solid lines) as the phases are being overcome.

Figure 3.1 Technological Package Structure: Systems as per Product



Source: Aguiar, R.C., 1986:42

Embrapa is not responsible for the performance of all research institutions in Brazilian states. As a consequence, two important roles have been defined by Embrapa. On one hand, it is responsible for creating and/or supporting the state research systems. On the other hand , it is responsible for creating and implementing commodity-oriented national research centres.

Embrapa's actions at the level of carrying out agricultural research are undertaken through national centres. These are defined in terms of national needs for the agricultural sector. The main strategy is to concentrate resources and skills in a few crops and in specific regions. Wheat, sugar cane, corn, beans and soybeans are defined as the crucial agricultural products for the country. Among the key resource areas to be developed through national centres, Embrapa has included savannah grasslands, semi-arid agriculture, and humid-tropical agriculture.

Eliseu Roberto de Andrade Alves, one of its creators gave the following description:

"Embrapa proposes to change the focus, of the relationship between developed and developing countries, from 'technology transfer' to 'science transfer'. For this reason, Embrapa could be considered an important element in the strategy for transferring knowledge in various directions between national and international institutions. These institutions must be active in agricultural research, and interested in the Brazilian experience in transferring science and advanced technology from developed to developing countries, thereby creating an indigenous scientific capacity. Only by building its own national agricultural research institutions, can a country generate appropriate technologies for its agro-climatic conditions ".

(Alves in Yeganiantz, 1984:5)

From the documents which support the creation of the institution, it can be easily inferred, that Embrapa served as a political mechanism to promote the new model of economic development as defined by the government. With respect to the relations of Embrapa with universities, the private sector and the Brazilian System of Technical Assistance and Rural Extension (SIBRATER), the principles which were formally conceived in the documents that defined the functioning of Embrapa, have not been fully applied.

The role reserved for the University in the cooperative system of research was not totally fulfilled, apart from a few notable exceptions. Under the original conception, a prominent role was attributed to it in the generation of basic scientific knowledge which would contribute to a more pragmatic orientation reserved for Embrapa. Not only does Embrapa undertake basic research, but the universities have progressively distanced themselves from the process of defining the priorities of technological research in the Embrapa system. It should be emphasised that, among the many factors which have contributed to this weak relationship, was the decline of teaching and research work facilities in the university system.

With respect to the private sector, the degree of utilisation of research results produced by Embrapa Centres by industries and agricultural industries has varied. This normally occurs in developing economies depending on the degree of participation of foreign enterprises in the sector, the degree of availability of foreign technology and feasibility of adapting this technology to local conditions.

The necessary diffusion of technologies produced ought to lead to an intense relationship between research and extension. The concept of diffusion and its practice, however, differ in both institutions. According to Embrapa, this concept is understood as the transfer of technological packages to farmers, starting with the dissemination of research results, and coming close to the idea of providing technical assistance. The diffusion of technological packages remains restricted to producers located in areas close to national centres. The work of developing extension with the farmers would fall under the realm of rural extension, involving systematic procedures.

Although also belonging to the Ministry of Agriculture, the Brazilian Enterprise for Technical Assistance and Rural Extension (Embrater) is a body with its own aims, functions and methodology, completely separate from its partner Embrapa, described above. Besides initiatives of the government, a hundred rural technical assistance enterprises exist distributed all over the country; however, all of them are affiliated to the Brazilian System of Technical Assistance and Rural Extension (SIBRATER).

For SIBRATER, rural extension is conceived as a counselling service for farmers, their families, their community groups and organisations, in the areas of agricultural production technology, rural administration, food education, health education, ecological education, co-operative and community actions. Its implementation implies residence teams of technicians linked into the above agrarian sciences in municipal or regional locations and to the social sciences, in areas where farmers work and live. Also proposed is an educational process which envisages contributing to the improvement of the standard of living of rural families by means of an improvement in their net real income, economic productivity and agricultural production. In Brazil, this is usually effected by the public federal or state sector or by the economically strongest cooperatives. Among the official institutions which carry out extension policies those linked to SIBRATER stand out .

Apart from these, Ceplac and the Secretary for Agriculture of the state of São Paulo can be mentioned. The system operates in 25 of the country's federal units and, according to Embrater's annual report in December 1983 was operating in 3,166 Brasilian municipalities, through 2,506 local offices, 199 regional offices and 25 central ones, the last based in the capitals of states, territories and the Federal District. It had a staff of 21,047 out of which 12,121 were technical staff and 8,926 administrative. The rural extensionists worked with 1,113,557 farmers, 534,626 rural housewives and 143,883 young people.

A new phase of Brazilian rural extension is beginning, in which the direct influence of the state is beginning to grow. Ideas such as 'national development' and 'agricultural modernisation' have progressively gained ground, during the 1960s. The 'extension principles' and the 'humanistc philosophy of action' of the original phase, has only been maintained on the level of rhetoric. Actions with a short-run impact are gradually taking the place of broader educational concern. Family credit (*credito orientado*) in which considerations which are not of a directly economic nature (such as housing, health, clothing, formal education, food, production for domestic consumption) are left aside, is rapidly taking the place of function-specific credit (*credito supervisionado*). The general trend is to intensify production. Extension is concentrated on production areas and products which respond most rapidly to the modernist incentives of the Federal Government and in this way the poorest farmers have been largely ignored.

A trend towards centralisation is thus evident in Brazilian extension as a consequence of the process of encouraging the production of exportable agricultural goods. The strategy followed to achieve modernisation was based on the same assumptions as those of the 'Green Revolution', which implied the massive use of modern inputs (fertilisers, pesticides, machinery, among others) as a means of increasing the physical productivity of agriculture. In this context, what became known as 'conservative modernization' was applied to agriculture. This was a set of policies which without altering the latifundiae and even aggravating the concentration of land tenure, integrated agriculture into the process of economic development, as a consumer of industrial products as well as a supplier of raw material for agroindustry in transition.

This process, beginning with the action of the State, brought about a rapid transformation of agriculture, mainly in the Southeast of the country, where apart from traditional export products such as coffee, sugar and cocoa, others such as soybean and oranges appeared. Agricultural exports grew between 1974 and 1980 from US$ 5.8 billion to US$ 10.2 billion; the area planted to soybean expanded from 200,000 hectares in 1960 to 8 million hectares in 1980, and that under sugar-cane grew between 1971 and 1986 from 1.7 million hectares to nearly 4 million hectares. In the period from 1964 to 1979, the productivity of the fifteen principal crops grew by 16.85 per cent while the consumption of inputs increased by 124.3 per cent for chemical fertilisers, 233.65 per cent for insecticides, 584.5 per cent for fungicides, 5,414.2 per cent for herbicides and 389.1 per cent for tractors. At the same time, the real price of land in the country went up

3.65 times between 1966 and 1981 (Lombardi et al. 1986).

Rural credit played a central role among the tools of economic policy adopted by the government to make the modernisation of agriculture viable. Extension workers, committed to making agriculture fulfil its 'functions' in the national development, were always very keen to follow the capitalist orientations of federal and state governments. Rural credit, known as technical credit, became their primary tool. In this manner it contributed to the process of concentration of income, wealth and power, which was developed in Brazilian society as a whole as well as in rural areas.

Social inequality was the most constant characteristic of the process and pace of modernisation, which occurred with greater intensity in the South and Southeast regions, especially in the areas of export farming. Changes in work relations led to partial and precarious payment of wages, by virtue of the increase in seasonal labour and in monocrop farming in various parts of the country. Apart from this, the model of modernisation made the agricultural sector highly dependent on the industrial urban sector and on the importation of raw materials for the over-use utilisation of modern inputs. The unequal nature of the process also made itself felt with respect to products themselves. While the subsidy and minimum price policy favoured exports, products destined for the local population were penalised. So as not to worsen the situation of the working class, already a victim of a wage squeeze, food products with their demand also reduced, had their prices frozen for long periods, with the result that their production did not keep pace with growth in demand.

In 1975, with a view to restructuring rural extension, Embrater was set up. Embrater tries to achieve a synthesis between 'productivist' and 'humanistic' lines. On the one hand, the diffusion of agricultural and management technology stands out as its primary goal. For this aim, it is linked even more intimately to systems of rural credit and agricultural research (Embrapa) developing 'technological packages' in conjunction with the latter. On the other hand, it places among its aims 'the promotion of farmers with low incomes'. To reach this aim and emphasise the line of work as one of adapted technologies and the domestic economy, the factors of pressure from the World Bank, the political opening of the country and the economic and social crisis contributed. From 1980 onwards, the principles of Embrater were redirected.

The concept of extension was rethought inside Embrater, beginning with the meeting of all the directors of rural extension services in Latin America, held in Tegucigalpa, Honduras in July 1984. The following was defined at this meeting:

"Rural Extension is a process of education and training of a permanent character which is characterised by the permanent and reciprocal interaction and communication of technicians with farmers, their families and their organisations. The objective of this process is to obtain through participatory means an understanding of agricultural problems, as much at the level of the unit of production in an individualised form as at that of communities and agricultural regions where farmers are located; the selection of the best solutions to these problems, with an emphasis on the utilisation of resources existing in the means itself; the holding of training programmes which emerge from these analyses and the permanent evaluation of the process".

(Embrater-PRESI/ASCOM,1986:11)

In 1986, a new target plan for 1986-1989 based upon these principles was published. It was hoped that, in view of the failure of the accelerated economic growth model (the so called Brazilian miracle), a government policy in favour of the disadvantaged sectors would open the way for extension workers, society and political leadership to find alternatives solutions for farming.

However, the expected changes in the political context which would favour these ideas did not come about with the new government. This led to the extinction of Embrater in 1990. Under the programme of cuts in public expenditure and in order to improve the efficiency of the state apparatus, the Collor government abolished SIBRATER. As a consequence, Embrater was also closed down in 1990. The extension service has been transferred to the States under the policy of working with farmers' representative organisations such as cooperatives, associations and trade unions. However no specific agricultural policies for small-scale farmers were formulated.

Concluding this topic, the logic of the National System of Agricultural Research can be understood as an instrument for encouraging the model of agricultural modernisation adopted by the government. As such, it is associated with other instruments of state intervention in the agricultural sector: the Brazilian System of Technical Assistance and Rural Extension and the National System of Rural Credit. Those bodies were set up and gravitated around the so-called technological package already described. The National System of Research was responsible for the generation (or adaptation) of the technological package; technical assistance and rural extension, for its diffusion to the farmers; and rural credit for its financial support. This integrated mechanism adopted by the state, envisaged the modernisation of Brazilian agriculture to make it able to compete in the international market. Thus, it was a top-down research strategy directed at large producers, expected to produce significant results in a short period of time, utilising an expensive technology.

2. IAA-Planalsucar's Research

Since the time of its introduction in Brazil at the beginning of colonisation, sugar cane has had a prominent place in the Brazilian economy. The industry developed very rapidly and cultivation expanded on a large scale using slave labour and a rudimentary technology. This situation lasted for centuries, concentrated principally in the Northeast, where there was an abundance of land and slave labour. Research for sugar cane breeding/improving and diffusion of technology have been important in increasing productivity. A superior variety of sugar cane (*Caiana*) was imported from French Guiana in 1810. Initially this variety had several advantages over the more common variety (*Crioula*): a short maturation period, greater resistance to climatic instability and easy industrial processing. However, in the middle of the nineteenth century, it was affected by Gomose disease (*Xanthomonas vascularum*), which reduced its production in the country drastically. The response to the problem was to import other varieties of Java, and for the first time use a variety native to Brazil, *Cristalina*. This concern with the introduction of new varieties ran hand in hand with the adoption of new agricultural practices, including the introduction of mechanisation and the use of organic fertilisers, using the bagasse from sugar cane and other plants.

For a long time, there was a predominance of arbitrarily introduced traditional varieties putting at risk sugar cane farming because of the incidence of diseases, owing to the vulnerability of those varieties and the absence of plant health controls (control of pests and diseases). Suffice it to mention that an illness called mosaic attacked the canes in the 1920s (over 90 per cent loss of production in São Paulo) leading to the collapse of the sector. Owing to a lack of support of an all-embracing research program in sugar cane, the traditional varieties were gradually substituted by other less productive ones and/or with a low sugar content, resistant to mosaic but as yet without adequate plant health controls.

Sugar cane research was intensified in the twentieth century, especially after 1930, when crises in the international market begun to force the producers to obtain better quality and higher productivity. Initial research work was set up in Campos (Rio de Janeiro), with the aim of developing the breeding of Javanese varieties ('POJ') and the creation of a new national one ('CB') - Campos/Brasil. These varieties resolved one of the main problems, that of providing a greater resistance to existing diseases, especially mosaic (*Marmor sacchari holmes*). The CB variety also offered a high sucrose content. In 1935, the sugar cane department was created in the Institute of Agricultural Research in Campinas (São Paulo), which together with the Campos station showed a considerable capacity for research into new varieties, plant spacing and density, cultivation practices and the use of fertilisers as well as for the construction and maintenance of modern sugar factories. The research group was small but of high quality. Its efforts were much appreciated by large farmers and industries, and consequently by the researchers who were capable of carrying out their experiments on the farmers and quickly obtaining feedback from them. Interaction and continuing research were guaranteed and had an important role in transferring technology to the sugar cane mill farms which took their specific problems to the researchers.

Since research in Brazil, principally agronomic, was almost always relegated to a secondary plane, various sugar cane research bodies created over time had an ephemeral existence, becoming extinct before producing any results. The exceptions were the Experimental Station at Campos and the Cane Section of the Agronomic Institute in Campinas, already mentioned, which had an important role in the introduction of foreign varieties (Co, CP, B, POJ) and in the cross-breeding and selection of new varieties (CB and IAC-Agronomic Institute of Campinas) which succeeded in achieving wide acceptance in the producer environment and still today play an important part in sugar cane production in Brazil.

Before the research into crop variety, plant spacing, cultivation practices and the use of fertilisers, the state of São Paulo produced less than 15 tons a hectare. After five years of research work, productivity practically doubled. Around 1943-1947, the state was producing 43 tonnes per hectare. The gains continued until the beginning of the 1960s when 100 tons a hectare was reached. Today with the research system, the fertile soils are being fully utilised and the savanna soils are now beginning to be cultivated. To meet the nutritional requirements of these poor soils, the research sector is developing a new line emphasising the use of fertilisers, irrigation, climatology, sucrose content, entomology, phytopathology, with special attention to the borer *Diatraea sacharalis* (sugar cane pest), and the ratoon stunting disease (disease caused by virus).

The agroindustrial character of sugar cane has meant that the large farms and industries are always involved in research. New varieties were directly tested by the private sector which, in exchange, gave feedback to the research stations. In 1963, the irregularity in research activities motivated the Cooperative of Sugar Cane Mill Owners in the State of São Paulo (Copereste) to set up a structure which envisaged importing foreign varieties and beginning a programme of breeding and selection, with the purpose of widening the range of options for the commercial planting of sugar cane. This structure was later incorporated by Copersucar, today the most modern and strongest cooperative of sugar cane mill owners, which not only provides information to the research agencies but has started its own line of research with encouraging results. A little later in 1968, the Sugar Cane Experimental Station in Alagoas was created. In this way, in Brazil, lack of support led sugar cane research to act in an intermittent way, preventing the obtaining of continuous results which would allow effective progress, principally of agricultural technology. On the other hand, the main producing countries have had research programs established for almost a century without a break, as for example those located in Java (1891), Barbados (1889), Guyana (1889), Hawaii (1904), India (1912), Florida-USA (1918) and South Africa (1928).

At the start of the 1970s, the international sugar market indicated that, in the medium term there would be a clear tendency towards buying with good prospects of increasing production quotas. This tendency, allied to the glimpse of a solution to the energy crisis by fuel alcohol derived from sugar cane, stimulated an intensification of discussions on the deficiency of research to support the modernisation of the agroindustrial sugar sector. It was these discussions, in which government sectors and private enterprises took part, that led to the decision that it was necessary to create institutionalised technological support for the sector, according to the government logic for development of agriculture. As the government already possessed an institution directly connected with the problems of sugar cane, sugar and alcohol, the Sugar and Alcohol Institute (IAA), this was the most suitable body to take up a programme of research. In 1971, the technicians of the Division of Production Assistance of IAA, gave a final form to the studies which they had been carrying out over the years on the necessity of setting up in the country an enormous programme of sugar cane breeding and selection with the aim of strengthening the sugar cane economy.

The policy statement said the following "studies have been made by the technical team of this division with the aim of providing satisfactory and necessary means for the development of agronomic research on sugar cane which is still highly deficient in Brazil" (Azzi,1971). This envisaged the development of a broad, viable work programme, with the aim of providing better conditions for carrying out the research deemed indispensable to the improvement of production in the sugar agroindustry. The main problems of the sector in the country at that time were defined in the statement;

-a lack of financial resources for research adequate for dealing with the necessities of agroindustry;

-a lack of the availability of financial resources for research at the required time;

-a lack of highly trained technicians to guarantee the continuity of knowledge;

- a lack of objectivity in the plans;

- a lack of long-term planning;

- a lack of uniform methodology, so that the few results obtained made comparisons and generalisations impossible and limited the possibility of any wider replication.

In August 1971, the National Programme for the Breeding of Sugar Cane (Planalsucar) was set up through an agreement signed between the IAA and the producers, (represented by sugar industry unions of São Paulo, Minas Gerais, Rio de Janeiro and Pernambuco and the Federation of Brazilian cane farmers) with the following objectives:

I-The creation of varieties of cane adapted to the country's different ecological zones which would facilitate greater agricultural productivity and a higher income for the industry as well as greater resistance to diseases and pests;

II-The introduction, with rigorous quarantine techniques, of varieties coming from other regions, national or international, with the aim of improving the germplasm used in cross-breeding and its possible commercial use in large-scale farming;

III-Establishing of a corresponding infrastructure of agricultural experimentation, based on the most modern techniques of research and administrative organisation, giving priority to the utilisation of physical, financial and human resources.

The IAA-Planalsucar (which belongs to the Ministry of Industry and Trade), begun to follow the same policies which inspired Embrapa's creation as well as the whole Brazilian agricultural research system. From its creation until 1975, IAA-Planalsucar made use of five experimental stations located in traditional sugar-producing areas in the states of Pernambuco, Alagoas, Rio de Janeiro and São Paulo (see appendix three). With the setting up of Proálcool the capacity for expanding areas traditionally producing sugar cane showed itself insufficient to meet the projected demand for alcohol. This fact led to the incorporation of new agricultural areas to the productive process, confirmed by the addition of new entrepreneurs and rapid expansion of cane into regions where, until then, this crop was practically non-existent.

With this expansion in the cropped area, various problems became more evident with the shortage of technological information about the cultivation and processing of sugar cane, the lack of management experience on the part of the new entrepreneurs, the scarcity of qualified manpower for the sector and the difficulty of obtaining specialised technical assistance. It became necessary to widen the scope of IAA-Planalsucar with a view to supporting technically the increased area occupied by the farming of sugar cane in the country. By 1981, IAA-Planalsucar had 23 experimental stations. This institutional growth has also brought a series of questions in relation to its primary objectives. It is evident that the new 'clientele' in the areas of expansion, lacking a tradition of sugar cane cultivation, has begun to demand more of the Institution.

From 1979, attempts to redefine its guidelines and strategies began to emerge, until in 1983, IAA-Planalsucar was defined as a body for the generation and diffusion of technologies (IAA-Planalsucar, Annual Report, 1984). With the General Superintendency in Piracicaba-São Paulo, by 1987 there were five coordinating centres. These centres which include the 23 experimental stations, mentioned above, have their headquarters in the following locations: the Southern Regional Coordinating Body (COSUL), Araras-São Paulo; the Eastern Regional Coordinating Body (COEST), Campos -Rio de Janeiro; the Central Regional Coordinating Body (COCEN), Ponte Nova - Minas Gerais; the Northern Regional Coordinating Body (CONOR), Carpina-Pernambuco; and the Northeastern Regional Coordinating Body (COONE), Rio Largo - Alagoas (see appendix three). It relies on 250 researchers (higher level technicians) and 923 medium level ones, developing activities of the generation and diffusion of technology according to the 'technological package' strategy, developed also by Embrapa.

The Research includes the following areas: breeding and selection, agronomy and industrial processing. Each one with its specific aims leading to a compartmentalisation for better results.

I - Breeding and Selection

Among the activities in this area, the following were important:

- Obtaining new varieties of sugar cane, better adapted to the edapho-climatic conditions of the various sugar cane cropping regions of Brazil, resistant to diseases and pests and with a high agricultural productivity and industrial profitability. By 1983, 10 RB (Republic of Brazil) varieties have been disseminated;

-Variety Management, comprising studies of behaviour of the varieties in different edapho-climatic conditions of cultivation, and those resistant to diseases and pests. The results obtained have allowed the indication of varieties for cultivation , especially in the new areas;

-The production of healthy setts and checking of producers' seed-beds, to guarantee a supply compatible with national targets;

-Tissue Culture. In the laboratories, studies were being carried out in this area, principally with respect to the technique of obtaining of plantlets from callus and the micropropagation of sugar cane from meristem culture method;

-The production and spread of natural enemies of sugar cane pests through biological control and the assessment of sugar cane mills and distilleries in their setting up and in the running of their laboratories.

II - Agronomy

The principal activities developed in this area were:

-The utilisation of residues from the production of alcohol, such as vinasse which has a high polluting capacity but high mineral and organic richness. The application of natural vinasse in sugar cultivation through ferti-irrigation has been an important alternative in place of mineral fertilizer, leading to a rise in agricultural productivity. Besides this, it has contributed to the reduction of pollution of water resources and an increase in the longevity of the culture.

-Sugar cane and production of food and fiber. This project contributes to the raising of the food supply, increasing net farmer income, minimizing the problem of seasonal employment of the workforce in the sector and providing a more adequate utilisation of the soil;

-Analyses of soil and recommendations for sugar cane fertilisation;

-The production and testing of models of machinery and agricultural equipment which improved conditions for the cultivation, harvesting, loading and transport of sugar cane;

-An edapho-climatic analysis of the sugar cane regions of Brazil, systematising environmental information, with an emphasis on soil and climate and defining the existing limits to sugar cane cultivation.

III - Industrial

In this area, IAA-Planalsucar was carrying out the following activities:

-The implementation, coordination and prioritisation of the Payment of Sugar Cane According to Sucrose Content (PCTS) in the whole country. This system is based on a quantitative evaluation of the cane according to its sucrose content and purity of juice, giving the farmers a fairer remuneration;

-The technology of non-corrosive alcohol production. By means of a technical cooperation agreement, studies were being carried out to eliminate the corrosive agents of alcohol at source;

-The selection, multiplication and distribution of yeast for alcoholic fermentation;

- Studies on the utilisation of residual yeast from the 'vat bottom';

- Studies on the use of the bagasse of sugar cane , both in animal feeding and the production of electrical energy, for use in the industry itself and in the public electricity network in the case of any surpluses.

The activities of technological diffusion in IAA-Planalsucar were first carried out only in Alagoas (when it was established) through a modest sector of rural extension which had a short life span. Then, the sugar cane research became closed in itself, in a elitist pose, waiting for the governmental extension service to spread its findings, according to the 'technology package' approach. This brought about serious consequences for the farmers, which will be discussed below.

To minimise those consequences, attempts were made (without much success) until a specific area of technology diffusion (discussed in detail in Chapter V) was created in 1983. This area envisages the transfer of information, discussing the technological solutions to the problems experienced by farmers, so that the productivity and profitability of cultivation can be increased, reducing costs and improving the social and economic condition of the farmers.

All the work is developed through 'multiplying agents' (*agentes multiplicadores*) who were the technicians linked to farmers organisations and the official bodies of rural extension and technical assistance with which IAA-Planalsucar maintained agreements of cooperation for the development of Strategic and Participatory Projects of technological diffusion. In an attempt of verify the validity of this participatory approach in practice, a Pilot Project was established and it was implemented in two representative Brazilian sugar cane regions. This project became feasible and generated a national plan, the 'Three Year' Plan for Diffusion of Technology for Sugar Cane Agro-Industry Resource-Poor Farmers-1984/86. The performance of these projects forms the central focus of this thesis. Through this experience, despite the adverse overall context which was previously discussed, an attempt was made to minimize the oppressive consequences of the agricultural 'conservative modernisation' policy in

Brazil.

From 1986, the IAA-Planalsucar began to experience increasing difficulties. When the agreements to develop the plan came to its end, the projects either stopped or were taken over by farmers or their organisations. In 1988, the government decreed the transference of IAA-Planalsucar to Embrapa. However, this did not happen in practice as only the budget for sugar-cane was under Embrapa management. The personnel were still under the tutelage of IAA until 1990, when the government decided to close it. Research in sugar cane, already stagnant, finally stopped. In January 1991, the researchers with tenured posts were transferred to universities all over the country. The sugar cane research situation itself is still undefined.

3. Policy Implications and Consequences

The primary concern of this section of the study is the critical analysis of the consequences of the policies employed by Brazilian extension and research institutions in the rural sector for the disadvantaged farmers. These institutions function as independent bodies, having no links nor common objectives. Furthermore, these bodies and their policies were created to stimulate and organise agricultural production along the modernisation line embraced by the government. This fact has generated a series of negative consequences for any comprehensive development effort.

As was pointed out in the previous section, research in Brazil has been systematically directed mostly to cash crops for export. The technocratic approach promoted after 1964 had a bearing on planning, technical rationale and technical efficiency. This inspired the establishment of a governmental research body which embraced agricultural technology as its principal function.

It is said by Embrapa that the generation of technology should be incorporated into the production system, a statement that presupposes a complete submission of the production system to the designs of government and research.

"Since resources are scarce, it is necessary to limit the number of production system prototypes developed and the number of commodities researched. Clearly, priorities must be established, but this means that some groups of farmers may not receive the benefits of research .... It may be difficult to develop systems of production adequate to the needs of the small farmer who combines various enterprises in his operation".

(Pastore in Yeganiantz, 1984:125)

This is clearly indicated in the emphasis given to the whole mechanism of formulating technological packages, which stresses economic and technical efficiency. These packages ignore the economic and social realities of the individual small farmer who, generally, on embarking on such projects does so without any real understanding of his actions but rather is carried by the persuasive pose of those who 'know' and have the 'technical know-how'.

"The 'package' effectively diffused was more the result of action on the part of large enterprises, producers of fertilizer and agricultural machinery available on the market, than a result of the recommendation of institutional research ".

(Naidin and Castro,1985:10)

Embrapa sensed that 'something' was wrong but, due to its tendency to look for technological excellence through narrow specialisation, using the methodology designated as the 'ideal process of the production of knowledge', it did not reformulate its model in a way adequate to the context of disadvantaged farmers.

As a result of the political and institutional context in which the Brazilian researcher finds himself, he has been concerned with the writing of scientific papers (reflected in a veritable 'paper chase') and taking part in scientific events, because, he is also judged on the basis of technical excellence. In spite of the fact that it has already been stated by the institution itself (in the Socio-Economic Evaluation Programme of Agricultural Research of the Project II - Embrapa/BIRD-Brasília-DF,1982) that this 'excellence' does not itself guarantee the adoption of technologies by farmers. The technologies produced through this elitist policy of research cannot be adopted by disadvantaged farmers precisely because they do not respond to their explicit needs. There is realistic definition of the problem to be researched. Moreover, farmers do not participate in the process of technology generation. It can be concluded that a strong reason for the existence of this situation in which agricultural research in Brazil find itself could be a direct consequence of the guidelines of an agribusiness biased-policy, stimulated by the government.

As already mentioned, one of the most serious implications of the political strategies used has been that the technologies generated by research are not adopted by the farmer because they do not respond to his needs. On the other hand, at the level of discourse, more emphasis is given by extension to improving the standard of living of rural populations and to the educational characteristics of extension action. However, in reality, has been a vehicle for the transfer of technology fulfilling the role of interpreting, demonstrating and stimulating the farmer to adopt technology recommended by research according to a clear line of persuasion. The process of adoption itself with all its implications, stimulated no interest, and monitoring and evaluation were not carried out.

Government activities had been restricted to the:

"training of technical personnel by means of the formal teaching of agriculture, research, experimentation and the promotion of agricultural production. This was without taking into account the farmer as the direct beneficiary of these activities, which were limited to its own subjects with no interplay with the others. Technical knowledge was not transferred to the rural area, nor did the work of motivating the adoption of new methods of action and gaining better living standards become a developed practice".

(Araújo et al, 1984:12)

The paternalistic nature of the promotion activity gave:

"a privileged minority access to a more advanced technology in the period, items such as selected seeds, machinery and implements, brood mares from government and varieties of inputs. It was a system that lacked dynamism in which farmers of greater influence were favoured by immediate service on seeking the service centres located in the towns".

(Araújo et al., 1984: 12)

President Kubitschek said: "our economy is being transformed from a predominantly farming stage to the stage of intensive industrialisation when an transition takes place from cottage industry to basic industrialisation". Economic expansion thus determined the modernisation of agriculture in relation to the establishment of specific industrial sectors - fertilisers, crop protection and machinery - and the presence of financial capital through the modernisation of rural credit. This Brazilian agriculture industrialisation process has, according to Graziano da Silva (1981:46), a double meaning: "the elevation of the technical composition in agricultural production units and the subordination of the agricultural sector to the interests of financial and industrial capital".

The prevailing idea was that research should promote the advance of knowledge but that extension should set it going, making 'progress' advance. It thus fell on the Government to support and strengthen rural extension as an 'educative' system with the aim of motivating and inducing the farmer to adopt 'rational' practices and obtain a larger income. In this way, barriers arising out of traditions, customs, apathy, ignorance and scepticism would be overcome, creating a 'progressive' mentality in agriculture. The innovation of modern technology would provoke social change.

As a consequence of this working philosophy, the technologies diffused by extension came to be rejected by small and medium-size farmers since these did not meet their concrete needs. Thus, the small and medium-scale farmers were forgotten - in accordance with the diagnosis made in 1979 by SIBRATER. Their production declined and, consequently, so did their living standards. The SIBRATER study also tries to clarify what happened in the agricultural sector in the 1970s, during the 'Brazilian miracle'. The whole effort was concentrated on production of agricultural export products which led to an economic enrichment of Southern Brazil, where the large cash crop producers are situated, and an impoverishment of the Northeast region, essentially a producer of subsistence crops. Then, as we saw in the first chapter, eighty per cent of food production was in the hands of small and medium scale farmers located for the most part in the Brazilian Northeast. The consequences of policies used by the extension services and research institutions could be better understood by considering three interlinked areas: the political, the social and the technological.

The claim that the extension worker and researcher should be apolitical was an illusion of neutrality which alienated sectors of the rural population. Under the flag of 'neutrality' the technician had to defend the government, implement and side with its agricultural policy, and not discuss with farmers state action with respect to land, prices, interest, and insurance, among others. The socio-economic reality of the municipality or region continued to be an unknown entity for the farmer and was never discussed in his associations, unions, cooperatives and communities. Researchers and extension workers tried to persuade the farmers of the benefits of agricultural policies or of the priority nature of the technological proposal for improving socio-economic conditions. They did not question the farmers about their reality, did not carry out analyses with them, did not undertake research together, did not evaluate or have a high regard for consequences in an open dialogue. The farmer completely ignored the fact that decisions about credit, the financing of production, prices, imports and exports, contributions and technologies, did not have equal consequences for everyone. He would embark on them blindly, not knowing how to carry them out.

They remained equally remote from the fact that state policies can only be understood or analysed in terms of the relations of social forces, pressure and strategies of different sections of society. There was a lack of frank and open debate between the researchers and extension workers and the sections of society acting in the rural area, which would favour the association of groups with common objectives. This would have increased the capacity for action of the group and helped to resolve their problems.

There was no stimulus or support for the association of rural groups that sought common aims. There were no associations that were totally free of the guardianship of technicians. The researchers and extension workers did not support this type of grouping as a form of struggle, by furnishing such associations with correct information about study, policies, research, technical experience and other items. Thus, these associations, cooperatives, unions, groupings and community institutions ended up meeting only the aims of the government and of some privileged minorities, the disadvantaged farmers remaining outside the process.

The concept, steeped in authoritarianism, which presents the extension worker as an 'agent of change' or 'agent of development' presupposes in essence that he has a deep understanding of social reality and knows how to change it. At the same time, it denoted the detachment of the extension worker from the process of change itself. It was up to him or her to motivate, persuade and orientate farmers to carry out the changes. These ought to, in the end, be made by the farmers themselves who would shoulder their consequences often without fully realising what the changes entailed.

Horizontal and vertical centralisation led to decisions at a higher level without any participation by farmers, or above all their associations and organisations. In isolated cases, when there was a participation of commissions and councils, these merely represented an already approved and symbolic case. The programme controls and schemes which authoritarianism and centralism imposed to achieve uniformity and standardisation thwarted creativity. The descending flow of information down the administrative ladder consisted of impositions, guidelines, demands and control. On the other hand, the technical staff, often highly specialised from the technological point of view as it mentioned before, did not possess the ability to analyse social situation, nor did they have experience in non-authoritarian educational methods. The technical teams were not multidisciplinary in a balanced way, with professionals from agrarian and social sciences. This did not allow a proper consideration of viable operational alternatives nor a better understanding of the technological question .

The myth that scientific or technological knowledge is something which stands firm, is socially neutral and ethically good has led researchers and extension workers to the deeply-rooted belief that science, technology, modernisation, economic growth, development, production and productivity are necessarily instruments of social welfare. This insufficient consideration of the technological question has led to the belief that poverty can be overcome with new technological knowledge and new skills to be 'given' or 'taught' to the farmers by people, groups and institutions. The adoption of new technology as a simple psychological process, an essentially individual one, through which a person freely believes in the 'new' as a saving solution to all problems. The practice of the model of making agriculture more technological ('*tecnificação da agricultura*') which has prevailed in Brazil over the last thirty years had led to disastrous consequences. The greater physical yield of a productive factor or the larger initial revenue often meant depredation of non-renewable resources, waste of energy, increase in risks, loss of autonomy and even the ruin of many farmers. Agricultural research and rural extension did not assume that the process of generation and diffusion of technological research ought to begin and end with the farmer, as the subject of actions. Thus, these policies did not touch upon the concrete reality of the farmer, aiming at an improvement of his living conditions.

However, the basic premise of this thesis is that agricultural research, must be approached with a clear understanding of the economic and social context, with clear objectives and with a clear conception of the link between research and policy. Research ought to be determined by the concrete needs of the farmers in conjunction with them. A farmer participation approach is proposed in this study, based on IAA-Planalsucar's empirical experience, which will be described in the next section. Through this, it is hoped to be able to make suggestions which would enable agricultural research, especially in sugar cane, to act in such a way as to minimise the technological problems of the disadvantaged in order to maintain them as a productive force.

Chapter IV - The 'Three Year' Plan for Diffusion of Technology for the Sugar Cane AgroIndustry's Resource-Poor Farmers - 1984/86.

1. General background

From its foundation until 1977, IAA-Planalsucar underwent a period of organisational restructuring, and of technical staff training. Because of the needs of the institution, this period was marked by a preoccupation with technical excellence. Another detail to be considered, and one which caused great criticism, was that all agricultural experimental work was carried out in areas belonging to the sugar cane mills (*usinas*) and alcohol distilleries. This policy was justified on the grounds of the cost of setting up the experiments, like their transfer from these areas, which could only be sponsored by the sugar-cane mills and distillery owners. Thus, owing to its close ties with the sugar and alcohol producers (*usineiros*), IAA-Planalsucar was accused of catering for a only minority of interests.

In 1978, IAA-Planalsucar began to come under pressure from farmers seeking solutions to their problems. This was due in the main to the expansion in land area turned over to the cultivation of sugar cane, which in turn was due to the creation of *Proálcool*. The majority of farmers from these areas of expanding sugar cane cultivation did not traditionally cultivate cane. At the same time, farmers from traditional cane-growing regions began to demand the new Brazilian varieties. Another factor which played a role in sparking off this external pressure was the referral of farmers approaching the national extension service (Embrater) seeking information about sugar cane, to IAA-Planalsucar. Embrater felt that, as there was a specialised organisation dealing exclusively with sugar cane, it had no business getting involved. For its part, IAA-Planalsucar replied that, since it was an institution for applied research, technical assistance and/or rural extension were not its job. In short, this phase in the life of this institution was characterised by a search for space and a clear rôle in sugar cane research. This, therefore, explains its early alliance with those most likely to make this desire a reality, the scientific community and *usineiros*. This behaviour was the result of the modernisation ideology in which IAA-Planalsucar was immersed.

In the following year, 1979, a serious questioning of the prime function of IAA-Planalsucar arose from within the institution. Its role in minimising the production problems of the farmers was challenged at the same time as its relationship to medium and small-scale farmers, the resource-poor farmers, was being re-examined. The question was clear: were the institution's original objectives being met? From this arose the first attempts to take IAA-Planalsucar to the farmers. 1980 saw the formation of the Co-ordinating Body for the Provision of Products and Services (*Coordenadoria de Fornecimento de Produtos e Serviços* -COPES), for this purpose. The model for this body was borrowed from the United States' industrial technology transfer model. Unsurprisingly, the structure proved to be unworkable in its new context. Despite this failure the initiative behind this remained a precursor for the actions which followed.

This problem continued to trouble the institution until it was realised that what was needed was a means of including all the technical components involved directly and indirectly in sugar cane agroindustry to participate in an integrated fashion. It was on 16 July 1982 that IAA-Planalsucar set up a meeting of all technicians in Araras, in the state of São Paulo, who were involved in the sugar cane agroindustry in that particular state. In this meeting, 78 technicians participated, representing the following governmental and non-governmental organisations: municipalities, universities, research, extension, sugar cane mills and alcohol distilleries, farmers' co-operatives and unions, manufacturers of farming inputs and banks.

São Paulo was chosen for strategic reasons. The headquarters of IAA-Planalsucar was located there, and this particular region was responsible for the highest concentration of sugar cane, sugar and alcohol production (40%) in the country. At this meeting, in an attitude of self-examination and of recognition of past mistakes, the failure of research and/or adapted technologies to reach the resource-poor farmer was discussed. The initial concern was to solve the IAA-Planalsucar's problem, but as discussions developed, the debate broadened to involve a concern for meeting farmers' concrete needs, with the participation of the farmers themselves. The institutions would be jointly responsible, while their identity would be preserved. For example, if a particular problem had a strong social origin the municipality, extension service and/or co-operative or union would be responsible for that particular action. If the problem were of a strictly technical nature, then research institutions and/ or the universities and/or the agricultural department of the *usinas*, and so on, would be involved, without at any time weakening the integrated nature of the action. Another important point made at this meeting was the priority attached to the technological component as being the main instrument of intervention.

It must be underlined that this meeting was a landmark event for the country's sugar cane agroindustry since, for the first time, the institutions involved in this sector, through their personnel, were able to formulate integrated action with the aim of solving the mainly technological problems of sugar cane growers. The meeting defined two strategies for action: direct and indirect. The latter was to take the form of monthly meetings of all the members of the technical community with the aim of discussing, in a critical manner, current day-to-day technical problems. It also aimed to coordinate the language and technical recommendations for farmers, within a participatory approach. There would thus be no room for the 'expert', that is the researcher or lecturer would not be allowed to dominate in the area of their specialisation; there was a free exchange of experiences among all the technical personnel present. The items to be discussed would arise from the group itself. This plan of action was considered to be indirect as it did not include the actual farmer. IAA-Planalsucar would begin to understand the farmers' situation from the technicians who worked directly with them. This proved to be beneficial, as this feedback started to influence the selection of research topics.

Direct action for resource-poor farmers was defined by the technical community present at the meeting, involving researchers and extensionists. Large-scale farmers and *usineiros* should not participate owing to their privileged access to private technical assistance. Bearing in mind that there had not yet been any successful experience in working with disadvantaged sugar cane farmers, the technicians unanimously decided to take direct action through pilot projects, which as they themselves stated, would be a 'research laboratory'. The other decision taken was that, from that moment on, the technical community present would have the final say in the decisions to be taken concerning direct action, instead of the institutions which employed them. Progress should be reported to the technical community for approval by the entire meeting.

1.1 Pilot Projects

1.1.1 Organisation

Two sites which were representative of the cane-growing regions in São Paulo, Piracicaba and Ribeirão Preto, were chosen for the implementation of pilot projects. The criterion behind these choices was that they should offer contrasting examples of medium and small scale farmers with regard to size of farm, land use, land productivity and technological know-how. In other words, social, cultural and economic background and technical knowledge and skills, were very different. Piracicaba was representative of those resource-poor farmers with the lowest production and technological levels in the state, with a concentration of small landholdings and properties, relying mostly on the family unit as its source of labour. On the other hand, Ribeirão Preto, while at the same time containing small and medium-sized farmers, tended to have a higher level of technology (exemplified by the virtual absence of smallholdings) and a higher average level of agricultural income, rarely relying on the family unit as the main labour source.

For each site a working group was elected by the technical community at the Araras meeting. This group would attempt to establish a methodology for integrated action, with the assistance of the farmers, with a view to attending to the needs of sugar cane resource-poor farmers. Each group, or team, would contain members from each of the participating bodies: research organisations, university, extension services, sugar cane mills and distilleries, farmers' cooperatives and unions. Within each region, each work team selected or defined a community within which the pilot project would be carried out. The selection of the community in question followed the principles of uniformity. This meant that all the farmers in the community, in a very general way, possessed a similar socio-cultural, economic and technological background, shared the same needs, and had common problems and aspirations. The work teams would select, from their own numbers, two technicians for direct involvement and contact with the communities. The criterion for their selection was previous experience with rural communities, irrespective of the approach used. Usually, these persons tended to be technical personnel from the *usinas*, co-operatives, unions, and /or rural extension.

Their first recorded meetings took place on the 25 of October 1982 at the Costa Pinto *usina*, for the Piracicaba team, and on the 26 of October 1982 at the Guariba Union, for the Ribeirão Preto team.

1.1.2 Development and Strategy

The guideline for all integrated action was:

"The identification of technological solutions to the problems identified by the sugar cane growers, attempting at all times to respect their socio-economic and cultural context, in such a fashion that they are then able to raise their productivity and profitability of their agricultural labours while at the same time reducing their costs and improving their socio-economic standing. This takes place in the participating organisations, through the work teams, in attempts made to raise the level of consciousness regarding the need for integration in order to formulate an alternative approach which begins with the identified concrete needs of the farmer".

(IAA-Planalsucar, 1984:84)

On the level of strategies for action, the following points were fundamental to the project:

-"action to deal with what are really felt as problems, by the farmers, problems which can be solved by means of adaptations or changes in the farmer's production systems with their active participation;
-acquisition of an understanding of the local/regional situation, in which the work team would permit action and interaction with the farmers with a view to identifying, in a joint fashion, the concrete needs of the farmers;
-integrated action with bodies representing sugar cane, sugar and alcohol producers, providing support and training to their technical teams and guidance in the development of a participatory approach;
-the inclusion of the entire technical community, be it cane growers' co-operatives and unions, mills, distilleries, NGOs and/or government organisations playing a part in the provision of technical assistance and /or extension, in such a manner that these bodies become effective vehicles for the work in question;
-integration with Planalsucar's, and related entities' (universities and EMBRAPA) research programmes, allowing the selection of appropriate technologies capable of meeting the farmer's requirements; and that the identification of problems in the production systems be a joint exercise between farmer and researchers; the aim of the above is the creation of space for research to elaborate its own project portfolio with farmers' participation;
-priority to be given to activities to be carried out with sugar cane resource-poor farmers;
-the creation of opportunities allowing the farmers and technical personnel, working alongside them, to develop a critical awareness of their own realities and that of the institutions with which they are involved;
-continuous evaluation of the integrative action through a process of participation (farmers and technicians), the objective of this being the improvement of the process and a guarantee of its efficiency and

effectiveness".

(IAA-Planalsucar, 1984:84)

The project was implemented through a series of open meetings at two levels, that of the work teams and that of the field technicians with the farmers. At these meetings the main concern was how to provide the participants with opportunities to contemplate and question their own values and position (action-reflection-action). In principle, as a consequence of the field team meeting with the farmers and then returning for discussion on the participatory action with the work teams, all are enriched and benefitted by the new ideas arising from this process. The course of action decided upon commences from the problems which are aired, and tries to keep in mind the social, cultural, economic, and political context of all those involved.

Institutional changes are not demanded by the work teams. The institutions themselves should opt for the re-direction of their own objectives and strategies as a result of a process of self-evaluation, with a view to catering for the needs of the agricultural sector through the new approach, integrative action. In other words, those who make the new proposal a viable option are the farmers themselves. The work team was conscious that it should be the institutions that adapt to the farmers' reality and not the reverse.

1.2.3 Methodology

The stages of the project, along with its respective methodological direction, obeyed the following sequence:

a. Selection of the Municipality

The work team, aided by the entities involved, gathered all the pertinent data on the cane-growing area in the state of São Paulo. The work was basically office-based and involved the analysis of all existing secondary data. The aim was the selection of a municipality which could be said to be representative of the each region. These regions had already been decided upon previously in the original meeting of the technical personnel. Two municipalities were selected: Piracicaba, in the region of the same name, and Guariba in Ribeirão Preto.

A survey was carried out again, this time in each of the municipalites, in order to identify a representative community. Factors such as physical and social structures, education, health, local economy and types of agricultural activities were studied. In this phase, after the work team had pre-selected the community, the field agents visited the leaders of these communities *in loco* with a view to confirming the work carried out in the office. The units of industrial production and farmers' organisations were also consulted as to the representative nature of the chosen communities. At the end of this phase, the following communities were deemed to be suitable for the implementation of the project: Tabela do Recreio in the Santa Luzia District, in the municipality of Piracicaba, and another in the Jaboticabal region near Guariba.

b. Analysis of the Community

The field technicians visited farmers in each community to define their socio-cultural, economic and technological levels. This exercise did not involve the use of a questionnaire but, rather, participant observation. The decision not to use a questionnaire was made by the work team, as they recognised that the overuse of these in cane-growing areas had made them synonymous with meddling bureaucracy. The technicians were aware of the information needed and this informal approach resulted at times in farmers seeking clarification of certain technical obstacles; these discussions thus became a principal source of data. Upon leaving the farmers the technicians immediately carried out a retrospective analysis of the conversation, identifying and recording useful information. This procedure was repeated every time throughout the duration of the survey. The technicians also avoided using government vehicles, known as *chapas brancas* (literally 'white licence plates') which were associated by the farmers with discredited official technical agencies. In the course of this survey the technicians did not give details of the proposed project approach because an abrupt change of methodology was involved. This could have lead the new integrative action to collapse before it had even started.

Upon conclusion of fieldwork, all the information collected was presented to the work teams, which then compared the data to the official records and consulted the *usinas*, co-operatives and unions present in the community. The official community leaders were also consulted. Even so, the work team regarded this mass of information as the pre-diagnostic stage and, consequently, subjected it all to a final verification which took the form of a meeting involving the farmers themselves. At this meeting, alongside the process of verifying the data arising from the survey, the objectives of the project and the concept of integrative action were presented. The initial reactions to the proposal and its authenticity were one of disbelief, as could be seen by the dumb-struck silence of the farmers who participated only in the verification of the survey results. Attendance at these meeting was high, since around eighty per cent of the farmers' community came to them. At the time, the work teams concluded that the high turn-out was due to the fact that the invitation to the meetings had been made through the *usines* and co-operatives and, as such, the farmers came in the hope of obtaining some 'good news' - the promise of help with the harvest and/or transportation of their harvest, loans - or 'bad news' - extra charges, the retention of credit, etc.

c. The Identification of Needs

Several meetings and new visits to farms took place with a view to identifying the technological needs of the farmers. The methodology employed in the meetings with the farmers was one of their identifying problems arising from their situation - *Esquema do Arco* (Arc Outline) - (Maguerez, 1969). With regard to the identification of farmers' concrete needs, a few devices were used. For example, questions of the following kind were put: " if a bag of money were to appear on your farm and you were only allowed to spend it on your sugar cane crop, what would you do ? " The most common answer, at least in the case of Piracicaba, was: 'buy more fertiliser'. This provided the work team with an initial orientation, complementing an earlier confirmation based on research findings in that particular community that the purchase of fertilisers was one of the major expenses in the production of the crop in question. In some cases, especially at the beginning, it was necessary to guide them towards a conclusion. The role of the field team in the exercise was that of motivators. As the process advanced there arose an ever-increasing degree of participation on the part of the farmers.

d. Definition of Possible Solutions

Following the identification of needs, a new discussion on possible solutions to these problems was initiated. A variety of experiences were recounted and suggestions heard. The field team would raise, in the course of the discussion, the question of inviting an 'expert' on the matter for an exchange of ideas. The idea would be to allow the researcher to first get to know the reality of the farmers and identify the validity of his indigenous knowledge in an exchange of experiences with the farmers. The final decision on the possible solutions to be implemented would have to be taken by everyone together, taking into account the farmers' production systems as a whole. There were cases in which suggestions made by the farmers were supported by the work team. This initial integration between researchers, extensionists, and farmers was the high point of the participatory approach. From that point onwards everyone was involved in the project. Even those who were sceptical at first were convinced in time and espoused the new approach. Eventually, it came to be realised that working with farmers meant respecting their points of view and that all concerned would have to give mutual consideration to the experiences of the others involved in the process.

To allow this phase in the process to occur, it was vital in the course of the discussions for research to put aside its desire for technical excellence in order to allow space for the farmers' indigenous technical knowledge. It must be noted that this step demanded the same of the farmers. This phase of the work was known as the 'experiences adjustment' phase.

Another important point guiding the direction of research was the need for it to be coherent with respect to the economic, technological, social and cultural situation of the farmers. Researchers were already aware that it was absolutely necessary, in cases where it was unable to come up with a practicable solution to a problem, that the community should be informed and that the problem in question should be transformed into a research priority and/or alternative solutions sought. The work team also reserved the right of adjustment and/or veto of the suggestion made by researchers before these were presented to the farmers for discussion.

e. Conduct of Trials

Based on the results of previous phases, the work group would prepare some suggestions to be discussed with the farmers. Also presented were the traditional methods of farming experimentation and dissemination of these results, which are used by the research and extension institutions. After a lengthy discussion, it was decided that the whole trial phase would take place on the community farms, with expenses divided among the farmers and the involved institutions, and the harvest among the farmers. There were experiments with three or four plots, using two or three different alternative production systems and of a witness (actual farmer production system). Most were 0.5 hectare each, using non-parametric statistical methods to analyse the results. This allowed full participation of the farmer in the experiment design, and brought the trial to his farming situation, since the few plots used , and their size, practically corresponded to the commercial plantations. The idea was to simplify the statistical delineation used in the agricultural experiments, avoiding parametric statistical methods (causality blocks with large numbers of repeated plots, using factorial mathematics, traditionally used). There was not this excessive control of variables, which had already demonstrated a different behaviour whenever subjected to the conditions of commercial plantations.

Depending on the previous phase, three types of trials could take place: (a) if the solutions were pre-defined, there would only be proof in the practice of the identified production system. A commercial planting was made in a surrounding area of two hectares which was followed by the whole community from planting stage to harvesting. The work group named this trial 'Demonstration of Results Unit-DRU' and the farmers called it the *prova dos nove* (revised proof), trial-1: (b) On the other hand, it could be that solutions were not pre-defined due to a lack of consensus in the group (technicians and farmers). In this case, farmers and researchers conducting their own trials, but interacting, trial-2; (c) the solutions were not arrived at due to a lack of suggestions. A trial would be set up with farmers and researchers conducting the trial jointly, trial-3. In relation to the experiment design, in both cases (b and c), the decisions were made together. This was to guarantee the validity of the results, bearing in mind, above all, the inexperience of the farmers in planning their own trials.

Almost immediately, an unsophisticated chronogram was developed for the sole purpose of indicating or providing everyone involved with a rough idea of what activities were taking place - setting up of trials and/or demonstrations of results units, method demonstrations, field days, visits, meetings, excursions, with dates, location and name of those organising the activity.

This phase was also an opportunity for rural extension personnel to reflect on their situation. The work team stressed the following points: the extension methods, if employed, must not become an end in themselves but rather viewed as a means; in an educational exercise there is no such thing as 'the method', the 'recipe', 'the good or ideal', only principles guiding the creativity of the technicians towards a continuous methodological reformulation. Audio-visual and other resources should not be confused with 'learning aids' (which diminish the audience's creative and operational capacity by encouraging passivity). They are, rather, useful for facilitating communication; resources should ease the people's process of assimilation, or thought processes, and not diminish, impede or complicate it.

It was at this stage that trips to the 'usinas' own fields and to Planalsucar's own research stations were made. The underlying reason behind this move was, among other things to initiate the practice of participation, in the hope of sensitising both the public involved in this integrative action and the personnel of these institutions.

f. Evaluation

When the harvest from the trials and results from the demonstration units had been collected, the farmers were allowed to weigh the crop and estimate the income it would bring in. This was made possible as all expenses had been recorded by farmers themselves for this very purpose. They were thus presented with an opportunity to verify for themselves the productivity of the harvested plots and to compare it with their own production systems. Immediately following this exercise, everyone in the work team, researchers, field team, extensionists, technical personnel from the units of industrial production, co-operatives, unions and university, met with the community for a critical analysis of the entire procedure (technologies and approach). It was at these meetings that the highest degree of participation was observed. Below are examples of some the statements and observations recorded at these meetings: " ... for the past ten years I have been doing things incorrectly. Now as a result of having participated in this work, I finally feel professionally useful"(a researcher). " ... I never imagined that the 'doutores' ('doctors', term loosely used when referring to technicians), could help me in any way " (a farmer).

It was decided that the project should be continued through into the following cultivation stages, to the second and third harvests, that all those involved in the pilot project would receive detailed reports on the role of this integrative action, and that there should be nation-wide diffusion of details of the project carried out through the printed media. These results were also presented at the monthly meetings of the technical community (indirect action) where the new approach had been tried. From that point, the approach started to be adopted by the technicians of the sugar cane mills, distilleries, co-operatives and unions. Although the approach did not permit an extension service comparable to the existing one, its extensionists did start to relate to farmers within the new approach. Thus, the methodology employed in this project was modelled on that outlined by Burke and Molina (1979), who presented the *Esquema do Arco* (Maguerez, 1969), already cited, and its practical implementation by means of a methodological guide (see in figures 4.1 below).

PHASE	SPECIFIC CONTENT	DIDATIC TECHNIQUES	RESOURCES	TIME
OR	- Are ants a problem in your properties? - Is it easy to deal with them? - What type of insecticide and equipment do you employ? - Is it an expensive activity, trying to eradicate ants? Why?	Led debate	Blackboard	25'
	- Complexity of application (cleaning out an ants' nest, and equipment. - High costs due to the need to repeat treatment, and of labour. - Difficulty of locating the ants' nests ("quemquem", "formigueiro amuado"). - Difficulty of gaining access to the nests (sited under roads, under houses, etc.).	Expository Synthesis (summary of the points raised during OR)	White paper and air brush	10'
DS	- How leaf-cutting ants live and feed. - Possibilities of utilising the ants' own life style and feeding habits in combating them.	Open discussion (discussion on ideas to do with control.	Slide show "How ants live"	20'
	- The action of poisonous ant bait. - The Bait: How long it takes to act, forms of application, timing, season, precautions to be observed in storage and handling.	Informative presentation (talk)	Seriate album and samples of the product.	30'
IM	- Reports given by farmers of the region on the advantages they found in using of the bait.	Testimony given by farmer	Graphs and diagrams showing results of cost & efficiency of the bait.	15'
	- Experimental facts and information on cost and efficiency.	Informative talk		15'
IR	- Other information requested by the farmers. - Where product may be purchased, its cost and packaging, etc.	Question and answer session	Blackboard, folders & sheets of paper.	10'

Figure 4.1 Methodological Guide
Source: Burke and Molina, 1979:38

Such an outline is constructed on the principle that all learning should commence with a challenge, characteristically a problem-situation which, by mobilizing the knowledge and structures of the subject, encourage him/her towards the development of activities which facilitate an understanding of the object. Thus, the scheme moves from the concrete to the abstract, from the near and familiar to that further away and less familiar; from a syncretic vision to an analytical one, until reaching a synthesis (a global and indistinct perception from which later emerges the perceived distinct objects). This particular outline, *Esquema do Arco*, is composed of three stages with their five consecutive phases (figure 4.2) upon which all activity or activities undertaken should be based, in order that there be rational, objective and conscious learning.

Figure 4.2 *Esquema do Arco*: A Description of its Components
Source: Burke and Molina, 1979:44

STAGES	PHASES	CONTENT OR ASPECTS
CHARACTERISATION OF THE PROBLEM SITUATION	(O.R.) OBSERVATION OF THE REAL SITUATION	- Survey of Aspects or Problems in the real situation, in order to arrive at a perfect characterisation (a syncretic view of reality or of the Problem Situation).
	(O.M.) OBSERVATION OF THE ROUGH MODEL	- Highlighting or summarising of key-points or fundamental problems observed in real life (those which will be changed or solved through the schemes proposed during the D.S. phase).
SEARCH FOR SOLUTIONS	(D.S.) DISCUSSION OF SCHEMES	- The theoretical causes of the problem situation and the foundations upon which possible solutions could be constructed. - Alternative solutions and hypotheses. - Theoretical and practical knowledge necessary for the implementation of the solution.
	(I.M.) IMPLEMENTATION IN THE MODEL FORM	- The state or conditions of the points (or problems) brought to light in (O.M.) after the implementation of the schemes outlined in (D.S.). - Experiments, Tests, Demonstrations of results, Examples, etc.
ACTUALISATION OF SOLUTIONS (A.S.)	(I.R.) IMPLEMENTATION IN REAL LIFE	- The implications of a practical nature, having to do with the implementation of the proposed schemes. - Other information, recommendations or provisions required for the actual application of the suggested (in the D.S. phase) solutions or innovations.

1.2 Critical Analysis of the Project

In order to carry out a proper critical analysis of this project it is necessary, before all else, to state that when it was still just an idea it was faced with a range of problems and was forced to overcome many institutional obstacles. The project was attempting to develop within a State research system characterised by technocratic and centralist tendencies. Even so it proposed integration with other government institutions with similar characteristics, and with non-governmental bodies, mainly *usinas*, which regard financial gain as the most important factor. Prior to all this, the idea had to be developed and matured in a secretive manner with the mills, distilleries, cooperatives and unions who, directly and indirectly, all affected the decision-making processes within IAA-Planalsucar. As a consequence of this work in the 'wings', there arose the opportunity for an official proposal to be made to all the institutions considered for participation in the project.

The proposal could still not be discussed as an attempt to promote the participation of resource-poor farmers in research work, but it could, however, be discussed as a possible 'model' for the diffusion of technology appropriate to the technical needs of farmers cultivating sugar-cane. Before this, there were many biases which impeded the practice of participation. This gained ground gradually as the project itself unfolded alongside the farmers' own decision to participate. It was only on completion of the first phase of the project, nearly two years later, that it was possible to initiate an open discussion on the authenticity of the 'bottom-up' approach. The lack of a sound theoretical base and practical experience with participatory work on the part of the work team members created innumerable difficulties. Thus, every action contemplated required, firstly, an exhaustive effort to clarify as well as to reach a level of awareness as to how to proceed with the farmer. The excessive preoccupation with transforming the technical personnel's attitude towards participation and attempts to convince them that it was a feasible course of action caused much time to be wasted. This occurred, however, for the simple reason that the acquiescence of personnel from the institutions taking part was a vital factor for establishing the area of technology diffusion in IAA-Planalsucar which, in turn, was to be the first step in the participatory process for farmers. The lack of formal responsibility for specific action in particular areas within the project, for each of the institutions involved, resulted in the project being given secondary importance. This was heightened by a shortage of necessary resources, which caused many delays in the schedule of activities outlined in the chronograms.

Another negative point was the failure to integrate all aspects of rural community life; for example, health, education, infrastructure and rural credit. Frequently, the farmers' basic problems were situated within a wider context and could not be solved only technologically. For example, how can a small resource-poor farmer be expected to apply fertiliser in post-planting if there is no credit available? How can marketing be improved through bridge or road construction? How can literacy, nutrition or immunisation programmes be developed in order to meet farmers' basic needs?

As positive achievements the project can point to the following:

- a substantial increase in requests for technical services and assistance put to the mills, co-operatives, rural extension and IAA-Planalsucar, by the farmers who came to regard this, thanks to a new awareness of their situation, as the claiming of their rights.
- the adoption of technologies, now suited to the farmers, free of the 'great methodological strategies' of rural extension, proving that whatever seems able to meet a farmer's concrete need will be automatically adopted by farmers. The main people responsible for disseminating project results were the farmers themselves. All technological solutions were developed from a base which allowed for adjustments, respecting the farmer's infrastructure and seeking at all times to reduce his costs. The factor of increased production could occur, but this was by no means the central objective.
- the contemplation of large-scale participation as a possible option in their daily work and their private lives and dealings with people, by many technical personnel;
- a new degree of respect and consideration among the institutions involved. This was made possible by the interaction of their agents within the framework of their daily activities together and geared to serving the farmers. This could be considered a vital factor if there is to be any extension of this sort of action in other communities and regions of the country. The preoccupation with laying the blame for the failure of a technology to get to the farmer, gave way to an awareness that all action,

be it teaching, research or extension, must commence with the farmer's circumstances.

- research which was previously elitist was, in this particular experience, able to open itself to the participation of the farmer and thus change its perspective with regard to the farmer, from seeing him simply as a passive object to seeing him as an active subject.

IAA-Planalsucar's diffusion-of-technology area thus becomes feasible as a consequence of the work carried out jointly by the farmers and the sugar-cane agro-industry's technicians. This stimulated the development of similar philosophies of work in other sugar cane regions of the country, and this, in turn, resulted in the formulation of a National Plan of Technology Diffusion, The 'Three Year' Plan for Diffusion of the Technology for Sugar Cane Agro-Industry Resource-Poor Farmers - 1984/86 (*Plano Trienal*).

1.3 Closing comments

Other factors, at a wider level, also contributed in effect, to the creation of a favourable atmosphere for the implementation of this new approach. From the 1970s onwards, the evolution of the sugar-cane agro-industrial sector received a great stimulus when it was asked to contribute to solving the problems produced by the 'energy crisis' arising from the sharp rise in petrol prices. The expansion of area planted to cane and of industrial processing, with a greater emphasis on alcohol production, led not only to the incorporation of fields in the already traditional regions but also to a quest for new areas in regions where sugar cane had not been previously tested. That rapid expansion generated technological challenges for the crop, as there was an increase in productivity in the traditional areas, which would permit the cultivation of smaller areas to obtain the same production levels. At the same time, it required technologies be used which were adapted to the conditions of these new regions.

Another problem arising from the expansion of sugar cane monoculture which demanded an effort to establish new technologies, was the occupation of land previously used for food crop production. Efforts were quickly mobilized to search for techniques that permitted the combining of cane with food crops, both in rotation and intercropping. The setting up of the Payment of Cane According to the Contents of Sucrose (*Pagamento de Cana pelo Teor de Sacarose*-PCTS), required increased technological inputs in order to avoid losses by the farmers and to allow them to benefit from the advantages offered by the new payment system, when compared to payment by weight.

These considerations were also the basis of the definition of new Sectorial Directives and Strategies of the Ministry of Trade and Industry (*Ministério da Industria e Comercio*-MIC). They were to be implemented by the IAA, which was responsible for the coordination of the entire sugar cane agro-industrial sector. Among these directives and strategies, those that stand out are:

"to promote the increased efficiency of the sugar-alcohol agro-industry;
-to stimulate the adoption of practices adequate for the cultivation of sugar cane;
-the implementation and consolidation of the sugar cane payment system according to sucrose content;
-intensification of the use of technical assistance and rural extension mechanisms;

-to promote improvements in incomes, employment, and standards of well-being in the sugar -alcohol sector:
-stimulation of managerial improvement of the sugar and alcohol agro-industry, with emphasis on the small-and medium-size enterprise;
-full support for co-operatives and farmers' associations;
-incentives for planting other crops, bearing in mind the use of available production factors between harvests;
-incentives for intercropping and /or rotation of sugar cane with staple food or fibrous crops;
-promotion of measures that lead to the decrease of seasonality of occupation of labour according to the food crops intercropped with the sugar cane as well as the use of late or precocious sugar cane varieties;
-setting up and/or strengthening of research structures and technical assistance in sugar cane expansion areas;
-to support the agricultural sector through the industrial development of inputs and machinery directed, mainly, for the cultivation and processing of sugar cane;
-incentives to generate and adapt new farming technologies in the sugar cane areas;
-stimulation of research and development of new more productive varieties and to the production of resistant setts (*mudas*) to pests and diseases, adapted the peculiarities of the country's diverse sugar cane regions;
-development of research into alternative forms of fighting pests and diseases in the sugar cane fields;
-promotion of training and specialization of workmanship involved in the production and industrialization of sugar cane ".

(Ministério da Industria e Comércio - MIC, 1983)

In this way, the execution of governmental directives defined by MIC became formalised due to the new organizational structure of IAA-Planalsucar, the technology-diffusion area and its Master Plan. The *Plano Trienal* (The "Three year" Plan), therefore, while trying to attend to the concrete needs of the farmer, would guarantee an institutional policy coherent with the new governmental directives.

2. The Plan

The 'Three Year' Plan for the Diffusion of Technology for the Sugar -Cane Agroindustry's Resource-poor Farmer 1984/86 was the guiding document developed by the Technology Diffusion Advisory Service (*Acessoria de Difusão de Tecnologia* -ADT) of IAA-Planalsucar, comprising the group of activities developed by Technology Diffusion Regional Advisory Departments (*Acessorias Regionais de Difusão de Tecnologia* - ARDT) at regional level. The *Plano Trienal* presented an analysis of the institutional and environmental circumstances that justified both the general project proposal and the specific activities to carried out in each region. It also defined the objectives of IAA-Planalsucar's institutional effort concerning the diffusion of specific technologies available.

This document outlined the group of Programmes, Projects and Activities that would be developed at the four regional levels (at that time the Central Coordination had not yet been created), which were based on the objectives, directives and strategies specified at national level, and duly adapted according to the regional socio-economic, cultural and ecological conditions of sugar cane agro-industrial production. It is worth mentioning that the *Plano Trienal* proposed an annual evaluation as well as continuous monitoring of its projects and activities in order to permit alteration, exclusion or inclusion of new proposals.

2.1 Objectives

The fundamental goal of IAA-Planalsucar's technology diffusion activities was the identification of technological solutions with the participation of the farmers, for their concrete problems, to enable them to increase the productivity and profitability of sugar-cane, while reducing costs and improving their social and economic well-being. Consequently, activities developed with farmer participation presupposed a redefinition of the research objectives of IAA-Planalsucar.

2.2 Directives and Strategies

The guiding principle of the whole technology diffusion activity to be undertaken by IAA-Planalsucar, through the ADT, was that procedures for dealing with farmers' problems could be best attended with their participation, according to adaptations or alterations in their production systems. Operationally, the main prerequisites for researchers that formed the basis of *Plano Trienal* programmes , were as follows:

-"knowledge of the regional/local situation where interaction with the community of farmers takes place, in order to define, with them, their concrete needs;

-acting in an integrated manner with the representatives of producers of sugar cane, sugar and alcohol, supporting technical team training and guiding them in the new approach;

-involvement with the whole technical community, both regional and/or local, be it of associations, co-operatives and unions of farmers, sugar cane mills, distilleries, NGOs and governement organisations, turning them into catalysts for the technology diffusion project to be developed by IAA-Planalsucar (according to IAA-Planalsucar these were 'multiplying agents');

-action taken is to be directed primarily at resource-poor sugar cane farmers, small-and medium-scale farmers;

-integration among the several areas of ADT and continuous training of its technicians, in order to guarantee a participatory approach;

-interaction with the other areas of IAA-Planalsucar in such a way that the technologies suggested by researchers to solve farmers' needs should

be relevant, and that the problems of the production system identified by technicians and farmers, should form the basis of the choice of research topics;
-ample dissemination of the results obtained by IAA-Planalsucar at the level of research and technology diffusion in order to maintain an image of technical and scientific credibility;
-permanent evaluation in order to provide constant feedback".

(IAA-Planalsucar, 1983, vol.I: 21-22).

2.3 Means of Implementation

Based on the directions and strategies already defined, ADT action would be made through regional plans to be developed by the four ARDTs: COSUL, COEST, COONE and CONOR. Two implementation strategies would be considered; integrated action and the new organisational structure.

2.3.1 Integrated action

As has already been made clear above in 'Strategies', the basis of IAA-Planalsucar action in the field of technology diffusion was integration with government organisations and NGOs that are linked either directly or indirectly to the sugar cane agro-industrial sector. This integration was both technical and/or financial. Those involved, mainly the farmers' representative organisations, would act as 'intermediate users' or 'multiplier agents' in order to implement the whole range of integrating activities for their members. IAA-Planalsucar technicians would occasionally intervene in the absence of the 'multiplier agents'. The institutions which became integrated at a national and international level in the *Plano Trienal* in 1984 are briefly listed in figure 4.3.

Figure 4.3 Institutions which Participated in the *Plano Trienal* in 1984
Source: IAA-Planalsucar, 1983:29

ENTITY	Co-operation		
	RANGE OF ACTION	TYPE	SITUATION
1) Industrial Technology Secretariat-STI/MIC	Brazil	Financial support	Formalized
2) National Scientific and Technological Development Council - CNP_q	Brazil	Technical-scientific and financial support	Formalized
3) Organization of Sugarcane Growers of the State of São Paulo - ORPLANA	State of São Paulo	Technical co-operation	Formalized
4) Sugar and Alcohol Producers Society - SOPRAL	Central-southern region	Technical co-operation	Formalized
5) Brazilian Technical Assistance and Rural Extension Agency - EMBRATER	Brazil	Technical co-operation	Formalized
6) Co-ordination of Integral Technical Assistance (CATI) of the Secretariat of Agriculture and Supplies of the State of São Paulo	State of São Paulo	Technical co-operation	Initial Contacts
7) Sugarcane Suppliers Association of Pernambuco	State of Pernambuco	Technical co-operation	Under negotiation
8) Sugarcane Growers Association of Paraïba ASPLAN	State of Paraïba	Technical co-operation	Formalized
9) Sugarcane Growers Co-operative of the State of Rio de Janeiro - COPERPLAN	State of Rio de Janeiro	Technical co-operation	Formalized
10) ASPLANA - AL	State of Alagoas	Technical co-operation	Document drafted
11) College of Agriculture "Luis de Queiroz" of the University of São Paulo - ESALQ-USP	State of São Paulo and Paraïba	Scientific co-operation in Technology Diffusion	Formalized
12) Federal University of Viçosa - UFV	State of São Paulo and Paraïba	Technical co-operation	Formalized

ENTITY	Co-operation		
	RANGE OF ACTION	TYPE	SITUATION
13) Federal University of Paraîba	States of Paraîba, Pernambuco, Rio Grande do Norte	Technical co-operation	Formalized
14) Rural Federal University of Pernambuco	States of Paraîba, Pernambuco, Rio Grande do Norte	Technical co-operation	Formalized
15) EMATER - MG	State of Minas Gerais - (COEST area)	Technical co-operation	Formalized
16) EMATER - ES	State of Espîrito Santo	Technical co-operation	Formalized
17) Sugar Industry and Alcohol Industry Union of Paraîba	State of Paraîba	Technical co-operation	Initial contacts
18) Rural Federal University of Rio de Janeiro	State of Rio de Janeiro	Technical co-operation in Technology Generation and Diffusion	Under negotiation
19) EMBRAPA	Brazil	Technical co-operation in Technology Generation and Diffusion	Activities being carried out
20) SENAR	Brazil	Preparing multiplying agents	Under negotiation
21) ASSOALCOOL	State of Goiâs	Technical co-operation for Technology Generation and Diffusion	Under negotiation with Mid-Western - SOPRAL
22) EMATER - AL	State of Alagoas	Technical co-operation	Formalized
23) EMATER - PE	State of Pernambuco	Technical co-operation	Programme of work ready

ENTITY	Co-operation		
	RANGER OF ACTION	TYPE	SITUATION
24) EMATER - RN	State of Rio Grande do Norte	Technical co-operation	Programme of Work ready
25) Interamerican Institute of Co-operation for Agriculture - IICA	South America	Cultural exchange pro gramme	Under Negotiation
26) British Council	England-Brazil	Cultural exchange pro gramme	Initial contacts
27) EMATER - RJ	State of Rio de Janeiro	Technical co-operation	Initial contacts

2.3.2 Organizational Structure

The IAA-Planalsucar sector in charge of the operationalization of the *Plano Trienal* was the ADT and its regional representatives. This structure was responsible for disseminating technological information already available within the IAA-Planalsucar and/or generating new solutions. They were as follows:

a. The central level

The central level of the ADT was located in the 'General Superintendency' (General Headquarters) in Piracicaba, São Paulo, directly subordinated to the General Superintendent (Chairman), and comprised five departments: Technology Transfer, Communication, Training, Public Relations and Library. In short, ADT's work at central level (see figure 4.4) was as follows:

-" to advise the 'General Superintendent' in technology diffusion activities;
- to collaborate in the elaboration of regional activity programmes of technology diffusion;
- to keep the 'Superintendent' informed of advisory activities;
- to integrate the activities of the Training, Communication, Technology Transfer, Public Relations and Libraries bearing in mind the unity of the diffusion activities ;
-to support the Research and Development Coordination (COPED) in order to keep it informed of the level of adoption of technologies generated and /or adapted and also of the farmers needs;
-to guide the execution of activities in the technology transfer sectors whenever this is requested by the regional offices;
-to develop a training methodology in accordance with regional programmes;
-to produce adequate means of communication for the dissemination of research results, the diffusion of technology and the maintenance of Planalsucar's institutional image, supporting the administration and finance coordination in the production of administrative documents;
-to advise the 'General Superintendent' in any public relations activities by developing, coordinating and monitoring the institution's communications policy;
-to support COPED in its technical and scientific information needs through

the libraries network;
-to elaborate technical statements of the ADT, whenever these are requested by the Superintendent".

(IAA-Planalsucar, 1983, vol.I:23).

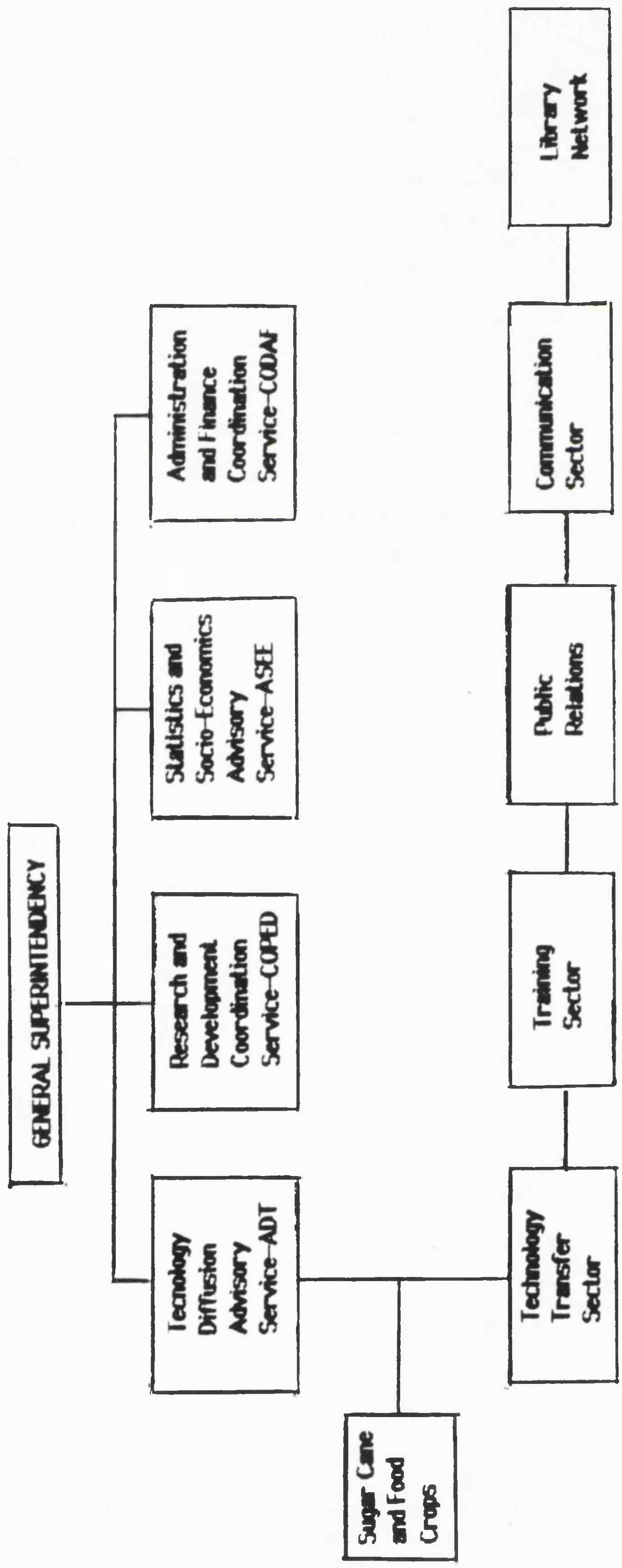


Figure 4.4 ADT's Organizational Structure - Central Level
Source: IAA-Planalsucar, 1983:24

b. The Regional level

At this level, the same functions were reproduced with the same organizational structure.

2.3.3 The Regional Plans

The regional plans for technology diffusion were composed of the Programmes, Projects and Activities to developed by the ARDTs, based on the Directives and Strategies of the *Plano Trienal*, adapted according to the circumstances of each regional office. The Programmes refer to the group of Projects and Activities that each department of the ARDT proposes to carry out in the accomplishment of the the regional objectives. Before describing the Participatory and Strategic projects, it is necessary to point out the number of those projects and people involved after the establishment of the *Plano Trienal* in 1984. See Table 4.1 and Appendix Three.

Table 4.1- Number of Plano Trienal's Projects and Rural Families-1984

States	Number of Projects	Number of Families
São Paulo	20	841
Rio de Janeiro	6	249
Pernambuco	5	210
Minas Gerais	5	201
Alagoas	3	118
Espirito Santo	3	126
Paraíba	2	88
Rio Grande do Norte	2	86
Paraná	1	44
Santa Catarina	1	42
Total	48	2005

Source: IAA-Planalsucar, Annual Report 1985

- Each project (Participatory and Strategic) involved an average of 33.4 families totaling two thousand and five families at national level.
- Considering that the participant families had around six members each (a couple and four children), the *Plano Trienal* directly involved twelve thousand and thirty people in 1984. This does not include people who were indirectly involved such as: relatives of the families, surrounding farmers, inputs suppliers, technicians, policy-makers, civil servants and formal leaders, among others.

2.4 Description of the Projects

The ideas of Burke and Molina (1979) formed the basis for the structure of the technology-diffusion sector created within IAA-Planalsucar. They see diffusion of technological innovation as implying three processes: communication, learning and adoption. The farmer had to know of the innovation, learn how to use it and then decide whether to adopt it. These premises gave rise to the Training, Communication and Public Relations Departments, whose function was to support a Technology Transfer Department directly responsible for the actions of the technology-diffusion area. This would communicate the innovation supported by the Communication and Public Relations Departments, while the Training would enable the farmers to make decision about the innovation. Only those projects of the Technology Transfer Department (Strategic and Participatory), will be analysed in this thesis.

The Strategic Project was linked to national, regional and institutional directives and strategies in terms of its economic focus. From the institutional point of view, it was defined as a priority with the principle focus being towards already existing groups contacted through the persuasive, systems and 'technocratic' approaches, which allowed only a low degree of people's participation.

The Participatory Project was to be different due to its focus on dialogue. It was based on analysing the specific situation in farmers' communities and on interaction between researchers and the community.

The aim was to identify concrete technological needs, and then to find technological solutions. This approach, therefore gave priority to the social context that is, considering the whole range of social and economic conditions of and constraints upon the farmers.

Doubts could be raised by the reader in relation to the establishment of two opposite approaches in the IAA-Planalsucar's technology-diffusion area. Why should it make use of the 'persuasive' approach while the Pilot Projects (mentioned in the first section of this chapter), had shown the positive results of participation in practice ? As already mentioned, the elitist and conservative posture of IAA-Planalsucar would not even accept the Technology Diffusion sector with the traditional approach, making it impossible to implement a progressive project, considered subversive at that time. The concern, above all else, was to make research feasible within the internal context of the institution through the persuasive approach.

Another problem to be faced concerned training the researchers who would participate in the projects. The same group of technicians were supposed to work on both projects, so it was decided that the researchers would have to be trained in both approaches (systems and participatory). Therefore, all researchers from IAA-Planalsucar who were to be involved in these projects were given training at the University of Viçosa in Minas Gerais between 17 and 29 October 1983. The 'technocrats' were represented by the Viçosa group and the 'progressives' by the University of São Paulo group, who were responsible for this pre-service training. The Strategic and Participatory Projects designed to operationalise the *Plano Trienal* are described below.

2.4.1 The Strategic Project

2.4.1.1 Organisation

Before implementation of the Strategic Projects, each ARDT contacted farmers' organisations and industrial units to prepare and sign the agreements within the area of each Regional Coordination (see to 2.3.2). Those farmer's organisations were chosen which had most members and, with agronomic technical teams located near the experimental stations of IAA-Planalsucar. These were chosen because they could respond quickly to the institutional interests and requirements. The decision was politico-institutional, as the institution (IAA-Planalsucar) had to get complementary resources for the programme as a whole and to contract the services of the EMATERs. Following this, training was given to the extension workers by the IAA-Planalsucar researchers with the aim of providing or improving the level of agronomic knowledge about sugar-cane. IAA-Planalsucar, through its ARDTs, was responsible for project activities. But no limit was placed on the number of projects that could be included regionally.

2.4.1.2 Development and Strategy

The Strategic Projects were an institutional priority, theoretically based on conventional FSR, using a 'persuasive' approach with a low degree of participation. According to Biggs' (1979) typology of farmer participation, already mentioned,they could be defined as 'Contract' and 'Consultative'. The projects had no previously defined public and their starting point was the belief that researchers knew farmers' problems and needs. Class organisations and industrial units might be consulted in relation to this. The execution of the projects at field level was the responsibility of EMBRATER (through the EMATERs), where class organisations could not take on the job. Sometimes they had no technical department or their teams did not have a sufficient number of technicians. The researchers' contact was with the extensionists and, in exceptional cases, with farmers.

2.4.1.3 Methodology

a. Analysis of Population

Researchers carried out a diagnosis of the co-operative and union situation utilizing existing secondary data at IAA-Planalsucar and in other regional institutions. This diagnosis comprised: the socio-economic characteristics of farmers; their stratification; production systems; soil, climatic and topographic aspects; variety of sugar cane census; other crops census; structure of marketing; and area infrastructure such as, roads, water and electricity supplies, schools, hospitals, etc. The conclusions were afterwards presented and discussed with the farmers' organisations.

b. Selection of Project Membership

The researchers chose the municipalities based on the criteria of sugar cane production and technical, social and economic representativeness within the area of the co-operative and/or the Union. After the technical decision was made, the IAA-Planalsucar's governing body had to be consulted before the final decision was reached. In the first instance, this had to fulfil IAA-Planalsucar's institutional interests without clashing with co-operative or union interests. Following this, researchers consulted co-operative or union technicians to define such areas within the municipality, using the same criteria used for municipality selection. They also considered certain other aspects such as the location of farms, the capacity of farmers to quickly respond to the project and the multiplier effect in terms of adoption of new technologies.

After defining the areas, researchers drew up a formal questionnaire to be applied to the farmers by the field team. This questionnaire would complement data already gathered. It was composed of four parts: reference data, farmer identification (socio-economic, educational and cultural aspects), production unit identification (assets and production systems) and other data. The farmers who were interviewed formed the project group.

c. Identification of Needs

The technological problem of the area was defined on the basis of: (1) research files consisting inter alia of soil maps, production systems, pests and diseases, climatic conditions, sugar cane varieties cultivated; (2) information drawn from the previous phase of the project; (3) researchers' individual knowledge of the the project area.

d. Definition of Possible Solutions

After learning of the technological problems of the area, the researcher teams defined the solution. The degree of involvement of a particular research area would depend on the type of problem it presented, although all researchers took part in and were responsible for decision-making. At the end of this phase there were three possibilities: (a) solutions already existed and could be diffused; (b) solutions existed but needed to be tested under the farmer's field conditions; and (c) solutions had to be researched.

e. Conduct of the Trials

In the event of there being no solution to the problem identified, experiments would be set up under local farming conditions, with a statistical design and with total control of variables by the researchers (trial-4). They were located on farmers' land and/or sugar cane mill land and were kept confidential. They were closed trials and there was no farmer participation. When solutions required observation under field conditions, Observation Units (OU) were set up (trial-5). Trial 5 areas consisted of approximately two hectares and had no statistical design, like commercial plots. If the trial results warranted it, the extension service would be invited to take over project activity. This was the point at which the farmers became involved. Usually that involvement was during harvesting. In some cases, farmers were not involved even at the stage where the OU presented good results, perhaps due to lack of time. In such cases, results were diffused to the farmer through the Results Demonstration Units (trial-1), which were set up to follow trial 5. Trial-1 were commercial plots, open to farmers, using similar areas to the trial 5 as mentioned above.

f. Dissemination

When there was no doubt about solutions the extension service took over. The trial-1 would be set up and the extension method/strategy was defined: demonstration of methods, visits, excursions, talks, meetings, courses and other methods would be used, in order to persuade farmers to adopt the new technologies. The trial-1s were placed on farmer's land or sugar cane mill areas on easily accessible locations, with a reasonable infrastructure (human and material) and aimed at reaching a larger number of farmers. In certain cases, areas were rented and the infrastructure and facilities were only provided by the institutions involved and *usinas*. As the groups of farmers to be involved were an outcome of the previous requirements mentioned above, the categories of small-and medium-scale farmers followed suit. Homogeneity regarding their technical, social and economic aspects would prevail. Only rarely would a small farmer be included in a group of medium-scale farmers, and vice-versa. In some cases, there was farmer rotation among those involved in the project activities.

Before setting up a trial-1, farmers were invited to a meeting where they were told about the project. At this meeting they were informed about their technological problems and the solutions which could be presented by the extension workers. This type of relationship (technicians-farmers) could be called 'doctor-patient'. They were also informed about rural extension activities to be developed, and were invited to follow the development of the trial-1s, from soil preparation to harvesting. In this last phase, the extensionists presented the production data, productivity and profitability of the trial-1 developed by the researchers. However, it was rare that any researchers were involved, except when classes were organised for the farmers.

g. Evaluation

After harvesting at trial-1, researchers, using their records and information from the extension workers, would evaluate the economic and technical performance of sugar cane. These results then were sent to the institutions involved and to IAA-Planalsucar headquarters. The co-operatives or unions were free to decide if they would make the results available to their members. The extension service would also send its report to the same institutions. Depending on the validity of the results, the media would be invited to make them known to the public.

2.4.2 The Participatory Project

As the Participatory Projects were based on the Pilot Projects, their activities were developed in the same way (see item 1.1 of this chapter). Considering, that they were implemented in different regions throughout the country, some methodological aspects were adapted to varying situations.

2.4.2.1 Organisation

As in the Strategic Projects agreements were made with class organisations. However, sugar cane mills did not participate. Instead of being responsible for operations, they provided technical and financial aid to the activities in general. All class organisations at a regional level were unconditionally invited and numbers were not limited. Everybody who wished could participate. EMBRATER was also invited to join the agreement this time, not as executor, but as co-participant. Following this, researchers and extensionists had a meeting to discuss the procedures and technical recommendations for technical language uniformity. Extension workers received training in participative methods. Each ARDT received orientation from IAA-Planalsucar general headquarters to work with at least one Participatory Project. The responsibility for project activities as a whole would be shared by IAA-Planalsucar, co-operatives, unions, extensionists and farmers themselves.

2.4.2.2. Development and Strategy

The Participatory Projects were not a priority for IAA-Planalsucar. The theoretical foundation for these was based on a combination of FSR and FPR approaches, involving significant farmer participation. According to Biggs' (1987) typology, the Participatory Project could be classified as 'Collaborative' and 'Collegiate'. The Project was meant to be directed at resource-poor farmers. Actions had to be taken in conjunction with the farmers, so that the technicians could understand the farmers' own experience. Farmers' indigenous knowledge had to be respected and considered in making the technical decisions which would follow. Execution at field level was developed by researchers and extensionists without using conventional strategies of rural extension. The extension service accepted this as a condition for being allowed to participate. It was one of the reasons why the extension service had only modest involvement with the Participatory Projects. Therefore, in some cases, researchers had to work directly with farmer organisations since the Ematers did not want to take part in this new approach.

2.4.2.3 Methodology

a. Analysis of Population

Researchers and extensionists had meetings and, according to their experiences in the region, they tried to identify those sugar cane municipalities which were more socially and economically deprived. No socio-economic and technological characteristics of the municipal area had yet been obtained. Secondary data from the official records could be consulted but only to identify those municipalities to be included. The technicians could decide without consulting their superiors, who were merely informed of the decisions taken.

b. Selection of the Project Population

After the municipalities had been selected, the technicians tried to classify them according to social, cultural, economic, educational and health characteristics using secondary data and their own experience in the region. This classification was not as sophisticated as in the Strategic Projects. It aimed to identify deprived communities within the chosen municipality . After that, a pre-selection was made for each municipality and then local leadership consulted. In some cases, after the local consultation, other communities were included. It did not take into consideration any institutional strategic interests but only the community's level of deprivation. The work had to be community-oriented and all problems, even if non-technical, had to be taken into account as far as possible. The technicians had the same decision-making power as in the previous phase above. The institutions were informed about decisions taken so as to be prepared for the initial contacts with farmers and other community representatives.

c. Identification of Needs

After the selection process described above, the whole community was gathered together and informed about the objectives of the programme to be set up. This meeting was the starting point for researchers and extensionists for intensifying the use of participatory methods. Applying the same methodology as in the Pilot Projects, technicians tried to identify the socio-economic and technological conditions of selected communities. On conclusion of the survey, the data was discussed with the community, which either approved it or not, with a view to proceeding to needs identification together. The technicians worked as 'animateurs' using the *Esquema do Arco* (Maguerez, 1969) already mentioned, helping farmers in this process. However, as they were not accustomed to this particular participatory exercise, it was very difficult to get them to identify their own needs. Many meetings were held without obtaining from them any word or statement.

One particular procedure, however, was carefully followed: at no time were they informed of the conclusions arrived at earlier by the researchers on the surveyed production systems. In the traditional approach, the 'recipe' would have been turned over to extensionists and they would have had to 'persuade' the farmers to adopt it. In the Participatory Project, however, discussion and queries continued until a consensus among all the farmers was reached. In the early stages of this approach, therefore, it can be said that it was characterised by great difficulty in obtaining a clear definition of the problem. In some cases, the needs identified were not of a technical nature, and technicians tried to involve representatives of the local authority to help with solutions. This phase confirmed the experience gained in the Pilot Projects and it pre-supposed a lot of hard work, because of peoples' lack of experience in participation.

Bearing in mind the fact that the other phases were identical to the Pilot Projects, the major contrasting features of the kinds of Projects analysed here are now presented briefly in Figure 4.5 below.

Figure 4.5 - Characterization of the Projects

Character	Participatory	Strategic
1. Theoretical Framework	FPR and FSR combination	Conventional FSR
2. Approach	Participatory	Persuasive
3. Biggs' Tipology	Collaborative and Collegiate	Contract and Consultative
4. Implementing Team	Institutions and farmers	IAA-Planalsucar
5. Execution Team	Technicians [1]	Extensionists
6. Agreement's Objectives	Technical and financial co-operation to develop all action	Financial co-operation to contract extension services
7. Training's Objectives	Unification of technical procedures and recommendations/ use of participatory methods by the technians	to improve the extensionists' sugar cane technical standard
8. Analysis of Population	Technicians using secondary data -if necessary	Researchers using secondary data with consultative inputs from industries and co-operatives - if required
9. Selection of Population	Technicians and farmers	Researchers with consultative inputs from institutions
10. Population	Community	Group
11. Identification of Needs	Farmers	Researchers - farmers involved
12. Definition of possible solutions	Technicians and Farmers - ITK considered	Researchers - farmers involved - ITK not considered
13. On-farm Trials - OFR-Local	Farmers' land	Farmers and Industries' land
14. Types of OFR	Trial-1,Trial-2 and Trial 3	Trial-1, Trial-4 and Trial-5

15 Who decides on Trial design/content	Technicians and farmers	Researchers
16 Who manages the trial	Technicians and farmers	Researchers
17. Research process	Technicians decide jointly Degree of participation varies according to the type of problem and experiences	Researchers dominate all decisions - farmers involved
18 Dissemination	Farmers - no strategy	Extentionists - with extension methodology
19. Evaluation	Technicians and farmers Whole action's economical, social, technical, political, methodological aspects	Researchers - trial's economics and technical aspects
20. Farmers/researchers relations	Equal partners	'Teacher-pupil'
21. Farmers/extensionists relations	Equal	'Doctor-patient'
22. Extensionists' Role	Activities of support such as help in the surveys, diagnoses, identify sites, to invite farmers to meetings among others	To persuade farmers to adopt technologies
23. Researchers' Role	Motivators	Teachers
24. Records and reports	Farmers with technicians' assistance	Reseachers with extensionists' information

(1) Researchers and extensionists

2.5 Research Within the Plan

The main objective of research was to study through social research methods, experimental and quasi-experimental, the new approach implemented by IAA-Planalsucar, in an attempt to substantiate it scientifically or to propose a new approach. At the same time, the professionals who were to undertake the activities were to receive training since it was not always available at the universities. This was centralized at the IAA-Planalsucar's headquarter by the Technology Diffusion Improvement Programme for the Sugar Cane Sucro-Alcohol Agroindustry, listed already, which consisted of four integrated research projects.

The first project is concerned with the sugar cane farmers' typology. By applying discriminating analysis, mathematical techniques and multifactorial statistics, the farmers are grouped according to their social and economic features and their needs. This classification permits a homogeneity among chosen sugar cane farmers included in the Strategic and Participatory schemes. The second project is aimed at analysing technology generation and dissemination using the participatory approach. It is intended to check the effectiveness of the Participatory Projects and their superiority in relation to the conventional FSR approach, as represented by the Strategic Projects. The third refers to technology generation and dissemination using the traditional FSR approach. It aims at checking the effectiveness of the Strategic Projects and their superiority in relation to the participatory research approach, as represented by the

Participatory Projects. The last project endeavoured to study the degree of integration among research, teaching and productive sectors through researchers, lecturers, extensionists, who were part of the government organisations and NGOs, and farmers involved particularly in the participatory approach.

The research was to be developed within the *Plano Trienal*'s field of activity, using representative sample-regions over four years, involving interdisciplinary teams of lecturers, scholarship students (scholars-graduates and post-graduate professionals), under the coordination a lecturer from the participating universities. These were the University of São Paulo, the Rural University of Minas Gerais, the Rural University of Pernambuco and the Federal University of Paraíba. In order to operationalise the research, technical and financial cooperation, agreements were made between IAA-Planalsucar, the universities above and the following organizations: The National Technical Development and Research Council (CNQp), The Interamerican Institute of Co-operation for Agriculture (IICA) the National Bank for Social Development (BNDS) and the World Bank.

3. Difficulties with Farmer Participation in Practice

3.1 Government Policy

From 1964 to 1985 Brazil was under a military dictatorship characterised by dramatic changes in the policy input and policy-making structure. Economic policy was once more focused on economic growth, based on a 'conservative modernisation', "which seeks to mobilise domestic and export surplus while retaining the present unequal structure of landownership" (Goodman and Redclift,1981). Any attempts to stimulate the rural sector were determined by the view that this sector was a mere source of export material. This period was also the 'golden age' of planning, to the extent that a new government ministry was created for this specific task. The technocratic approach to development was the order of the day. The official policy decision-making process was in the hands of technical personnel who all obeyed the central government. It was a time where the people received 'packages', or 'recipes' which were to be followed, which in themselves met the specifications made by those above in their plans for those below. Only powerful interest groups were invited to participate. In addition this period was characterised by the variety of financial subsidies given to multi-national enterprises, as it was thought that foreign capital would stimulate national production and lead to economic growth.

As a direct consequence of these policies the degree of popular participation allowed, which had been encouraged and stimulated during the Kubitschek and Goulart presidencies which preceded the military government, was severely cut back. Thus, a paternalistic attitude on the part of the Government, towards the people and their needs was taken. The government sought to aid the needy, the poor, the hungry, those living in misery, by means of a series of palliative short-term solutions such as temporarily subsidies, cane prices or credit.

This created a degree of mistrust and disbelief among people when these were confronted with activities bearing traces of an alternative approach to finding solutions to their problems. Any attempts to stimulate people to become aware of their own abilities to analyse their own situations were both mistrusted by farmers and regarded as subversive by the government. The farmers' cautious attitude during the initial phase of the Pilot Projects is an example, as well as the fact that the person who created the new approach was transferred for overseas training, which led to a delay in implementing IAA-Planalsucar's diffusion initiative.

3.2 The Institutions Involved

Due to these wider political constraints, most technicians and institutions involved in this activity did not in reality believe in the seriousness of the proposal. Initially, however, the institutions involved were more concerned with safeguarding their own interests. IAA-Planalsucar, for example, sought to 'satisfy' the large suppliers of sugar cane (*os grandes fornecedores*) and the *usineiros* , from whom it sought answers to its investigations derived from both new and traditional sugar cane growing areas. Co-operative officials, showed 'interest' in solving their members' problems, but were, without exception, more concerned with maintaining their jobs. The units of industrial production, who had the very real objective of obtaining more raw materials, albeit by restricting themselves to the cane-growing areas, were concerned mainly with inter-factory competition. Finally, the rural extension services sought to stimulate integrative action as a means of safeguarding their own space. These particular concerns brought with them serious problems, since the technical personnel involved in the plan found themselves serving 'two masters', integrative action and the interests of their employing institutions. It must be emphasised that, with respect to the last point, what lay at the core of the issue was the survival of the technicians, that is the preservation of their jobs. As an example, one could quote the attitude of the team that elaborated the Plan, expressed through the definition of the *Plano Trienal*'s objectives, directives and strategies. The team sometimes attempted to emphasise participation, dialogue and integration, but at other times, adopted on the contrary, more traditional positions. This situation resolved itself little by little as the farmers started to make the plan viable and, in turn, began to make themselves understood.

3.3 The Farmers

Brazil has never experienced politically favourable conditions allowing democratic participation in national concerns. This situation was aggravated under the the dictatorship. This lack of participation resulted in what Freire calls the 'culture of silence'. People in general, and the small farmer especially, at any meetings seeking to define a solution to their problems, reacted with apathy, disbelief and a lack of confidence. These obstacles were identified during the implementation of the plan, as they occurred in the Pilot Project, and were the cause of serious problems, mainly during the phase in which farmers' concrete needs were identified.

This was also true during the first contacts with the communities. The farmers took part in the initial meetings, almost under duress, for fear of losing out on benefits given by the *usinas*. The people thus always took part expecting to 'receive' something in a paternalistic way without asking questions about it, a response to the situation of oppression and exploitation in which they found themselves. They went to these first meetings, but in reality the farmers were not interested in questioning their situation, they were merely present, physically but silent. For the most part, farmers omitted information about their farming systems and they found it very difficult to concentrate on the central objective of the meetings, which could be seen in the way that they enquired after the possible 'benefits' that were being offered them. It took many visits and conversations of an informal nature before the farmers started to awaken and show some interest. There was no real sense of the potential benefits that the opportunity to participate could offer them. There was no sense of solidarity, each farmer being preoccupied with his own personal problems. In other words there was no group consciousness in the majority of cases. In this context, during the *Plano Trienal*'s implementation, it was generally difficult for the technicians to act as facilitators with a view to encouraging farmer participation.

Chapter V - An Introduction to Selected Projects

The data in this section relates to the situation before the implementation of the projects (pre-test) and will be briefly gathered together, in three sections: General Data, Population Profile and Farmers: Outline. It is derived from secondary data and questionnaires which were completed during fieldwork in Brazil as well as through participant observations within IAA-Planalsucar's programme.

For the purpose of data analysis, the projects were coded. This subject will be explained in more detail in the next chapter, but it is necessary to explain the procedures which were used in this coding.

Codes

(a) C = Classes of Farms

C1 = Small Scale Farmers

C2 = Medium Scale Farmers

C3 = Larger Scale Farmers

(b). T = Technology

T1 = Simple

T2 = Non-Simple

(c) A = Approach

A1 = Participatory

A2 = Persuasive

The classes of farms, were defined considering the classification of each region or municipality used by the farmer's class organisations and theoretically substantiated by Lavorenti et al., (1979a,1979b,1979c; 1980; 1981; 1984 and 1985) and ASEE/IAA-Planalsucar (1985). Thus, a farmer group classified as small-size in a municipality or region could be labelled as medium or large-scale in another area. For the farmer classification the above authors and class organisations took into consideration the following aspects: farm size, sugar cane production, sugar cane area cultivated and farmer's assets. The classification was composed from various categories, however, the three most important were: small, medium and large.

The technologies followed these criteria: (a) Simple technologies were the ones that did not require great structural change, and therefore little material and human resources were necessary for their adoption. (b) Non-Simple technologies were the reverse. Application of fertilizers would be an example of the first, while soil conservation (building terraces) can be considered as Non-Simple technology. The approaches were extensively explained in item 2.4 of Chapter IV.

The level of organization of each group/community was based upon the following indicators: individualism, cohesion, critical awareness, socio-economic dependency, organisation, ignorance, suspicion, isolation, solidarity, participation, initiative, articulation, administrative experience and motivation. The levels were classified as high, regular, low and none.

Project 1 - C1 T1 A1

1. General Data

This project was implemented in the community of Vanglória in the municipality of Pederneiras, State of São Paulo. The municipality had 32,645 inhabitants (IBGE,1987) and was 350 kilometers (km) from São Paulo, the capital city. It involved 45 small-scale farmers. The project (simple) technology consisted of the particular sugar cane variety used. According to the Sugar Cane Suppliers Association of Lençóis Paulista region (*Associação dos Fornecedores de Cana da Zona de Lençóis Paulista*) the classification of the farmers in the municipality was as follows:

Category	Area (hectare-ha)	Production (ton)
Small	< 20	< 1,000
Medium	21-50	1,000-10,000
Large	> 50	> 10,000

The participating institutions were: the Association and Co-operative of Sugar Cane Growers of the Lençóis Paulista region and the Sugar-Cane Union of the Lençóis Paulista region. Project activities began on 12.08.84 and when the field work was carried out (12-14.10.88), the project had 20 farmers participating who were all interviewed. The community had taken on the Project activities.

2. Population Profile

Among the farmers who participated in the original survey 60% were aged between 40 and 60 and 90% were illiterate. Agriculture was the main activity and only three farmers practiced other professions. 65% of the families had 3-6 children. 45% utilised family manpower at no wage and 35% of these had household members working for a wage on other farms and 65% received financial help from their family. Only 15% had any other income source. 70% of farmers lived on the farms, which were supplied with water and electricity, television sets and radios (95%) while 80% of the farmers had their own car. 85% of the farmers owned their farms and 15% owned more than one farm. They were all members of the farmers' organisations. All had received technical assistance from the agronomic department of the co-operative, 50% utilised rural credit and 75% had never adopted new technologies. The community was considered conservative. None of them knew of IAA-Planalsucar, the extension service and the technical department of the sugar cane mill. By way of community/group organisation indicators mentioned, the community had an average level of organisation.

3. Farms: Outline

All farms were smaller than 20 ha, with a flat topography and soils such as purple and dark red latosols of medium fertility and , the average annual rainfall was 1,800 mm. 80% of the cultivated area was planted to sugar cane, which yielded a harvest of 1,200 tonnes with an average yield of 50 tonnes per hectare. The farmers cultivated plant cane (70%). 15% did not need to renovate their sugar-cane area (to destroy old sugar cane and to re-plant) [1] and only 5% intercropped staple food with sugar cane. Rice, beans and maize were the single crops planted. 75% of farmers did not raise beef cattle and those who did had no more than two head. 30% raised 1-2 head of dairy cattle and none of the farmers raised draught cattle. In relation to machinery and equipment: 70% did not own trucks, 95% did not own utilitarian vehicles, 50% did not own tractors and 75% did not own mechanical grabbers. All the farmers cultivated their land using mechanical traction (owned or hired) [2] and did not use modern inputs. On the farms, 65% had income from sugar cane averaging 90%-100% of gross income. The majority of the farmers (80%) had a net income of US$1,000.00 per year. They cultivated other single crops (60%) and among these, only 35% sold the harvest surplus on the open markets (*feiras livres*). The sugar cane production was delivered to the São José Sugar Cane Mill, with 80% of the farms 1-10 km from the sugar cane mill. All the farms were located more than 200 km from the IAA-Planalsucar's experimental station and 60% were between 11-20 km from Lençóis Paulista where the banks, the Co-operative, association and Union were situated. All farmers managed their own farms. Family labour represented 89.7% of the total work force. The paid labourers were seasonal workers or non-permanent workers (*bóias frias*). Before the establishment of the project, the farmers had indicated seven different technological problems in their production units of which the variety of sugar cane was the most serious.

Project 2 - C1 T1 A2

1. General Data

This was set up on the colonization project of the National Institute of Agrarian Reform (INCRA), located in the Municipality of Agua Preta, with 38,528 inhabitants at that time (IBGE,1987). The municipality was 100 km from the capital city, Recife, state of Pernambuco. The farm (*Engenho Belamonte*) where the Project was implemented, was in the area which was owned by *Usina* Catende and after the settlement (1978) the farmers began sugar cane plantation. The *engenho* had 45 families planting 400 ha of sugar cane with a production of 22,500 tons (harvest of 1983/84). The regional stratification, under responsibility of *Associação dos Fornecedores de Cana do Estado de Pernambuco* (Sugar Cane Suppliers Association of State of Pernambuco) was as follows:

Category	Area (ha)	Production (ton)
Small	< 20	< 500
Medium	20-50	500-5,000
Large	> 50	> 5,000

The 45 participating farmers were all small-scale farmers, without any previous experience as owners. The technology implemented was a new variety of sugar cane and EMATER and the *Sindicato dos Plantadores de*

Cana de Pernambuco (Sugar Cane Growers Union of Pernambuco) were the participating institutions. Project activities began on 02.10.84 and during the fieldwork period (12-14.09.88) the activities had stopped because of a lack of agreement between the Emater and IAA-Planalsucar. 21 farmers were interviewed.

2. Population Profile

With one exception, the farmers were aged between 41 and 50 and 30% were illiterate. They were all farmers but 52% had other activities. 95 % of the families had more than three children. All farmers utilising family manpower worked for a wage on other farms (100%), as well. Among the farmers, 62% received financial help from their families for the household budget. All had agriculture as the main income and 52% had other sources of income. 100% lived on the farm, did not have water and electricity facilities nor owned a car, 80% had a television set and 72% a radio. The farmers owned their farms and were all members of farmer organisations. They had already received technical assistance, did not use rural credit and 90% had already adopted techniques recommended by research, but knew EMATER and none of them had heard of IAA-Planalsucar. The community had little collective organisation.

3. Farms: Outline

Although the settlers did not cultivate more than 20ha each, the plots were between 30 and 50 ha in size. The cultivated areas consisted of sugar cane (90%), banana and manioc. The topography was classified as hilly land, with soils such as red and yellow latosols and red and yellow podsols, from medium to low fertility with an average annual rainfall of 2,000 mm. Their sugar cane production was smaller than 500 tonnes, with a yield of about 30 tonnes per hectare. All farms had more than half of the sugar cane areas in need of renovation (the remnants of the *usina*'s sugar cane plantations remainder), 57% had plant-cane and none of them had sugar cane intercropped with food. In relation to livestock, 23% raised 1-3 units of beef cattle, 72% had 1-2 head of dairy cattle and did not raise draught cattle. The farms did have vehicles, machinery, equipment and tools (mechanical traction or animal drawn). All agricultural practices were carried out manually. Only one of the farmers used fertilizers and three cultivated new varieties of sugar cane. They sold their sugar cane production to the *Usina* Catende, the sugar cane income provided more than 90% of the farms' gross income. The farms cultivated other single crops which were delivered to the local markets (*feiras livres*) and, only one farmer used this food crop production for family consumption. 80% of the farmers had a net income of less than US$ 1,000.00. All the farms were located about 10 km, 100 km and 9 km from the "Usina", IAA-Planalsucar and town, respectively. The farmers managed the farm activities themselves. They used paid labourers (*bóias frias* and sharecroppers), only during the sugar cane harvest, representing 36.4 % of the total manpower. During the survey period the community pointed out 15 distinct technological problems, of which cane variety, soil preparation and fertilization were the most important.

Project 3 - C1 T2 A1

1.General Data

The Project was implemented in the communities of Bonsucesso, in the Municipality of Urucânia, state of Minas Gerais. The Municipality had 10,114 inhabitants (IBGE,1987), and was 202 km from Belo-Horizonte, the capital city. According to the *Cooperativa de Crédito Rural de Ponte Nova* (Rural Credit Co-operative of Ponte Nova) the classification of farmers in the region was as follows.

Category	Area (ha)	Production (ton)
Small	< 20	< 300
Medium	21-50	300-3,000
Large	> 50	> 3,000

EMATER, the *Escola Estadual Helder de Aquino* (State School Helder de Aquino), the local parish, the *Superintendência de Desenvolvimento Cooperativista* (Superintendency for Co-operative Development) and the co-operative above were the participating institutions. Project activities began on 06.09.84 and 38 small-scale farmers took part. The selected technology was sugar cane intercropping and food crop. When the fieldwork was carried out (20-21.09.88) the community had taken over the Project and among the farmers who had participated in the beginning, 20 were interviewed.

2. Population Profile

All the farmers were aged between 40 and 60, 70% being less than 50. Half of them were literate and the rest were equally divided into illiterate and those who had completed primary school. They practiced agriculture as their main activity and four of them had other professions. As regards family size, 80% had more than 3 children, all utilized family labour, who also worked for a wage on other farms, and the majority (52%) of the farmers received financial help from their families. Except for three farmers, all of them had sugar cane as the only source of income, 80% lived on the farms which had neither water nor electricity supplies. 80% of the farmers did not watch television, 75% did not have a radio and only three of them had their own car. They all owned their own farms, two owned more than one farm and one rented a second farm. The farmers were all members of their representative organisations and three of them were members of political parties. They had never had technical assistance, only one utilised rural credit and no one had adopted modern technologies. The community was considered conservative by technicians, and it had a low level of organisation. The farmers only knew of the co-operative and Emater.

3. Farms: Outline

The farms were smaller than 20 ha, with sugar-cane representing 95% of cultivated areas with beans, maize and coffee as the other crops. The topography is hilly land, the soils were red and yellow latosols and red and yellow podsols, of medium fertility and the average annual rainfall was 1,400 mm. Sugar cane production was less than 300 tonnes with an average yield of 37 tonnes per hectare. 85% of the farms, except for one did not grow plant cane, had half of their sugar cane area which needed to be renovated. They did not plant staple food intercropped with sugar cane. Only 10% raised 1-2 beef cattle head, 20% raised the same number of dairy cattle and 10% raised the minimum of 2 draught cattle head. One farm had one truck, the other had one utilitarian vehicle and none of the farms had either tractors or mechanical grabbers. All the agricultural practices were carried out using animal power and manual labour, 85% used fertilizers and 65% planted sugar cane varieties recommended by the research service. The annual sugar cane income was 95% of gross income and all the farmers managed their own farms. The sugar cane harvest was delivered to the *Usina* Ana Florença and only one farm sold the single crop surplus on the open markets. The farmers had a net annual income of less than US$1,000.00. The *usina*, IAA-Planalsucar experimental station and Ponte Nova (the municipality where the farmers carried out their business) were located no more than 10 km, 5 km and 20 km from the farms, respectively. 55% of farm labour consisted of unpaid family members and the remainder were all *bóias frias* (temporary workers). The percentage of family manpower was 62.3% of the total work force used by the Project group. The farmers had indicated four different technological problems, the main problem being sugar cane intercropping.

Project 4 - C1 T2 A2

1. General Data

This Project involved 34 farmers who lived in the Cardoso Moreira district in the municipality of Campos, state of Rio de Janeiro. The most up to date population data currently available for Campos (as well as the other population data reported in this section), were derived from the census taken in 1987 (IBGE), at which time the population was 366,176. Campos is 188 km from Rio de Janeiro, the capital city. The *Cooperative de Crédito dos Plantadores de Cana do Estado do Rio de Janeiro* - Coperplan (Sugar Cane Growers Co-operative of State of Rio de Janeiro) identified the following stratification for farmers in the region:

Category	Area (ha)	Production (ton)
Small	< 10	< 500
Medium	11-30	500-2,000
Large	< 30	< 2,000

The Coperplan and Emater took over project activities with the IAA-Planalsucar. The farmers were all small and the project technology was the Improvement of Sugar Cane Production Systems to PCTS (refer to Chapter V, item 1.3). The first project intervention was implemented on 08.12.84 and when the field research was carried out (03- 08.08.89) the project had been abandoned by the institutions due to financial problems. 19 farmers were interviewed.

2. Population Profile

68% of the farmers were aged between 40 and 60, 52% had attended junior school and 26% were illiterate. Only one of them was not a professional farmer, 53% had other activities and 89% had more than three children. All the farmers ultilised family labour of which 48% worked for a wage on other farms. 47 % of the latter helped the farmers with their household budget. The only income for 52% of the farms was from sugar cane. At the time of fieldwork, 58% lived on the farm and those who did not were owner-occupiers in an urban area, except one farmer who lived in privately rented accommodation. All the accommodation had water supplies, a television set and a radio, 89% had electricity and no household had a car. The majority of farmers (89%) owned their own farms and five owned two farms. They were all members of their organisations and only 15% were members of political parties. In the project group only one farmer had been assisted by technicians, two used rural credit, 42% had adopted modern technologies and 57% knew the institutions involved. The group did not have any community organisation.

3. Farms: Outline

Farmers had areas less than 10 ha, 98% cultivated with sugar cane. The topography was flat -*baixada fluminense* (Lower Fluminense), soil was of the yellow latosol type of low fertility and the average annual rainfall was 1,250 mm, which was very poorly distributed, with long periods of drought. 68% had an average sugar-cane production of 300 tonnes and the rest of them produced less than 400 tonnes, with a low yield of 35 tonnes per hectare. 21% grew plant-cane and all the farms had half of the sugar cane area planted with non-productive cane. Only one farmer had sugar cane intercropped with food crops. 74% of farms did not raise beef cattle, the rest of them had 1-2 units, 63% raised one head of dairy cattle and 52% raised 2 units of draught cattle. One farmer had one truck and none of them had utilitarian vehicles, tractors or mechanical grabbers. All the farmers cultivated their land using animals and manual labour, 42% planted new cane varieties and 15% used chemical fertilizers. On 73.6% of farms sugar-cane accounted for 90%-100% of gross income whereas the other farms had sugar cane which accounted for only 50%-70% of the gross income. The sugar cane harvest was delivered to the *Usina* Carapebus, 40 km away from the farms. The net income of the production units was less than US$ 1,000.00 per year and all the farmers managed their own farms activities. The IAA-Planalsucar was situated between 50 and 100 km from the farms and Campos was 30 km away. Family members were the main labour force used by the farmers, representing 99.2 % of the total manpower. The paid labourers were seasonal workers and were only utilized in the harvest season. When the questionnaires were completed the farmers pointed out 15 different technological problems, of which sugar cane yield and cane varieties were the greatest.

Project 5 - C2 T1 A1

1. General Data

The community of Milhã, consisting of 40 families of Italian immigrants, located in the Municipality of Capivari, state of São Paulo, was the Project area. In 1987, the municipality population was 31.480 (IBGE), was situated 50 km from Campinas and 141 km from the capital city, São Paulo. According to the *Organização dos Plantadores de Cana do Estado de São Paulo* -ORPLANA (Sugar Cane Growers Organisation of the State of São Paulo), the institution that united all Sugar-Cane Associations in the State, the classification of the farmers in the municipality was the following.

Category	Area (ha)	Production (ton)
Small	< 20	< 1,000
Medium	21-50	1,0000-3,000
Larger	> 50	> 10,000

The Project group consisted of small scale farmers and the technology used was the IAA-Planalsucar's sugar cane variety. In the case of São Paulo, in order to execute the IAA-Planalsucar's plan an agreement was signed with ORPLANA. The *Associação dos Fornecedores de Cana de Capivari*, a representative of ORPLANA for the region (Sugar-Cane Suppliers Association of Capivari), *Cooperative dos Plantadores de Cana de Capivari*

(Sugar Cane Growers Co-operative of Capivari), *Sindicato Rural dos Plantadores de Cana de Capivari* (Sugar-Cane Growers Union of Capivari), the State Rural Extension Service [3], and the University of São Paulo. The first Project activity took place on 02.09.84. At the time of fieldwork (05-12.10.88),the union had taken over the Project. 20 farmers were interviewed.

2. Population Profile

50% of the farmers were aged between 50 and 60 years, 25% between 40-50 years and the rest of them were more than 60 years old. Among them 55% had completed primary school and 45% were illiterate. All the participants in the project were professional farmers and only one of them practiced another profession. 65% of the families had more than three children, 90% utilised family labour and of this workforce 25% worked for a wage on other farms. None of the farmers received any financial help from their families and only one farmer had any other source of income. 60% lived on the farm and those who did not owned their own houses. All their accommodation had water and electricity supplies, a television set, a radio and 95% had their own car. Except for one farmer, who rented his farm, the others were all owner-occupiers with two units. They were all members of farm organisations and 10% were attached to political parties. None had received any technical assistance, 25% had already used rural credit and 45% had adopted new agricultural practices. They knew all the institutions involved and also of the existence of the sugar-cane mill's technical department. The level of organisation of the community was considered low by the workteam.

3. Farms: Outline

The Project farms had areas of between 5 and 20ha, with 80% of the cultivated area planted to sugar cane on a flat and slightly hilly topography, and the prevailing soils were red and yellow podzolic. The average annual rainfall was 1,460 mm, with adequate distribution through the year. The region was exposed to temperatures below freezing point in June-July. The other crops cultivated were beans, maize, tomato and rice. The overall average sugar-cane production was between 1,200 and 3,000 tonnes, with a yield of 45 tonnes per hectare. All the farmers grew plant-cane following technical recommendations (1/5 of the sugar cane area) and this figure decreased to 10% in the sugar cane re-planting area. Half of the farmers cultivated food intercropped with sugar cane. Only one farmer raised beef cattle (20 units), 40% had 3-5 head of dairy cattle and one farmer raised 6 units of draught cattle. 75% of farmers had trucks (one unit each), 39% utility vehicles, 90% had a minimum of one tractor and 65% had mechanical grabbers. All the farmers prepared their land using mechanical traction, 10% planted the cane variety recommended by research, none of them used fertilizers and 90% controlled weeds with herbicides. 65% of the farms' sugar cane income accounted for 90%-100% of the gross income. Sugar-cane marketing was done through the *Usinas*: Santa Cruz, São Bento, São Francisco, Bom Retiro e Santa Maria. The greatest distance from the *Usinas* to the farms was less than 20 km, with 55% of the farms located 10 km from the factories. Most of the farms (95%) produced single crops, and from these 55% sold their harvest to the Centre of Food Supply-CEASA (*Central de Abastecimento*). The farms had a net income of between US$ 2,000.00 and US$ 4,000.00, with half of them not exceeding US$ 3,000.00. All the farmers managed their own farms. The IAA-Planalsucar was 100km from the farms and 7km from Capivari. All the farms utilized paid labourers, *bóias frias*, representing 77% of the total manpower. 13 different technical problems were pointed out by the farmers, the greatest being poor sugar cane variety.

Project 6 - C2 T1 A2

1. General Data

The project was implemented in the municipality of Mamamguape, State of Paraíba. The municipality had 44,029 inhabitants (IBGE,1987) and was 50 km from João Pessoa, the capital city. The Project group consisted of 42 farmers, all medium-sized, according to the stratification below identified by the Sugar-Cane Growers Association of Paraíba- ASPLAN (*Associação dos Plantadores de Cana da Paraíba*):

Category	Area (ha)	Production (ton)
Small	> 20	> 300
Medium	21-50	300-1,200
Large	< 50	< 1,200

Project activities began on 05.03.84 , its target technology was cane variety and ASPLANA was responsible for its execution. When the survey was carried out (07-10.09.88) the project had been abandoned by the institutions due to financial problems and its activities had stopped. 20 farmers were interviewed.

2. Population Profile

The majority of farmers were aged between 41-60 (55%), 60% were literate and the others had completed primary school. Agriculture was the main activity and only 25% of the total group practiced other professions. 90% had more than four children and the rest had more than seven. Among the farmers 85% utilised family manpower of which 60% worked for a wage on other farms. Only 85% received financial help from the family in the household budget, all the farmers had agriculture as their main income source and 60% had income from other sources. None of them lived on the farm and 95% lived in rented houses. These had water and electricity supplies, a television set and a radio. They did not have their own car, most of them were farm owners (85%) and the others rented their farms. None owned or rented more than one farm. They were all members of their class organisations and there were only two members belonged to political parties. They had never worked with technicians, 100% did not utilize rural credit and 35% had adopted new technologies. They had only heard about IAA-Planalsucar and the technical department of ASPLANA. According to the work team's evaluation the group did not have any level of organisation. The majority got to know each other only.

3. Farms: Outline

The farms involved were between 20 and 50 ha in size, with nearly 100% of the total area planted to sugar cane. The topography was flat, with soils common to the coastal plateau known as *Tabuleiro Costeiro*, sandy woodland savanna with very low fertility. The average annual rainfall was 1,800mm, with an irregular distribution throughout the year. The farms had harvests of less than 1,200 tonnes of sugar cane, with an average yield between 30-40 tonnes per hectare. 20% of them grew plant-cane, only one farm re-planted its old sugar cane plots according to technical recommendations and no farmer cultivated food intercropped with cane or a single food crop. They did not raise any beef cattle, dairy cattle or draught cattle and did not have any type of machinery, equipment or implements. Agricultural practices were based on mechanical traction and manual labour. They rented tractors and tools from the *Usina*. The farmers did not cultivate new cane varieties, 60% used chemical fertilizers and 95% herbicides. All the sugar cane harvest was sold to the distillery AGICAN (Alcohol factory), which was 5-10 km from the farms. The project group only had sugar cane as a source of income and had an annual net income of between US$ 1,000.00 and US$ 2,000.00. They managed their own farms, which were approximately 10 km from the IAA-Planalsucar station and Mamanguape. There were paid labourers (*bóias frias*) on the farms representing 80% of the total manpower utilized. During the survey eleven different technological problems were determined, of which an inadequate sugar cane variety was the greatest problem.

Project 7 - C2 T2 A1

General Data

The Project group had 45 families and the target technology was the IAA-Planalsucar's sugar cane variety. They lived in the community of Pitombeiras in the Municipality of Ceará-Mirim, state of Rio Grande do Norte. At the time of the survey, Ceará-Mirim had 41,447 inhabitants (IBGE, 1987), and is situated 52 km from Natal, the capital city. The stratification of farmers in the municipality below was defined by the Sugar Cane Suppliers Association of Rio Grande do Norte (*Associação dos Fornecedores de Cana do Rio Grande do Norte*):

Category	Area (ha)	Production (ton)
Small	< 20	< 1,000
Medium	21-50	1,000-3,000
Large	> 50	> 3,000

Emater, *Usina* São Francisco, the Sugar Cane Growers Union of Rio Grande do Norte and the Association above were the participating institutions. All the farmers were medium-scale sugar cane suppliers and the target technology was Improvement of the Sugar Production Systems to

PCTS. The project began on 02.12.84 and when the 22 farmers were interviewed (01-05.09.88) the Project had been taken over by them. Emater's extension worker, who was responsible for the project implementation at field level had been contracted by the community. The institutions had withdrawn from the Project owing to financial problems.

2. Population Profile

The majority of the farmers were aged between 45 and 59 (86%), 68% were illiterate and the others had attended the primary school. 90% had more than three children, 95% were professional farmers and 50% also had other activities. Unpaid family labour was utilized by 36%, of which 14 % were paid labourers at other production units. None of the farmers received financial help from their families and 45% had other sources of income apart from agriculture. 72% of households were owner-occupiers and lived in the town. 72% of housing (urban and rural) had electricity supplies, a television set and a radio, 72% water supplies and 68% of all farmers had their own car. They were all farm owners and members of their organisations and 45% belonged to political parties. All the farmers had already received technical assistance (from Emater mainly), used with rural credit and only two of them could not be considered 'progressive' farmers. They only knew Emater and the level of organisation was evaluated as above average. The Project group had previous experience with community work.

3. Farms: Outline

The farms were between 20 and 50 ha in size and were planted to sugar-cane (75%), maize, beans and native grass land (pasture). Only 13% grew staple food intercropped with sugar cane. The topography was flat, soils were alluvial with difficult drainage (in the Ceará-Mirim valley) and the average annual rainfall was 1,600 mm. Sugar cane production of the farmers averaged 1,500 tonnes with 77% of them enjoying a yield of 40 tonnes per hectare and the rest less than 50 tons. 80% cultivated plant-cane and all the farmers had more than 25% of the sugar cane total area under old cane. All the farms had 2-5 head of beef cattle, 1-2 head of dairy cattle and none of them raised draught animals. The farmers did not have utility vehicles or mechanical grabbers, 27% had trucks and only one had a tractor. They cultivated their land using mechanical traction and manual labour and did not use modern inputs. The sugar cane harvest represented 71%-90% of the gross income in 90% of the farms and on the rest more than 90%. All the farmers had an annual net income of US$ 1,000.00 and US$ 2,000.00. The entire cane harvest was delivered to the *Usina* São Francisco, which was less than 10 km from the farms. The single-crop production was consumed by the farmers and the surplus sold at local markets. They managed their own farms which were located between 150 km and 10 km from the IAA-Planalsucar and the municipality, respectively. Of the total workforce used on the farms 98.1% were paid labourers, *bóias frias* and resident workers. The sugar cane variety, fertilization and drainage were the most serious issues among the ten technological problems identified by the farmers.

Project 8 - C2 T2 A2

General Data

The project was located in the municipality of Itapemirim, state of Espírito Santo. Itapemirim had 43,739 inhabitants (IBGE,1987) and was 140 km from Vitória, the capital city. At the beginning of the Project there were 46 farmers participating, all of them were medium-sized according to the classification below:

Category	Area (ha)	Production (ton)
Small	< 20	< 1,500
Medium	21-100	1,500-3,000
Large	> 100	> 3,000

The Sugar Cane Suppliers Rural Co-operative of the State of Espírito Santo (*Cooperativa Agrícola dos Fornecedores de Cana do Estado do Espírito Santo*), responsible for the above classification of farmers, implemented the Project. This began on 05.03.84, the target technology was healthy setts (*mudas sadias*) and when the fieldwork was carried out (11-13.08.88) the Project had been abandoned by the Co-operative and IAA-Planalsucar which alleged administrative problems. Its activities had stopped and 20 questionnaires were answered by the farmers.

2. Population Profile

At the time of the survey the farmers were aged between 30 and 60, 25% were illiterate, 65% with primary school education and 11% with secondary school education. 95% of the farmers had agriculture as a profession and 35% had other jobs. All the farmers had more than three children, they utilised unpaid family labour, of which 45% were paid labourers on other farms. 45% of farmers received financial help from their families, had the farms as a main source of income and 35% had other sources. Among them 55% lived on the farm and those who did not (10%) had rented houses in the town. Their accommodation had water and electricity supplies, a television set and a radio. 60% of the farmers had their own car, all of them owned their farms, 25% worked more than one farm, of which 15% were tenants. They were all members of farmer organisations and 35% belonged to a political party. None of them had worked with technicians or banks and 50% had already adopted new practices. The Project group knew Emater (100%), IAA-Planalsucar (40%) and the technical department of the co-operative (35%). After the survey the technical team concluded that the group did not have any level of community organisation.

3. Farms: Outline

Despite being situated in a traditional sugar cane area, on this Project sugar cane was beginning to be substituted by pineapple plantations. The farm areas were distributed as follows: 25% between 25 and 50 ha and 75% between 50 and 100 ha. The cultivated area consisted of sugar cane (80%), maize, beans, manioc (cassava) and pineapple, which was the second most planted crop, and 10% of the total Project farmers practiced sugar cane intercropping. The topography was of the plateau type, with woodland savanna vegetation, soils such as: red and yellow latosols containing significant acidity. The average annual rainfall was 1,200 mm, well distributed throughout the year. The average sugar cane production varied between 1,000 and 3,000 tonnes and the yield was between 35 and 40 tonnes per hectare. The farmers raised beef cattle (55%), with an average of 2-3 head per farm, 60% had the same head of dairy cattle and none of them raised draught animals. 65% had no trucks, 75% no utility vehicles, 60% no tractors and 75% no mechanical grabbers. Agricultural tasks were carried out utilizing mechanical traction (owned or hired), 55% cultivated plant-cane and all the farmers renovated their sugar cane fields without following technical recommendations. 55% planted new cane varieties and 35% utilized chemical fertilizers. Sugar cane gave a gross income as follows: less than 50% in 30% of the farms; between 50%-70% in 10%; between 71-90% in 25% of production units and in the rest more than 90% of income. All of them delivered the sugar cane harvest to the *Usina* Paineiras, which was approximately 10 km from the farms. The single crop production was sold in local markets, and the pineapple harvest to the regional fruit industries, with only 15% of the households consuming the food crop surplus. The farmers' annual net income was between US$2,000.00 and US$ 4,000.00 and they all managed the farms themselves. The farms were located around 150 km and 11-20 km from the IAA-Planalsucar station and Itapemirim respectively. The workforce used by them consisted of paid labourers, *bóias frias* (97%), and family manpower. When the farmers were questioned about the main technological problems experienced on their farms they enumerated thirteen of which planting systems and diseases were the outstanding preoccupations.

Project 9 - C1' T2' A1'

General Data

This Project, in the community of Carapebus, located in the Municipality of Macae, state of Rio de Janeiro, began its activities on 15.07.84. At the time of the census (IBGE,1987) Macae had 82,464 inhabitants, and is 168 km from Rio de Janeiro, the capital city. The classification of the farmers is the same as for Project 4 above elaborated by COPERPLAN. The Sugar-Cane Growers Association of Rio de Janeiro (*Associação dos Plantadores de Cana do Rio de Janeiro*) and the Sugar-Cane Suppliers Union of Rio de Janeiro (*Sindicato dos Fornecedores de Cana do Rio de Janeiro*) were the participating institutions. All the farmers were small according to the classification mentioned above, and the Project technology consisted of healthy setts. When the fieldwork was carried out (09-10.08.80), the Project was under the guidance of the COPERPLAN and 23 questionnaires were completed.

2. Population Profile

The majority of the farmers who participated in the Project were aged between 41 and 60, were literate (87%) and had finished primary school. Only one of them did not have agriculture as his main profession and 43% had other jobs. 82% had more than three children, 53% of them utilized unpaid family labour, 45% of which worked as paid labourers on other farms and 65% received financial help from their family. 39% lived on the farms, and of the rest, 64% rented houses in the town. 78% of their accommodation had a water supply and 82% electricity supplies, 86% a television set and 100% a radio. None of the farmers had their own car, 91% owned their farms, others were tenants and 13% owned two farms. They participated in their class organisations and 14% were members of political parties. The farmers had never received any type of technical assistance, only one of them had already used with rural credit and 56% adopted new technologies. Most of them knew about the work of IAA-Planalsucar (82%) and the technical department of the co-operative. The community did not have any level of organisation and the Project was its first experience such activities.

3. Farms: Outline

The area of the farms was less than 10 ha, with 90% of this area cultivated with sugar cane, a harvest of 500 tonnes and the yield averaging 40 tonnes per hectare. Maize and beans were the other crops. Except for one farmer, none of them grew food crops intercropped with sugar cane. The topography was slightly hilly, with red and yellow latosols, of low fertility, and an average annual rainfall of 1,250 mm concentrated in certain months. One farmer cultivated plant-cane in less than one-fifth of the cane area and 91% did not technically re-plant their sugar cane fields. 56% raised 1-2 head of beef cattle, 53% had the same number of dairy cattle and 18% raised draught animals not exceeding 2 head per farm. The Project group did not have any kind of machinery, equipment or implements. Agricultural practices were carried out utilizing animal and manual traction. The farmers used to rent draught animals. Sugar cane production was all delivered to the *Usina* Carapebus about 15 km from the farms and accounted for 90% of the gross income. 26% planted food crops and only one farmer sold the production surplus at the market. The farms' net income was less than US$ 1,000.00 annually and all the farmers managed their own farms. The IAA-Planalsucar experimental station was 10 km from the farms and the Project municipality was less than 20 km away. All the farms had paid labourers, seasonal workers and resident labourers (21%), which was 94.7% of the total manpower used by them. The farmers indicated thirteen distinct technological problems experienced by them of which erosion, cane-variety, fertilization and diseases were the most important.

Project 10 - C2' T1' A2'

General Data

This was located in the municipality of Assis, state of São Paulo. According to the IBGE census (1987), the municipality had 72,238 inhabitants, and it is 444 km from the capital city, São Paulo. The project began on 21.03.84, and involved 46 farmers, all medium-sized according to ORPLANA 's (refers to Project 5) classification below:

Category	Area (ha)	Production (ton)
Small	< 200	< 15,000
Medium	201- 500	15,000-26,000
Large	> 500	> 26,000

The participating institutions were: The Sugar Cane Suppliers and Growers Rural Association of Sorocabana Medium Region - ASSOCANA (*Associação Rural dos Fornecedores e Plantadores de Cana da Média Sorocabana*), a representative of ORPLANA and the Sugar-Cane Growers Union of the Sorocabana Medium Region (*Sindicato dos Plantadores de Cana da Média Sorocabana*). The project technology consisted of IAA-Planalsucar's sugar cane variety. At the time of research fieldwork (28.09.88-01.10.88) the project was in progress under the guidance of ASSOCANA and 20 questionnaires were completed.

2. Population Profile

The majority of the Project population (70%) was aged between 40 and 60, 85% had attended post-primary school and of this number 35% had attended the University. Half of the families who participated in the Project had more than three children, 55% had agriculture as the main profession and 54% practiced other professions. None of the farmers used unpaid labourers, 25% of their children worked but not on the farm and they did not receive any financial help from their family. All of them had agriculture as the main source of income and 65% had other sources of income. 95% lived in the urban area and were farm owners. The houses were provided with water and electricity supplies, a television set and a radio. They all owned a car and their own farms, 25% rented other farms and 40% owned other farms. The farmers were all members of class organisations, 65% were Catholics and 35% were closely linked with political parties. Four farmers had sons who had graduated in Agriculture working on their own farms, and all of them had already worked with technicians before the Project was set up. They used rural credit and had all adopted new technologies. The project group knew the IAA-Planalsucar and the technical department of ASSOCANA. The work team classified the level of community organisation of the group as low.

3. Farms: Outline

The farm areas were between 200 and 500 ha, with sugar cane occupying 60% of the total cultivated area and maize, soy bean, beans, rice and wheat being the other crops. All the farmers grew food intercropped with sugar cane. The topography was flat with the soil of the purple latosols type, known as *terras roxas*, with high fertility, well structured and drained. The average annual rainfall was 2,000 mm, falling evenly during the year. Sugar cane production was about 15,000-20,000 tonnes with a high yield of 75 tonnes per hectare. The farms had 20% of their areas cultivated with plant cane and none of them had unproductive sugar cane plots. 80% raised more than 10 units of beef cattle, 90% had at least 5 head of dairy cattle and only one farmer had 6 head of draught animals. 80% had 2 trucks and 2 tractors or more, 30% had utility vehicles and only one farm was not provided with mechanical grabbers. All the agricultural practices were mechanised, 25% planted cane varieties recommended by research, 30% used chemical fertilizers and 100% applied organic fertilizers and herbicides. On 50% of the farms sugar cane accounted for no more than 50% of the gross income while on the rest this figure rose to 70%. The cane harvest was all delivered to the *Usinas* Nova América, Maracaí e Quatá, situated approximately 20 km from the farms . The Project group sold its food crop production at the CEASA (see to Project 5, item 3) and only 20% used part of this production for its own internal consumption. The farms' annual net income exceeded US$ 20.000.00 and 75% of the farms were not managed by their owners. The nearest IAA-Planalsucar station was 200 km from the farms and Assis was no further than 20 km. There was no family labour and the *bóias frias* and resident labourers were the paid labourers. 85% of the farms were worked by resident workers. The sugar cane variety was the most important technological problem among the nine indicated by interviewed farmers.

The data presented in this section will serve as a basic reference point. It will help cross referencing among project characteristics/ performance and analysis, which will be the subject of the next two chapters.

Notes:

1. According to research recommendations one-fourth to one-fifth of the sugar cane area should be renovated annually. Old and unproductive cane should be destroyed and re-planted with a new cane. Following the same recommendation, a sugar cane plantation after its total planting is formed of: plant cane, first rattoon crop, second rattoon crop, third rattoon crop, fourth rattoon crop and some cases a fifth rattoon crop depending on soil, climate and topography conditions.

2. In sugar cane cultivation, mainly in the Northeast of Brazil, the "usinas" carry out agricultural practices for farmers with their own machinery. After the sugar cane is sold the "usinas" charge for these services, in certain cases with interest and indexation, subtracted from the sugar cane payment. The farmers receive their payment with the charges already levied.

3. In Brazil, the state of São Paulo is the only one which has its own Rural Extension Service, separate from the national EMBRATER system.

Chapter VI - Impact of the Projects I: The Statistical Focus

Introduction

The main aim of both this section and the next is to analyse the performance of selected projects, in order to provide empirical support to the central hypothesis of this thesis. The overall performance of the projects is analysed through statistical procedures. Firstly, observation of frequency distribution of qualitative variables in contingency tables (statistical analysis), discussed in this chapter and, secondly, qualitative methods, which will be the subject of the next chapter.

In this section where the quantitative analysis is developed the causal links between the research approaches used (Persuasive and Participatory) and project results are not studied. This, will be discussed in the qualitative study in Chapter VII. Furthermore, the literary style will involve the use of little actual prose text, sometimes with repetitions, which is characteristic of a statistical study.

The central hypothesis was tested using non-parametric statistical techniques appropriated to the measurement scales, ordinal and categorical, used in this study (Siegel, 1988). The hypothesis is summarised below, namely that:

The solution to farmers' technological problems could be facilitated and farmers' economic conditions improved if farmer participation were considered a crucial component in the agricultural research process.

The statistical procedures will be reviewed under the following headings: Variables, Populations, Data Collection, Data Analysis and Overall Conclusion.

I. The Variables

Two types of variables were defined: the planned and the circumstantial. The planned variables selected were the 'Classes of Farms' who participated in the projects, 'Types of Farming Technologies' disseminated, and 'Approaches' used during the research process. The circumstantial variables (see Introduction-Note No.5) were identified as the Farmers and Technicians themselves involved in the IAA-Planalsucar programme, as a whole. These variables will not be covered in this Chapter. To illustrate these points see Table 6.1 below:

Table 6.1 - Planned and Circumstantial Variables

Approaches	-	Participatory and Persuasive (Farmer Participatory Research and Farming Systems Research)
Technologies	-	Simple and Non-Simple (fertilizers, varieties, sugar cane intercropped, weed control, irrigation and drainage, soil preparation, technological adjustment, production systems, etc.)
Classes of Farms	-	Small and Medium-Scale Farmers (assets, sugar cane production, production area, area cultivated, farm size, etc.
Farmers	-	Education level, association member, social and economic situation, financial support (credit), leadership, owner or tenant, distance to experimental station and sugar cane mill, experience with sugar cane cultivation, etc.
Technicians	-	Extension workers, research workers, educators, sociologists, psychologists, communicators, etc.

In order to ensure greater consistency in the results of the study of planned variables, two separate levels were established for each one. For instance, in relation to the variable 'Technology ', the levels that were defined were 'simple' and 'non-simple' technology. The criterion used to define these levels, in relation to the Classes of Farms and Technologies has already been covered in Chapter V and the Approaches in Chapter IV. Therefore, each planned variable received the following classification, previously mentioned:

a) <u>Classes of Farm</u>

Small-scale farmers - C1

Medium-scale farmers - C2

b) <u>Technologies</u>

Simple - T1

Non Simple - T2

c) <u>Approaches</u>

Participatory - A1

Persuasive - A2

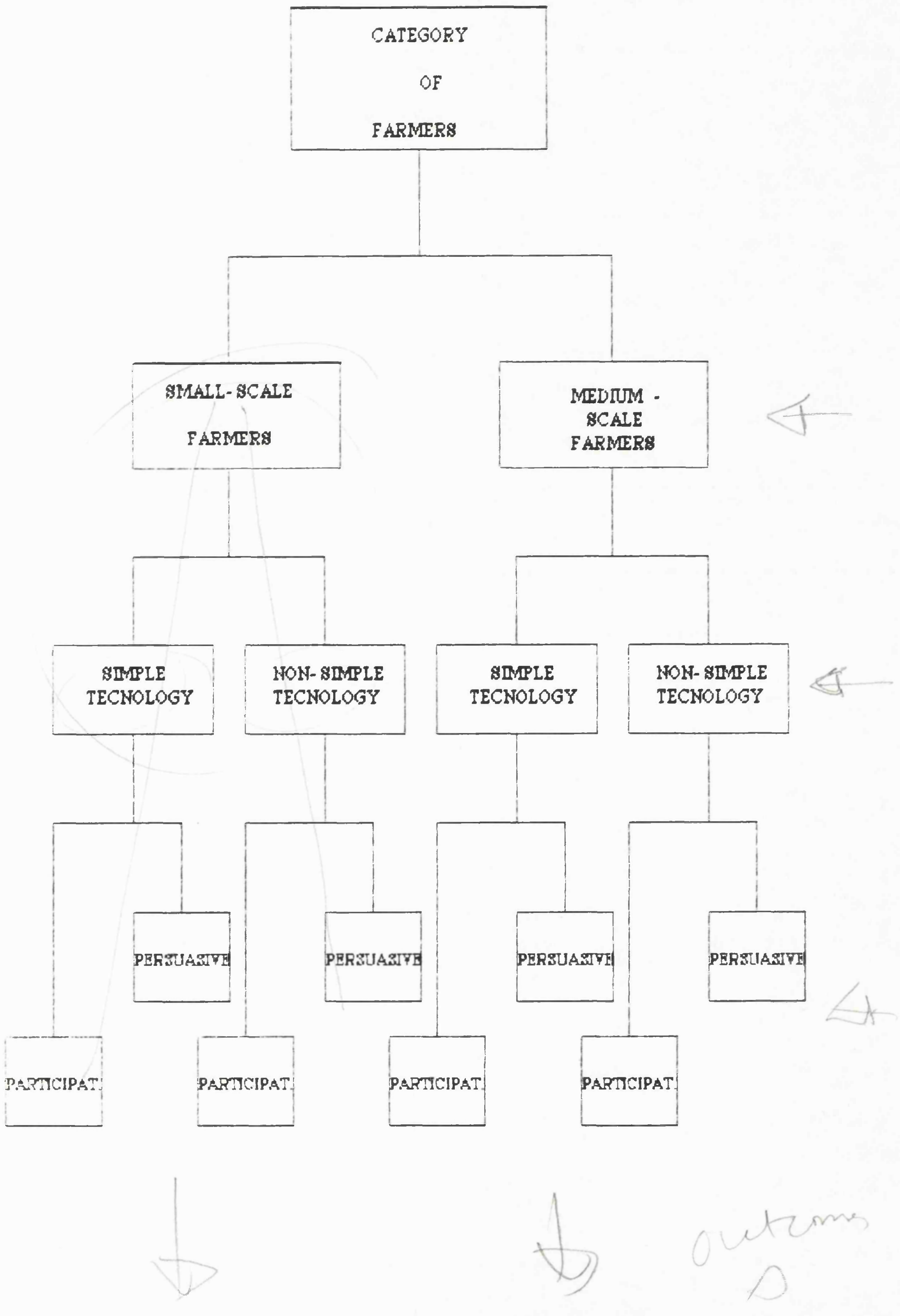
The planned variables numbered as three at two levels each, are now as follows: C1,C2,T1,T2,A1 and A2.

2. Definition of the Population

The defined population or target population to be covered was 2005 families in the 48 projects of the *Plano Trienal* (Table 4.1) This population was stratified considering the two levels within each planned variable, totalling eight strata.

The number and stratum, or survey population, was obtained by the Cartesian Product of these variables. According to the Collins English Dictionary (1986), the Cartesian product is " the set of all ordered pairs of members of two given sets. The product A X B is the set of all pairs < a, b> where a is a member of A and b is a member of B". One may therefore show that the total number of strata is 2^3 where the base of the potency is the number of elements of each group, and the exponent is the number of sets. In other words, the number of strata was the result of the product of both elements of C, times both elements of T, times both elements of A, which adds up to a total number 8 strata. The figure 6.1 below tries to clarify the process used in this definition .

Figure 6.1 Stratum/Projects Definition Chart



The definition of these strata was, in turn, derived from the different pairs resulting from the Cartesian product of {c1, c2} X {t1, t2} {a1, a2} which are presented as follows:

(1.) c1 t1 a1, (2.) c1 t1 a2, (3.) c1 t2 a1, (4.) c1 t2 a2

(5.) c2 a1 t1, (6.) c2 a1 t2, (7.) c2 a2 t1, (8.) c2 t2 a2.

In practice, these strata were part of the projects developed by IAA-Planalsucar, which forms the survey population. For example, the strata, c2 a1 t2 was a project formed by medium-scale farmers using non-simple disseminated technology and adopting a persuasive approach during the research process.

The selection criteria used in the choice of strata by Brazilian Region/State, was not only the proportion of the number of installed projects but also the socio-economic importance of the production of sugar cane, sugar and alcohol of the Region/State in relation to the country, that is, a proportionate stratified sample. Thus, the state of São Paulo, situated in the Southeast, for example, which had 40% of the 60 projects installed in the whole country and 40% of Brazilian production of sugar cane, sugar and alcohol in 1984 (IAA-Planalsucar's Annual Report, 1985), provided three strata in the study.

Apart from the original eight strata, two repetitions were added with the objective of increasing the possibilities of generalizing from the results of this research. In particular, it was decided to study two opposite C T A combinations, the strata c1 t2 a1 and c2 t1 a2 . The first is located in the same region (Southeast) but, with contrasting social and economic characteristics. The other combination was situated in two different regions (Northeast and Southeast) with contrasting social and economic characteristics . The list of the total 10 strata considered is displayed in Table 6.2, below :

Table 6.2 Strata/Projects Investigated and Their Variables

Project		Classes of	Technologies		Approaches	
Number	Code	Farms	Name	Type	Part.	Pers.
1	C1 T1 A1	Small	Variety	Simple	X	
2	C1 T1 A2	Small	Variety	Simple		X
3	C1 T2 A1	Small	Sugar Cane Intercrop.	N. Simple	X	
4	C1 T2 A2	Small	Production System	N.Simple		X
5	C2 T1 A1	Medium	Variety	Simple	X	
6	C2 T1 A2	Medium	Variety	Simple		X
7	C2 T2 A1	Medium	Production System	N.Simple	X	
8	C2 T2 A2	Medium	Healthy Setts	N.Simple		X
9	C1'T2'A1'	Small	Healthy Setts	N.Simple	X	
10	C2'T1'A2'	Medium	Variety	Simple		X

3. Data Collection

The data were collected from two sources and in two periods. The first one, utilizing archival records was collected before the projects started (pre-test), and the other , when the field work was carried out, 4-5 years later (post-test). At this time, the initial situation was investigated again (field work questionnaires).

3.1 The Sample

3.1.1 Sample Type

The adopted sampling technique was the proportionate stratified sample where the 'stratification factor' (Moser, 1979:85) was the number of projects as well as sugar cane, sugar and alcohol production. Within each of the ten strata, farmers were selected at random.

3.1.2 Sample Size

The sample size in each stratum varied between 19 and 23, totalling 205 individuals or 10.22% of the total population (2005, see chapter IV - Table 4.1). The sampled population (ten strata) composed 421 individuals when the *Plano Trienal* was established in 1984. During fieldwork, however, there was a drop-out of 77 farmers from strata 2, 4, 6 and 8. Table 6.3 illustrates this situation as follows:

Table 6.3 The Survey Population Variation - Period 1984 / 1988

Stratum	Sampled Population-84	Project Situation-88	Surveyed Population-88	Drop Outs
1	45	Active	20	-
2	45	Deactivated	21	14
3	38	Active	20	-
4	34	Deactivated	19	15
5	40	Active	20	-
6	42	Deactivated	20	22
7	45	Active	22	-
8	46	Deactivated	20	26
9	40	Active	23	-
10	46	Active	20	-
Total	421	-	205	77

Thus, upon completion of fieldwork, the possible sampled population consisted of 344 individuals (421-77).

There is a useful procedure for sample-size definition related to this issue, suggested by Galtung (1967).

"Galtung suggests that research hypotheses be carefully examined, and the number of variables to be examined for relationships in any given cross-tabulation be estimated. Then the researcher must incorporate the number of values these variables might assume, knowing that a minimally acceptable average number of cases in any cell of a cross-tabulation should be ten, and ideally twenty".

(Galtung, 1967 - quoted in Forcese et. al.,1973: 125)

According to this author the sample size (sz) is given by the expression:

$r^n \times 20$

where: n = number of variables

r = number of levels on each variables;

20= ideal number of case in any cell of a cross table (Galtung,1967:60 in Forcese et al., 1973:126).

In this present context, the ideal simple size would be calculated as follows:

n= 3

r= 2

then,

$sz= 2^3 \times 20$

$sz = 8 \times 20$

sz= 160

Hence it can be concluded that the sample of 205 farmers provides enough individuals to enable this study to examine the central hypothesis.

3.2 Techniques

In the pre-test phase of the projects (diagnostic) and in the post-test (field work) the following data collection techniques were mainly used: observation, questionnaires and interviews. The field work was carried out in Brazil in the states of São Paulo, Rio de Janeiro, Minas Gerais, Espírito

Santo, Pernambuco, Paraíba and Rio Grande do Norte, where the majority of the projects were located (Figure 6.2), during June/December 1988.

Figure 6.2 - The Position of the Projects throughout the Country.

3.2.1 Observation

Participant observation was undertaken during all the phases: Pilot Projects, implementation and operation of the IAA-Planalsucar programme, pre-test and post-test. As the researcher participated with the technical team of the Pilot Projects and then coordinated all the work in the field for the 'Three-Year Plan', he was able to accompany the reactions of the farmers regarding the approaches used by the projects.

The observations were, therefore, considered from the two initial phases of action, the Pilot Projects and 'Three Year Plan', and they were complemented in the diagnostic phase of the Projects and aforementioned pre and post-test periods.

3.2.2 Questionnaire

Two types of questionnaires were used, one in the pre-test (only in the Strategic Projects) and the other in the post-test (see Appendix 1).

The post-test questionnaire was administered by the researcher and was structured into five parts: Reference Data, Farmer Identification, Production Unit Identification, Reconstruction of the Farmer's Experience and Evaluation. The first recorded general data in order to identify the questionnaire and respondent. The second concerned personal details, such as: socio-cultural and economic facts about the respondent, individual and family data. The third collected information about the farm such as: assets, use of the land, production and productivity, technological level and any problems, among others. This included attempts to recall the farm situation (assets and technological level) before the establishment of the Project. In the fourth, an attempt~~ed~~ was made to compare the farmers' experience before the Project and during it, through retrospective questioning. The information collected from the retrospective questions was complemented and checked against the data collected in the diagnostic phase of the Projects. The last topic, Evaluation, focused on trying to evaluate action through the perceptions of the respondents.

The first three parts of the post-test questionnaires were common to the diagnostic questionnaires without the retrospective questions. The questionnaires contained structured or closed questions and unstructured or open-ended questions. both of which questions could be cross-checked by independent sources. For example, production maps of *Usinas* and of the IAA, were also used.

Before designing the questionnaire, previous research was consulted and a pilot study was carried out in which firstly, different questions were put to a small selected sample of 20 individuals. Having done that, a pre-test was administered. This took place at a field level, in order to adjust the questions and their terminologies to the circumstances of the questionnaire audience - the final check. The post-test questionnaires were applied to 205 farmers involved in the 10 selected Projects, on their own farms and/or in co-operatives and unions. On the other hand, the pre-test questionnaires were applied to all Strategic Project farmers who participated in the whole of the IAA-Planasucar programme. The questions, especially the open-ended ones, were coded in order to facilitate tabulation.

3.2.3 Interview

The post-test interview with technicians and farmers, along with the questionnaires, had their schedules defined beforehand, and consisted of the following sections: Reference Data, Identification, Evaluation, General Considerations and Political and Ideological Position (optional). The first two parts would identify the respondent. The evaluation reported the action as a whole- before and after, with special reference to the approach used in the project. The following part would be open to suggestions, and the last one would try to describe the political background of the respondent, in order to test its coherence in relation to the approach of his/her choice. This part would be left to the interviewee to decide whether to answer it. This schedule was not strict and, depending on the situation, was used merely as a guide. They were non-random interviews, unstructured in the pre-test and structured with retrospective questions in the post-test phase.

The public interviewed was comprised by Participatory Project farmers in the pre-test (participant observations in the Project diagnostis) and technicians (researchers and extensionists) who took part in the Projects and four farmers leaders who had participated direct or indirectly in Project coordination. The researcher was the interviewer throughout. The interviews were all recorded, totalling 27, with 31 hours of recording. Whereas the questionnaires provided information for a quantitative analysis, the interviews were intended to supplement this with qualitative data.

4. The Null Hypothesis

The Null Hypothesis (H_0) was formulated for the express purpose of being rejected, namely that:

"The solution of farmers' technological problems and farmers' economic conditions do not depend on farmer participation".

If H_0 is to be rejected, then the alternative hypothesis (H_1), previously defined, would be supported.

5. The Data

Once the data gathered from the questionnaires was known, questions and answers were disaggregated and organized into 200 tables. Once the tabulation data phase was concluded, the questions which seemed relevant to test the Null Hypothesis (H_0) were selected. 44 questions or tables relevant to this test were identified. They were classified as Priorities I and II, according to the following criteria: those that would test H_0, Priority I, and those that could explain the phenomenon or H_1 as Priority II. Given this classification, 18 questions were considered as Priority I, and other, 26, as Priority II.

All the questions were organized into contingency tables, a statistical procedure to find the best way of displaying the information obtained. Each question with it's central subject, became a variable to be studied. Its answers were re-grouped into two or three groups and became the levels of this variable.

6. Data Analysis

The Chi-Square test (X^2) for Contingency Tables was applied to verify the existence of an association among the variables of each contingency table (Wonnacott, 1977). If one of the variables was the project location, for example, the intention was to verify whether there would be a association between the Projects and the different levels of the distances (answers given on the table). Being independent, for example, in the case of Increase of Productivity (Table A, to below), would mean that productivity in any Project could not be used as a comparative indicator. On the other hand, being dependent, there would be an association between a specific Project and the level of Increase of Productivity and it could be used to compare them. In other words, if the Projects were different among themselves taking into account the levels of each variable, they could be compared. Where a association among the variables is non-existent, they would be exactly the same and because of that, a comparative study could not be developed.

The results of the X^2 tests were analysed according to their levels of significance. For example, had one found that the X^2 tests for the variable Increase of Productivity and Projects were not significant at a certain level, this would mean that Increase of Productivity was not particularly associated with any of the Projects. The level of significance considered was between 0.1% and 5%. The level of significance (∂) of a statistical test is the probability of rejecting the Null Hypothesis the (H_0) when it is really true. This is also known as Type I error. Ideally, this should be kept as small as possible. Associated with each ∞ is a critical value X^2 which defines the regions of rejection and acceptance of the H_0. If the observed value of the test statistic is greater than X^2, then the H_0 is rejected or accepted if smaller than X^2. When X^2 has been applied, only four tables of the Priority I and fifteen of Priority II, conformed to the above significance. They became the instrument of this analysis and are listed below, together with an explanation of the steps followed to arrive at the questions of the Priority I and II (indicators) from the primary data (questionnaires and interviews):

Priority I

A. Increased Productivity

- This is the productivity increase rate when comparing two situations: sugar cane productivity before and after (pre-test and post-test) the Project was established.

Productivity in this case, means the amount of sugar cane produce per area (ha) or ton of sugar cane divided by hectare cultivated. The unit of measurement is ton/ha. This information was the result of the combination of answers to the questionnaires (questions 2.4 and 2.5), crossed with secondary data provided by the Institute of Sugar and Alcohol-IAA [1].

B. Increased Assets

- This refers to the increased assets when comparing two situations: asset units before and after (pre-test and post-test) the Project was established.

The units of the operational assets (question 2.7 - questionnaire) and the buildings (information given on question 2.8 - questionnaire) were surveyed per farmers and projects, in order to identify the increase, non-increase and total possible increase, to establish comparisons.

C. Adoptions

- Technologies adopted as a consequence of the Project.

This indicator was obtained directly from the answers to the question 4.2 - questionnaire.

D. Technological Solutions

- Technological Solutions attributable to Project action.

The problems pointed out by farmers before the implementation of the project (question 3.1 -questionnaire) were compared with those alleged at the field work time (question 4.1-questionnaire). The technological problems indicated on question 3.1 and not repeated on question 4.1, were crossed with technologies adopted due to participation of farmers in the Project (question 4.2- questionnaires) and if there was coincidence, they came to be considered as technological problems which were solved.

Priority II

1. Schooling

- Educational level of farmers who participated in the Projects.

Information directly collected from item 1 of the questionnaire (4th line of the item) and crossed with the pre-test. In case of distortions the post-test information was considered.

2. Farmer's Residence

- Place where farmers live.

Ibid, 13rd line of the above mentioned item.

3. Visits to the Farm

- Number of times that the farmer goes to his/her farm to manage it.

Ibid.

4. Participation of Sugar Cane Income in Farm' Gross Income

- Percentage of sugar cane income in relation to other activities (crop/livestock) income.

Through question 2.11 of the questionnaire, the participation of sugar cane income was calculated in terms of a percentage in relation to the total income, considering the income from other products .

5. Farmers' Attitude

- Type of posture taken by the farmers in their relationships with the rural workers and technicians.

The information used on this topic comes from the sub-items in question 2.12- questionnaire (3rd and 4th question) in order to identify farmers' attitudes in their relationships with their employees. Regarding their relationship with the technicians the opinions given by the latter during interviews were used (Appendix two, item 4 - two first lines).

6. Distance from Farm to *Usinas*

Data directly collected in question 2.13 - questionnaire.

7. Distance from Farm to Experimental Station

Ibid

8. Distance from Farm to 'Business Town'

- Distance from farm to town where cooperative, union, bank and other facilities are situated.

'Business town' is, the town where he/she carried out his/her business.

9. Farmers' View of the Technical Team's Attitude

- How farmers evaluated the technicians' posture in relation to the approaches used.

Answers given in questions 3.9; 3.14; 3.5 - questionnaire, were combined in two themes: persuasion and participation, in order to characterise the technicians attitude viewed by the farmers, and also to analyse the coherence of this in practice according to the methodological approach pre-defined. This will be specifically discussed in the next chapter.

10. Political Situation of Brazil and Project Development

- Whether the Brazilian political situation has influenced Project results.

This information was directly obtained from question 3.17.

11. The Main Project Activity Responsible for the Changes

- Which was the main methodological procedure that he/she considered to be the cause of adoption of technology recommended by the Project team.

Taking the question 4.5-questionnaire, answers were combined considering what the Farming Systems Research and Farmer Participatory Research followers point out as crucial methodological instruments, On-Farm Trial [2] and Participatory attitude, respectively. In this particularly case, Participatory attitude was substituted by 'Technicians' Open Way' term [3].

12. Reason for Non-Adoption

- Why farmers did not adopt a particular technology despite the Project technician recommending it.

The indicator was obtained from the re-grouping of the answers given to question 4.2 -questionnaire (second part of the question -why) in two broad themes, financial and technological problems. In both cases, the problems with both direct or indirect origins were considered. As an example, the lack of access to credit related to the adoption of a specific technology was a financial problem (indirect) while, in the second case, lack of infrastructure was taken as a technological problem, although indirect.

13. Farmers' Participation in New Groups

-Whether farmers started to participate in different groups after the project.

This is direct information taken from question 3.13 of the questionnaire.

14. Positive Aspects of the Projects

- Which was the most important feature from a methodological point of view in two types of approach .

In order to give more consistency to the analysis in relation to methodological aspects of the project (persuasive and participatory approaches), again the data (question 4.7-questionnaire) were combined to compose two broad themes of a methodological character, 'Technicians' Open

Way' and On-Farm Trial.

15. Negative Aspects of the Projects

- An attempt was made to raise problematic issues related to methodology among others.

In relation to methodology, no negative aspect was identified. The answers to the same question utilized in a previous indicator (question 4.7 - questionnaire) were grouped in three themes: Discontinuity of the Project, Unappropriate Technology and None.

In the first instance, only the tables from Priority I will be analysed. Two types of measurements were used to evaluate the performance of the Projects by classifying and comparing them, the Nominal (also Categorical or Classificatory) and the Ordinal (or Ranking scales) (Siegel, 1988).

As a classificatory scale, tables from Priority I were used, or other economic indicators, which became the indicators of success. The Projects were then classified according to their performances, taking into consideration these indicators.

As for the ordinal scale, tables from Priority I and II were used and were carried out as follows. The percentages of individuals or occurrences were determined for each event according to the total number of individuals of the Project or the total possible numbers of occurrences. Taking as an example Table B (shown below), Increase and Non-Increase are the events, and the Total Possible Increase is given by the result of occurrences (items of the considered assets, in this case 14) times the number of individuals in the Project. After that, for each specific event the Projects were scored according to the percentages raised (% in the Table A). These scores oscillate on a decreasing scale of 10 to 1; 1 would represent the greater percentage of individuals in the event compared to the rest of the Projects, or the highest mark that a Project could receive in that specific event. The ranking system was based on the relative score calculated over the total of each Project. The ordinal scale enabled comparison of project performance .

The Contingency Tables of Priorities I and II, as well as the results of X^2 and their respectives critical values are presented below, in columns and rows. The column distribution is as follows. In the first (from left to right), the stratum/Projects can be found. In the following, the levels of variation or events and the total possible number of occurrences. In the last one, the total of individuals or total of frequency (frequency is the number of occurrences or the number of individuals per Project). On the rows, following the same sequence of columns, are: the project, the mark that the Project obtained in brackets [ ], the number of individuals or the number of occurrences in the events and the total number of individuals in the Project or total frequency . Initially, only tables from Priority I will be analysed, as follows.

Priority I

Table A - Increased Productivity (ton)

Projects	(%)	4 - 7 (a)	(%)	8 - 15 (b)	Total/Farmers
1	20	[10] 04	80	[1] 16	20
2	81	[4] 17	19	[7] 04	21
3	40	[9] 08	60	[2] 12	20
4	63	[7] 12	37	[4] 07	19
5	85	[3] 17	15	[8] 03	20
6	90	[1] 18	10	9] 02	20
7	73	[6] 16	27	[5] 06	22
8	90	[1] 18	10	[9] 02	20
9	44	[8] 10	56	[3] 13	23
10	80	[5] 16	20	[6] 04	20
Total		136		69	205

(%) = Exemplifying
[ ] = Scores
X^2 = 47.14
Degree of Freedom (df) = Number of Projects - 1 = 9
X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table B - Increased Assets

Projects	Increase(a)	Non-Increase(b)	Total Possible Increase (c)	Total/ Farmers
1	[3] 12	[6] 268	280	20
2	[9] 00	[1] 294	294	21
3	[2] 13	[7] 267	280	20
4	[8] 01	[9] 265	266	19
5	[7] 02	[3] 278	280	20
6	[9] 00	[1] 280	280	20
7	[6] 11	[4] 297	308	22
8	[4] 11	[10] 269	280	20
9	[1] 19	[8] 303	322	23
10	[4] 11	[5] 269	280	20
Total	80	2790	2870	205

X^2 = 32.29
df= 9
X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table C - Adoptions

Projects	Number of Adoptions (a)	Number of Non-Adoptions (b)	Total Poss. of Adoptions	Total/ Farmers
1	[4] 118	[7] 322	440	20
2	[10] 33	[1] 429	462	21
3	[1] 192	[10] 248	440	20
4	[5] 112	[6] 306	418	19
5	[7] 105	[4] 335	440	20
6	[9] 50	[2] 390	440	20
7	[2] 136	[9] 348	484	22
8	[6] 108	[5] 332	440	20
9	[3] 140	[8] 366	506	23
10	[8] 91	[3] 349	440	20
Total	1085	3425	4510	205

$X^2 = 217.68$
df = 9
X^2 (0.1%) = 27.87

Table D - Technological Solutions

Projects	Number of Solutions(a)	Number of Non-Solutions(b)	Number Poss. of Solution	Total/ Farmers.
1	[1] 88	[10] 372	460	20
2	[9] 01	[2] 482	483	21
3	[8] 01	[3] 459	460	20
4	[2] 42	[9] 395	437	19
5	[7] 05	[4] 455	460	20
6	[5] 09	[6] 451	460	20
7	[3] 35	[8] 471	506	22
8	[4] 17	[7] 443	460	20
9	[6] 10	[5] 519	529	23
10	[10] 00	[1] 460	460	20
Total	208	4507	4715	205

$X^2 = 359.69$
df = 9
X^2 (0.1%) = 27.87

Following the presentation of the Contingency Tables with the results of the Chi-Square tests at their respective levels of significance it was found that the Priority I tables showed significance levels lower than 0.1% (< 0.1%). This means that the probability of having an association among the variables is very strong. Depending on these variables, the projects performed differently; in other words, they are different among themselves. In the light of this evidence one can proceed to the second phase of the tests, to judge the performances of the individual Projects, taking into account the success of indicators already mentioned.

As an initial step towards that judgement, the Kendall Coefficient of Concordance (W), was used in order to test association or agreement between the judgements (Neave and Worthington, 1988). In other words, to test the association of the marks given to each project, taking into consideration the economic indicators (variable within their levels). In this particular case, W tested whether the economic indicators could be taken as a criterion of judgement to evaluate the performance of the projects.

The following economic indicators, relevant to this particular subject were selected: Increase of Productivity at 8-15 ton/ha [Table A + (b)] or Ab, Increase of Assets [Table B + (a)] or Ba, Number of Adoptions [Table C + (a)] or Ca and Number of Technical Solutions [Table D + (a)] or Da. The marks given to each project according to its economic indicators now form the following Table E below, in which the Kendall Test was applied.

Table E - Project Scores According to Economic Indicators

Projects	Ab	Ba	Ca	Da	Total/Scores
	Indicators				
1	1	3	4	1	9
2	7	9	10	9	35
3	2	2	1	8	13
4	4	8	5	2	19
5	8	7	7	7	29
6	9	9	9	5	32
7	5	6	2	3	16
8	9	4	6	4	23
9	3	1	3	6	13
10	6	4	8	10	28

Taking into account the fact that there are some repeated marks (draws) in the ranking given to the Projects, the formula for the Kendall Coefficient of Concordance with the correction for ties incorporated is:

$$W = \frac{12\,\Sigma Ri^{2} - 3K^{2}N(N+1)^{2}}{N(N^{2}-1) - (\Sigma T_{j})/K} \qquad \text{(Siegel, 1988:266)}$$

where, in the present context

K = number of indicators

N = number of Projects

R_i = rank associated with i^{th} project type or total scores (Σ)

i = Project

$$Tj = \sum^{gj} (t_i^{3} - t_i)$$

i=1

where,

t_i = is the number of tied ranks in the i^{th} grouping of ties

gj = group j tied observations in Project i

The above formula when applied produced the following result :

W = 0.8119

In order to test the significance of W, the formula below was applied:

$X^2 = K(n-1)W$ (Siegel,1988:269)

where,

X^2 = Chi- square test

K = number of indicators

W = value of W calculated

The result was: 29.228

Testing the value of X^2 with df=(N-1)=9, it is obtained, that

W is significant even at 0.1%

It can be concluded with considerable confidence that the agreement among scores is high. In other words, there is a coherence in the criterion used to give marks. This means that the economic indicators may be used to judge the performance of the Projects.

Considering the criterion of judgement above, the Projects were classified according to the total scores that they achieved. As the criterion used to give marks was in decreasing order, the project with the best performance (1st) received the lower total of scores (Table E). The Projects' rank presents itself as follows :

Rank I

1st - C1 T1 A1

2nd - C1 T2 A1

2nd - C1' T2' A1'

4th - C2 T2 A1

5th - C1 T2 A2

6th - C2 T2 A2

7th - C2' T1' A2'

8th - C2 T1 A1

9th - C2 T1 A2

10th - C1 T1 A2

After that, in order to verify the consistency of the results obtained in the above rank, weights were given to the economic indicators according to their level of importance, on a scale of 10 to 100, as follows: Ba = 10, Ab =20, Da = 30 and Ca = 40 (10+20+30+40 = 100). The decreasing scale continued, so that one can say that low weight equals high importance.

The criterion used to give weights to the indicators was Ba > Ab > Da > Ca, where > means of greater importance. To explain the relation:

1. a technology may be adopted (Ca), without solving the technological problem (Da), in other words Ca is less important than Da [4];

2. the technological problem (Da) can be solved, without increasing productivity (Ab), in other words, Da is less important than Ab [5];

3. productivity can be increased (Ab) without this meaning increase of financial gain [6];

4. however, in order to increase a property's assets (Ba), it is necessary that the profit margin also increases, in other words, Ab is less important than Ba [7].

In this way, all the scores given to Projects (Table E), to their indicators, were multiplied by the corresponding weights. For example, the score given to Project I according to Ab (column 1, line 1 of the Table E), of 1 became 20, which is 1 X 20 = 20. Table F below presents the results of this procedure.

Table F - Project Scores According the Level of Indicators' Importance

	Indicators				
Projects	Ab	Ba	Ca	Da	Total Scores
1	20	30	160	30	240
2	140	90	400	270	900
3	40	20	40	240	340
4	80	80	200	60	420
5	160	70	280	210	720
6	180	90	360	150	780
7	100	60	80	90	330
8	180	40	240	120	580
9	60	10	120	180	370
10	120	40	320	30	510

According to the data in the above table, a new ranking can be formed as a consequence of the criterion of weights that was used, which is shown as follows:

Rank II

1st - C1 T1 A1

2nd - C2 T2 A1

3nd - C1 T2 A1

4th - C1' T2' A1'

5th - C1 T2 A2

6th - C2' T1' A2'

7th - C2 T2 A2

8th - C2 T1 A1

9th - C2 T1 A2

10th - C1 T1 A2

If Ranks I and II are analysed the following conclusion can be drawn.

- Projects: C1 T1 A1, C1 T2 A2, C2 T1 A1, C2 T1 A2, C1 T1 A2, retain in the same order; 1st, 5th, 8th,9th and 10th, respectively;

- C1 T2 A1 went down from 2nd place in Rank I to 3rd place in Rank II;
- C1' T2' A1' went down from 3rd to 4th place;
- C2' T1'A2' went down from 6th to 7th place;
- C2 T2 A1 went up from 4th to 2nd place;
- C2 T2 A2 went up from 6th to 7th.

By taking into consideration the Rank I and the tests carried out, one can reach a final ranking (III) with the five Projects that represented the best performance, and where C1 T1 A1, stands out the most.

Rank III

Ist - CI TI AI (Ist and Ist)

2nd - CI T2 AI (2nd and 3rd)

3rd - CI' T2' A1' (3rd and 4th)

3rd - C2 T2 A1 (4th and 2nd)

5th - CI T2 A2 (5th and 5th)

6th - C2 T2 A2 (6th and 7th)

7th - C2' T1' A2' (7th and 6th)

8th - C2 T1 A1 (8th and 8th)

9th - C2 T1 A2 (9th and 9th)

10th- C1 T1 A2 (10th and 10th)

Interpretation of the Ranks and their Practical Significance

Before beginning the second phase of statistical tests, some considerations are necessary in order to explain the first phase in which the hypothesis was tested, and to explain what the results mean in practice.

Analysing the performance of the projects with the participative approach there is no doubt that they showed better results in practice when compared with the strategic projects. This can be broadly explained in terms of participation and more egalitarian relationships among people which could be called its 'hidden character'. Those taking part in a participatory process of technology generation and diffusion, technicians and farmers, shared their experiences, jointed identified problems and found possible solutions together. The direct consequence of this process, considering the indicators studied so far, is that the technology was adopted as the result of a natural process. There was no need for the bureaucratic, formal structure of research and extension institutions or for a great amount of material or human resources. The farmer and the technician became partners of the search for technological solutions, for the innovation. It has became evident that, with this kind of adoption process it is easier to solve the technological problem and agricultural productivity increases, reflecting in higher levels agricultural productivity itself.

The practice of participation allowed to develop a process of discovery of their situation. They identified the need to have access to the natural and material resources such as credit, technology, land, prices of sugar cane, basic infrastructure (water, electricity, roads), the means to demand their rights (representation in their trades union), in order to be respected as a class instead of being marginalised in the productive process as a whole. As examples, the Lençóis Paulista (C1 T1 A1), Ceará-Mirim (C2 T2 A2) and Urucânia (C1 T2 A1) projects can be mentioned. In the first, the community of Vanglória elected one of the cooperative directors. The second, as the result of a process of joint community action were supplied with electricity. In the third, they became participants in the elaboration of a research projects portfolio in the Experimental Station of Ponte Nova in Minas Gerais, home of the regional coordination of IAA-Planalsucar at the time.

However, returning to the 'hidden character' of participation, this broad correlation does not mean that the situation was reversed, in the Strategic

Projects where technicians and farmers did not develop the same degree of partnership in the identification of technological problems and in the definition of solutions. The data obtained during field work showed that these projects also demonstrated some positive results. The difference, as shown in the statistical study, lay in less positive results when compared with participative projects. For example, the farmers adopted fewer technologies, the technological solutions were less profound, there was less improvement in agricultural productivity and the increase in assets was not the same. Thus, Strategic Projects experienced a generally lower performance than participatories ones.

Another factor which can be considered as a facilitator of the 'hidden character' of participation is its practice. This seems to have influenced the implementation of the approach. That is, technicians and/or farmers with previous participative experience had less difficulty in adopting. This seems to have been an important factor in the performance of the Lençóis Paulista (1st and 1st) and Ceará-Mirim (4th and 2nd) projects. The Capivari (8th and 8th) project, where they had no previous experience, did not achieve a good performance.

However, participation alone can not be considered as responsible for the place occupied by the participative projects in the Ranks. Other factors were identified by the research as contributing to the performance of the Projects. The majority of these were specific to each Project. One of a more general character, can be considered of greater importance in the implementation of the approach, no matter whether it was persuasive or participative. This was the geographical distribution of farmers which determined whether they formed a community. Looking at the Rank, the Participatory Projects of Lençóis Paulista (C1 T1 A1), Urucânia (C1 T2 A1), Macaé (C1 'T2' A1') e Ceará-Mirim (C2 T2 A1), which did form cohesive communities, occupied the first places. In Capivari (C2 T1 A1), another participatory project, however, the farmers were not members of a community as such. They were joined together only for the purpose of work, meeting each other for the first time. They were considered a group according to their classification by area size, production, productivity, etc. (see Chapter V). On the other hand, Campos (C1 T2 A2), which was a proper community, although a Strategic Project, obtained 5th place in the final Rank. It was noticed, therefore, that when farmers lived in communities, even without previous experience in community action, they knew each other and had common problems. This, was a catalytic factor when the methodology was applied.

Following these general considerations about the statistical conclusions and their significance, each Project will now be discussed individually.

<u>C1 T1 A1 - Lençóis Paulista, São Paulo</u>

This Project presented the best overall performance in the three Ranks. Different factors can explain this position. The farmers already formed a community and had the experience of participating in community action. The technicians team responsible for the Project implementation and operation had previous experience in community work for more than three years, being familiar with the participatory approach. Thus, technicians and farmers already had experienced participation before the Project began.

This Project also received considerable assistance from the institutions responsible for its operation. One of them, the cooperative, had few members who were mainly small and medium scale farmers, and therefore knew about their situation. Besides, the directorate of the cooperative was the same as that of the other institution involved in the Project operation, the Association of Sugar Cane Growers of Lençóis Paulista.

In most of the other Projects, this assistance was not forthcoming as the cooperatives were formed by a large numbers of members, mainly medium and large scale farmers. In this context, the disadvantaged farmers' problems were usually put aside. Furthermore, the cooperatives, associations and/or unions' directorate responsible for the operation of the Projects were not the same. This sometimes brought about misunderstandings, reflecting negatively on the development of Project activities.

Another more technical characteristic, helps to explain the statistical results. The agricultural area of the Project was flat with soils such as purple and dark red latosols and the average annual rainfall was 1,800 mm (see Chapter 5). A flat topography opposite to hilly land, can be conducive to low production costs due to its favourable conditions for mechanisation. The Project soils were fertile, favouring a more rapid adoption of any technological innovation in contrast to the yellow latosol which was found on many other Projects. This was in addition to a good average annual rainfall (1,880 mm), which was above the minimum necessary for sugar cane (1,200 mm). It can be noticed that the Projects: Campos (5th and 5th), Itapemirim (6th and 7th), Mamamguape (9th and 9th) and Agua Preta (10th and 10th) when they did not have an average annual rainfall lower than 1,200 mm (Campos's case), had an irregular annual rainfall, such as high in some months of the year, alternating with rigorous drought periods.

The assumption of the Project by the community itself could alone demonstrate what Project performance meant for the farmers in practice. Nevertheless farmers increased their assets more than farmers on other Projects, according to the statistical tests. Moreover, they were empowered in the sense that they played an active role in the community and were becoming represented on the directorate of the cooperative.

C1 T2 A1 - Urucânia, Minas Gerais

The classification of this Project in the Ranks (2nd and 3rd) can be explained by three main reasons: the farmers were members of a community; the IAA-Planalsucar team had previous experience with a participatory approach (they were researchers but had worked before in rural extension); and the field team was supported by the local parish which was closely involved in community work. The priest was a genuine local leader and was already developing other community activities with the farmer's families.

The cooperative, despite having a large number of members, were mostly small scale farmers and its chairman had been a farm worker. The Project enjoyed considerable assistance from the cooperative, which provided a technician who was permanently resident in the Project area. This was considered by the farmers, during the field work, as a crucial feature to the development of the Project activities (this will be discussed in the next chapter).

Other features can be added: the farmers had never adopted technologies before (question 4.2 -questionnaire) and had a low technological level before the project operation (question 2.9 - questionnaire). The average yield was 37 tonnes per hectare (the third lower among the Projects) with half of the sugar cane field unproductive requiring re-planting, while the average yield of the region was around 55 tonnes per hectare. In this context, the number of technologies adopted was high, influencing the other economic indicators. The technological inputs produced higher and faster outputs when compared with other projects. Technically speaking, it is easier to improve the number of tonnes per hectare on a sugar plantation when production is low. In other words, to increase the sugar cane yield in this Project (37 tonnes per hectare) through technological innovations would be easier than to increase it in a Project such as Assis (7th and 6th) with an average yield of 75 tonnes per hectare. Thus, the Projects condition in terms of the technological level of sugar cane farmers was an influencing factor on its performance when compared with others.

The practical significance of the Project performance, besides those aspects revealed in the first phase of the statistical tests (economic aspects), was the control of the Project by the community and the active participation of farmers (right to vote) in defining research project portfolio.

C1' T2'A1'- Macaé, Rio de Janeiro

The Project was ranked in a special position, 3th and 4th. As in the two previous Projects, some important features can be highlighted in determining its classification: farmers belonged to a community and the technicians team already had experience in extension rural work and participation. The low yield, 40 tonnes per hectare and a deficient technological level favoured mainly the adoption of technology which was reflected directly in other economic indicators, and consequently, in the statistical results. Of 23 farmers interviewed, 13 had never had adopted new agricultural practices (question 4.2-questionnaire). Considering the technical aspect, in the region where the Project was developed, there was a large incidence of a disease vulgarly known as '*carvão*' (literally coal) mainly responsible for the low yield due to the growing of a degenerate sugar cane variety (CB 45-3). As the Project technology was healthy setts of new sugar cane varieties, bred and selected by the IAA-Planalsucar, the outputs were rapid and considerable. In other words, the adoption of the RB sugar cane variety alone, had a greater impact in the Project area when compared with Project C2 T2 A2 (6th and 7th) of Itapemirim- Espírito Santo which although it diffused the same technology did not have a high incidence of '*carvão*'.

In practice, this Project brought to the community positive results which were revealed by the cooperative's taking it over.

C2 T2 A1 - Ceará-Mirim, Rio Grande do Norte

Major factors which determine the position of the Project in the Ranks (4th and 2nd), can be identified as: the target group was a community, both farmers and technicians had previous experience in community work, and had already had worked together. Besides, the *usina* supported the Project operation through land, transport, agricultural machinery and technical personnel. It needed large amounts of row materials as a result of the expansion of its productive capacity. Added to that, the national rural extension service (Embrater) through its representative regional office (Emater) alone controlled the operation of the Project. All the technicians were experts in community work and participatory methods, also having a good knowledge of the regional agricultural problems.

In relation to the technical aspects, the decisive influence in the Project's ranks was affected by these factors: there was in the region a high incidence of a sugar cane plague (known vulgarly as '*cigarrinha*') favoured by its soils and climatic conditions, such as a, high level of humidity and alluvial soils with difficult drainage (Ceará-Mirim valley) (see Chapter 5). The cultivation of an unproductive sugar cane variety also contributed to that.

The technicians disseminated new and healthy varieties, the RBs (see Chapter IV) and released the natural enemies of the '*cigarrinhas*', known vulgarly as '*moscas*' (flies). This was responsible for the increase in yields in the farms linked to the Project. This fact was not observed in Project C2 T1 A2, Mamamguape-Rio Grande do Norte where, although there was an incidence of the same plague, the IAA-Planalsucar have already started (before the Project establishment) the dissemination of the RBs varieties and was releasing the '*moscas*'. Besides, the soils and climatic conditions were of a different nature to the Ceará-Mirim valley. In Mamamguape the soils were of a coastal plateau type known as sandy woodland savanna ('*tabuleiro costeiro*') with a dry climate (see Chapter V).

The community had taken over the Project without the participation of any institution and had paid for a technician as the head of the project operation team, which was an exceptional event compared with other projects. This technician was put up as a candidate in the local government elections to represent the community. Adding to this, the electricity supply in the community was the direct result of joint community action, already mentioned above.

C1 T2 A2 - Campos, Rio de Janeiro

It was the best classified in the Ranks among the Strategic Projects, 5th and 5th. This can be explained by the fact that the technician team, followers of participative methods, was the same team responsible for the Macaé Participatory Project. During Project operation the methodology developed was a combination of the two approaches, persuasive and participatory, initially as consequence of the natural participatory posture of the technicians and afterwards, of their practical experiences with these approaches. The technicians unwittingly began to select the positive points of the two methods which resulted in a final approach being a combination of participation and persuasion, despite the project approach having been pre-defined as persuasive. This discussion will reappear with more details in Chapter VII.

In Macaé's Project this similar methodological association was not identified. Campos was distinguished as the only project based on community, among the strategic ones. Also, the sugar cane region of Campos was perhaps the most motivated of all to adopt technology as a consequence of the establishment of Sucrose Rate Sugar Cane Payment (*Pagamento de Cana pelo Teor de Sacarose)* (see Chapter IV), since it had a low technological level and the lowest average yield of the country (IAA-Planalsucar,1985). The Project farms had a low yield of 35 tonnes per hectare, the second lowest among the projects. The predominant sugar cane variety was CB 45-3, genetically selected (1945) to the previous payment system based on weight alone. Due to its cultivation for such a long time and lack of technical observance by the farmers, by the sugar cane mills and negligence of research institutions, it was decadent, unproductive and susceptible to insects and disease. Thus, in this context, the changing of the payment system has influenced to the number of technologies adopted, highlighting the RB sugar cane variety with its high sucrose level as responsible for the significant increase of yield and the main output of the Project.

This technical aspect is considered as a decisive factor in explaining the statistical results which shows the position of the Project in the Ranks.

C2 T2 A2 - Itapemirim, Espírito Santo

This Project is placed 6th and 7th in the Ranks, which can be explained by the lack of experience of the technical team in working at field level and developing rural extension activity. On the other hand the farmers did not share the same problems as they were not a community. Despite being medium scale farmers (see Chapter V), showing uniformity in terms of land size, sugar cane production and yield, assets among others, they lived in different localities.

Other negative points were found in this Project, such as: the distance from the Project area to the IAA-Planalsucar experimental station (150km) and the marketing monopoly. The distance constraint brought up low assiduity by researchers in relation to technical assistance. Furthermore the field team was not adequately supervised by the diffusion technicians of IAA-Planalsucar (ARDT-see Chapter IV). In addition, it was difficult for farmers to visit the station.

Concerning the marketing monopoly, the *Usina* Paineiras, being the only one in the region, provided inadequate assistance to the farmers and sometimes delayed in paying for the sugar cane supplied by them. This discouraged farmers from growing sugar cane. Of 20 farmers interviewed, only 3 had any intention of continuing to plant sugar cane (question 4.7-questionnaire). As a consequence, sugar cane was being replaced by pineapple cultivation, as mentioned in the previous Chapter. Moreover, the soil and climatic conditions were appropriate (acid soil and high temperature with rain in alternative periods) for this fruit, and the exporting potential was attractive.

C2' T1' A2' - Assis, São Paulo

Although the Project experienced a problem common to the strategic projects, that of not being a community, the main contributing aspect to the Project's low classification in the Ranks (7th and 6th) was its high technological level before Project implementation. The Project area was formed by flat topography with soil of the purple latosol type, known as *terras roxas* with high fertility, well structured and drained (see Chapter V). The average yield of the farms was around 75 tonnes per hectare, which made it difficult to increase yields further. In other words, the amount increased among the economic indicators was lower than in the six first Projects, with direct consequences in its position in the Ranks.

The main factor responsible for these increasing economic indicators, which maintained the Project in a reasonable position (6th position) was the participation of the Association technician. He had been working with farmers for more than five years, being both a genuine leader and well accepted as a professional. Despite utilising a persuasive methodology in collective meetings, visits, field days, and so, which were coherent with the methodology pre-defined by the Project, the technician developed a participatory posture on face-to-face based contact.

C2 T1 A1 - Capivari, São Paulo

In addition to being the single participatory project in which the farmers did not live in a community, the main negative aspects responsible for its classification in the Ranks (8th and 8th), were the problems faced in the Project operation.

Initially, this operation was carried out by technicians without any experience in dealing directly with farmers. This brought up serious problems in the definition of the Project target group, which resulted in a mixture of small and medium scale farmers in the same group. The increasing difficulties found by the field team in Project operation led it to a break of six months, when a new team took over its activities. Then, they were re-initiated as it for the first time. The Project target group was selected again in order to avoid bias identified in the first group. In other words, the medium scale farmers were not selected any more as member of the target group. This fact reflected negatively on the Project as the prejudiced farmers (medium scale farmers) were not happy at being excluded from the target group. They criticised the programme as a whole and only after a certain time when the positive results became visible, they were able to understand the changes. Such problems in the process almost compromised the relationship between IAA-Planalsucar and the Association.

Even considering these problems, the new field team, being more experienced, was able to prevent the Project from being the last ranked, and to convince the Association directorate to recognise its importance, and give it support. The technician team was expanded in order to extend Project activities to a larger number of farmers.

C2 T1 A2 - Mamamguape, Paraíba

The main problem which accounts for the penultimate position of this Project in the Ranks (9th and 9th), is the prolonged drought in the Project area during mainly the vegetative phase (plant growth) of the sugar cane. This phase is characterised by a great need of water for growing. The resulting low production and yield was not well accepted by the farmers, who criticised the technicians team and institutions for not having provided them with irrigation facilities (questions 4.14 and 4.15, questionnaire), since drought was regular regional problem (see Chapter 5).

C1 T1 A2 - Agua Preta, Pernambuco

This Project as the last in the Ranks (10th and 10th) was the one which had more problems than any other. Its position can be explained by the presence of different constraints. Initially the bureaucracy intervened: IAA-Planalsucar, Emater and the Sugar Cane Growers Union of Pernambuco delayed the signature of the agreement. As a consequence, resources were not released on time, holding up the implementation of activities. This was responsible for the late formation of the field team. Moreover, the trials were settled at the end of the planting season badly affecting sugar cane yields. In addition, every time that IAA-Planalsucar was late in releasing financial resources to Emater, their technicians were ordered to sustain the activities related to the Project.

After the first year of Project operation, the agreement was again delayed as Emater demanded more financial support. This reflected negatively on Project activities as did the alteration in technicians field team three times during the Project life.

As the Project was set up on the colonisation project of the National Institute of Agrarian Reform -INCRA (see Chapter 5) it faced enormous barriers. The farmers originally selected for the colonisation Project came further to be participants of the IAA-Planalsucar programme but were not properly trained to receive their lands. The majority of them had no previous experience as owners. They were simply settled by INCRA and abandoned. Only one part time extension worker from Emater was placed there to give any kind of assistance (including medical and religious) to 40 families (his main activity was to assist the Emater local office in Agua Preta). All of them lived on the farms without any facilities such as, water and electricity supply. They did not have any financial resources themselves and had never utilised the rural credit. They did not have any help from the *Usina* Catende, once the Project area of colonisation was seized from the *usina*. In reality the settlers were worried about their basic survival, so that sugar cane technological problems were placed aside. Obviously, they were not very interested in new technology in these circumstances. They participated in Project activities as they were threatened with retaliation from INCRA, for example, with losing their land.

Another factor which contributed to the lack of success of the Project was INCRA's delay in granting their land ownership certificate. As the farmers did not have any financial resources and were not able to utilise rural credit it was almost impossible to adopt any kind of technology. The setts, for example, had to be bought and transported from the experimental station of IAA-Planalsucar distant, 100km from the Project area. The farmers who could get some money from the banks did so without being subsidised. This affected the profitability of the funds invested in the agricultural activity.

During the first harvest after the implementation of the Project when the farmers were supposed to experience the impact of the technologies adopted, INCRA gave land ownership certificates to only some of the settlers, disregarding almost half of the families. This provoked unrest among the settlers as most of them had the feeling of being deceived, that they would never receive the certificates. They thought they had been settled there only for political reasons and now they had to abandon the land. There was no working atmosphere in this context from then on. Some of the families left their lands or sold out to other settlers. When the fieldwork was carried out the problem still existed. Nobody had received their land ownership certificate and, of 45 families, 24 who had participated at the beginning of the Project abandoned their agricultural activities moving to urban areas. The activities of the Project had stopped because of lack of agreement between Emater and IAA-Planalsucar.

Concluding the comments on the first phase of statistical tests, the Contingency Tables of Priority II, or other indicators with the scores (ordinal scale), the results of X^2 and its respective levels are shown below:

Priority II

Table 1 - Schooling

Projects	Illiterate/ Literate (a)	Primary/ Secondary(b)	Total/Farmers
1	[8] 05	[2] 15	20
2	[1] 20	[10] 01	21
3	[5] 12	[6] 08	20
4	[2] 17	[9] 02	19
5	[6] 08	[5] 12	20
6	[3] 15	[8] 05	20
7	[4] 15	[7] 07	22
8	[8] 05	[2] 15	20
9	[7] 08	[4] 15	23
10	[10] 01	[1] 19	20
Total	106	99	205

$X^2 = 66.67$
df= 9
X^2 (0.1%) = 27.8 (Wonnacott,1977: 614)

Table 2 - Farmers' Residence

Projects	Farm(a)	Town(b)	Total/Farmers
1	[3] 14	[8] 06	20
2	[1] 20	[10] 01	21
3	[2] 17	[9] 03	20
4	[5] 11	[6] 08	19
5	[4] 12	[7] 08	20
6	[9] 01	[1] 19	20
7	[8] 06	[3] 16	22
8	[6] 11	[5] 09	20
9	[9] 09	[4] 14	23
10	[9] 01	[1] 19	20
Total	102	103	205

$X^2 = 62.16$
df = 9
X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 3 - Visits to the Farmers

Projects	Every Day (a)	2-4 Times p.w.(b)	Total/Farmers
1	[1] 18	[8] 02	20
2	[1] 19	[10] 02	21
3	[5] 17	[6] 06	20
4	[6] 16	[5] 03	19
5	[1] 18	[8] 02	20
6	[10] 03	[1] 17	20
7	[8] 14	[3] 08	22
8	[7] 15	[4] 05	20
9	[4] 20	[7] 03	23
10	[9] 11	[2] 09	20
Total	151	54	205

X^2 = 65.04
df = 9
X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 4 - Participation of Sugar Cane Income in the Farmers' Gross Income

Projects	50-70% (a)	71-100% (b)	Total/Farmers
1	[5] 06	[6] 14	20
2	[7] 02	[4] 19	21
3	[6] 02	[5] 18	20
4	[3] 06	[8] 13	19
5	[4] 06	[6] 14	20
6	[8] 01	[3] 19	20
7	[9] 01	[2] 21	22
8	[2] 09	[9] 11	20
9	[10] 01	[1] 22	23
10	[1] 20	[10] 00	20
Total	54	151	205

X^2 = 72.28
df = 9
X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 5 - Technicians' Attitude

Projects	Persuasive (a)	Participatory (b)	Total/Farmers
1	[7] 13	[4] 01	20
2	[10] 01	[1] 20	21
3	[5] 16	[6] 04	20
4	[8] 01	[3] 18	19
5	[3] 18	[8] 02	20
6	[2] 19	[9] 07	20
7	[4] 19	[7] 03	22
8	[6] 15	[5] 05	20
9	[1] 22	[10] 01	23
10	[9] 01	[2] 19	20
Total	125	80	205

X^2 = 118.21
df = 27.88
X^2 (0.1%) = 27.88 (Wonnacott,1977: 614)

Table 6 - Distance from the Farms to the Sugar Cane Mill (km)

Projects	≤ 10 (a)	> 10 (b)	Total/Farmers
1	[3] 18	[8] 02	20
2	[8] 03	[3] 18	21
3	[2] 19	[9] 01	20
4	[9] 02	[2] 17	19
5	[6] 11	[5] 09	20
6	[10] 01	[1] 19	20
7	[7] 12	[4] 10	22
8	[1] 20	[10] 00	20
9	[4] 18	[7] 05	23
10	[5] 13	[6] 07	20
Total	117	88	205

X^2 = 86.3
df = 9
X^2 (0.1%) = 27.88 (Wonnacott,1977: 614)

Table 7 - Distance from Farms to Experimental Station

Projects	≤ 20 (a)	> 20 (b)	Total/Farmers
1	[6] 02	[5] 18	20
2	[5] 03	[6] 18	21
3	[1] 19	[9] 01	20
4	[3] 04	[8] 15	19
5	[4] 03	[6] 17	20
6	[1] 19	[9] 01	20
7	[9] 01	[2] 21	22
8	[7] 01	[3] 19	20
9	[10] 01	[1] 22	23
10	[7] 01	[3] 19	20
Total	54	151	205

χ^2 = 123.99

df = 9

χ^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 8 - Distance from Farms to 'Business Town'

Projects	≤ 10 (a)	> 10 (b)	Total/Farmers
1	[6] 08	[5] 12	20
2	[3] 19	[8] 02	21
3	[9] 01	[2] 19	20
4	[7] 02	[4] 17	19
5	[4] 17	[7] 03	20
6	[8] 02	[3] 18	20
7	[5] 17	[6] 05	22
8	[1] 19	[9] 01	20
9	[10] 01	[1] 22	23
10	[1] 19	[9] 01	20
Total	105	100	205

χ^2 = 123.29

df = 9

χ^2 (0.1%) = 27.88

Table 9 - Farmers' View of the Technical Team's Attitude

Projects	Persuasive (a)	Participatory (b)	Total/Farmers
1	[5] 03	[5] 17	20
2	[7] 03	[4] 18	21
3	[2] 11	[9] 09	20
4	[10] 02	[1] 17	19
5	[3] 04	[7] 16	20
6	[1] 18	[10] 02	20
7	[8] 03	[3] 19	22
8	[5] 03	[5] 17	20
9	[9] 03	[2] 20	23
10	[3] 04	[7] 16	20
Total	54	151	205

$\chi^2 = 60.46$

df = 9

χ^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 10 - Political Situation of Country and Project Development

Projects	Prejudicial (a)	Unimportant (b)	Total/Farmers
1	[4] 17	[6] 03	20
2	[3] 18	[7] 03	21
3	[6] 15	[5] 05	20
4	[7] 14	[4] 05	19
5	[10] 07	[1] 13	20
6	[9] 11	[2] 09	20
7	[2] 19	[9] 03	22
8	[4] 17	[8] 03	20
9	[1] 20	[10] 03	23
10	[8] 13	[3] 07	20
Total	151	54	205

$\chi^2 = 27.55$

df = 9

χ^2 (0.1%) = 27.87 , χ^2 (1%) = 21.67 (Wonnacott,1977: 614)

Table 11 - The Main Project Activity Responsible for the Changes

Projects	On-Farm Trial (a)	Technicians' Open Way(b)	Total/Farmers
1	[4] 16	[7] 04	20
2	[1] 20	[10] 01	21
3	[10] 04	[1] 16	20
4	[3] 17	[8] 02	19
5	[5] 15	[5] 05	20
6	[2] 19	[9] 01	20
7	[9] 07	[2] 15	22
8	[5] 15	[5] 05	20
9	[8] 11	[3] 12	23
10	[7] 12	[4] 08	20
Total	136	69	205

$X^2 = 57.23$

df = 9

X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Tabel 12 - Reason for Non-Adoption

Projects	Financial Problems(a)	Technology (b)	Total/Farmers
1	[5] 15	[6] 05	20
2	[9] 07	[2] 14	21
3	[2] 18	[9] 02	20
4	[10] 02	[1] 17	19
5	[1] 20	[10] 00	20
6	[4] 17	[7] 03	20
7	[7] 12	[4] 10	22
8	[8] 07	[3] 13	20
9	[3] 20	[8] 03	23
10	[6] 12	[5] 08	20
Total	130	75	205

$X^2 = 60.34$

df = 9

X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 13 - Farmers' Participation in New Groups

Projects	Do Not Know (a)	Yes (b)	Total/Farmers
1	[4] 14	[7] 06	20
2	[9] 08	[2] 13	21
3	[1] 09	[9] 01	20
4	[10] 04	[1] 15	19
5	[1] 19	[8] 01	20
6	[3] 18	[8] 02	20
7	[6] 1	[5] 11	22
8	[7] 08	[4] 12	20
9	[8] 09	[3] 14	23
10	[5] 13	[6] 07	20
Total	123	82	205

$X^2 = 53.62$

df = 9

X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 14 - Positive Aspects of the Project

Projects	Technicians' Open Way(a)	On Farm Trial(b)	Total/Farmers
1	[3] 16	[6] 04	20
2	[9] 15	[2] 06	21
3	[3] 16	[6] 04	20
4	[8] 14	[3] 05	19
5	[3] 16	[6] 04	20
6	[10] 01	[1] 19	20
7	[2] 19	[9] 13	22
8	[6] 15	[4] 05	20
9	[1] 22	[10] 01	23
10	[6] 15	[4] 05	20
Total	149	56	205

$X^2 = 56$

df = 9

X^2 (0.1%) = 27.87 (Wonnacott,1977: 614)

Table 15 - Negative Aspects of the Project

Projects	Discontinuity of the Project (a)	Unappropriate Technology (b)	None	Total/Farmers
1	[3] 15	[8] 03	[6] 02	20
2	[10] 03	[7] 04	[1] 14	21
3	[7] 04	[4] 06	[2] 10	20
4	[1] 17	[10] 01	[7] 01	19
5	[4] 10	[1] 09	[8] 01	20
6	[7] 04	[4] 06	[2] 10	20
7	[9] 04	[3] 09	[4] 09	22
8	[6] 09	[6] 05	[5] 06	20
9	[2] 20	[9] 02	[10] 01	23
10	[4] 10	[1] 09	[8] 01	20
Total	96	54	55	205

X = 72.28
df = 18
X^2 (0.1%) = 42.31 (Wonnacott,1977: 614)

The results of the Chi-Square test, according to the levels of significance shown, led to the corroboration of what had been suggested when studying the tables of Priority I. That is, there is very strong evidence to support the view that the Projects performed differently according to the variables that have been studied. To apply X^2 to the Contingency Tables of Priority II, was the initial procedure, bearing in mind the final phase of data analysis. This was formed by applying Spearman's Rank Correlation Coefficient (r_s), to try to explain the phenomenon (H_1). The procedure was as follows: the scores given to the economic indicators (chosen levels: Ab; Ba; Ca; and Da) were compared two by two (matched pairs) with the scores given to other indicators, taking into consideration both their levels, that is: 1a; 1b; 2a; 2b; 3a; 3b; 4a; 4b; 5a; 5b; 6a; 6b; 7a; 7b;

8a; 8b; 9a; 9b; 10a; 10b; 11a; 11b; 12a; 12b;13a; 13b;14a; 14b; 15a; 15b. This was done to examine whether two sets of scores (1 'economic' and 1 'others') were related and, if they were, the degree of their relation (Siegel, 1988). In other words, to verify whether there was a tendency for the two indicators of the matched pairs to increase and decrease together (positive correlation) or, alternatively, for one to decrease as the other increased, and vice versa (negative correlation). The value of r_s near + 1 signifies strong evidence of a positive correlation, while strong evidence of a negative correlation is supported when the value of rs is near -1 . Then, the value of r_s lies between -1 and +1, or [$-1 < r_s < +1$] (Neave and Worthington, 1988 :173).

Finally, the test showed whether there was an association between the economic indicators and the other indicators, while their respective degrees of significance (∂) estimated the degree of this association. Only the matched pairs presenting a significance degree below 5% were considered. The tied observations were given an average ranking (Siegel, 1988:239). For example, two scores of 8 became 8.5 and 8.5. In order to illustrate the procedures used when applying the Spearman's Rank Correlation Coefficient with all matched pairs (comparisons), the pair Ab X 14a is shown.

The Spearman's Rank Correlation Coefficient (SRCC):

$$r_s = 1 - \frac{6 \sum_{i+1}^{N} d_i^{\,2}}{N 3 - N}$$

where,

i = Projects

di = r (Xi) - r (Yi)

r = Rank

Xi = One component of the matched pair

Yi = Other component of the matched pair

N = Number of pairs of observations

If one takes the (Ab X 14a), r_s is calculates as follows:

i = 10

di = r (Ab i) - r (14a i)

N = 10

The Table below tries to sort out the data of this case:

Table 16 - Difference between the Rank of (Ab X 14a) pair

Projects,	i	1	2	3	4	5	6	7	8	9	10
Increasing of Productivity (8-15 tonnes) rank,	r(Abi)	1	7	2	4	8	*9.5	5	*9.5	3	6
Technicians' Open Way rank	r(14ai)	*3.5	9	*3.5	8	*3.5	10	2	*6.5	1	*6.5
Difference	di	-2.5	2	-1.5	-4	-4.5	-0.5	3	3	2	-0.5
Square / Difference	di^2	6.25	4	2.25	16	20.25	0.25	9	9	4	0.25

(*) Tied Scores

Then,

$$r_s = 1 - \frac{6 \times 71.25}{990} \quad \text{or} \quad rs = 0.5681$$

Consulting the table of the significance level (Neave and Worthington, 1988: 390) the r_s value is well within a 5% critical region (∂ 5% = 0. 5636). There is normal evidence of a positive correlation (r_s = +) between Increased Productivity in the 8-15 tonnes range and Technicians' Open Way. One can, therefore, conclude that the Technicians' Open Way, is positively associated with Increased Productivity. That means, according to the SRCC definition, that there is a tendency for the two indicators (matched pairs) to increase or decrease together. For example; if technicians use more participative methods farmers will enjoy a greater increase in productivity, while the use of less participative methods corresponds to a smaller increase in productivity.

After having applied the SRCC to all the aforementioned pairs, considering what has already been stated, [in other words, those that were outside the ∂ 5% critical region were rejected], only the following matched pairs, apart from the one already exemplified, presented positive or negative correlations :

I - <u>Positive Correlations (PC)</u>

a) Increased Assets and Primary/Secondary Schooling - 8a X 1b

r_s = 0.6969

∂ 2.5 % = 0.6485

The r_s value is within the 2.5 % critical region (strong evidence of PC).

Farmers' primary and secondary schooling is then positively associated with Increased Assets. If the level of schooling increases the farmers' assets will increase or, conversely, a low level of schooling corresponds to a low level of productivity.

b) Increased Assets and $\leq$ 10km from the Farm to the *Usina* - Ba X 6a

r_s = 0.8424

∂ 0.5% = 0.7939

The r_s value is within the 0.5% critical region (very strong evidence of PC)

The same distance of under 10km from the farm to the *Usinas* is then positively associated with increased assets, which leads to the suggestion that the distance from the farm to the processing plant does influence its assets. In practice, the nearer the farm is to the *usinas* the lower production costs tend to be and the greater will be their assets.

c) Increased Assets and Technicians' Open Way [6] as the main Project's activity responsible for the changes - Ba X 11b

r_s = 0.7515

∂ 1% = 0.7455

The r_s value is within the 1% critical region (strong evidence of PC).

The Technicians' Open Way as the main activity of the Project responsible for the changes is then positively associated with increased assets. The more that participatory methods are used by technicians, the greater will be the farm's increased assets. Conversely, if technicians start to assume an authoritarian posture, increased assets begin to decrease. This confirms the suggestion based on the result of the pair (Aa X 14a) above, that the Technicians' Open Way, as opposed to On-Farm Trial, could influence the accumulation of assets.

d) Increased Assets and Technicians' Open Way as a positive aspect of the Project - Ba X 14a

r_s = 0.7621

∂ 1% = 0.7455

The r_s value is within the 1% critical region (strong evidence of PC).

Technicians' Open Way as the positive aspect of project activity is then positively associated with increased assets. In other words, it reinforces the previous suggestions that Technician Open Way positively influences increased assets.

e) Adoptions and Technicians' Open Way as the main project's activity responsible for the changes - Ca X 11b

r_s = 0.7787

∂ 1% = 0.7455

The r_s value is within the 1% critical range (strong evidence of PC).

Technicians' Open Way as the main project activity responsible for the changes is then positively correlated with adoption. The more frequently technicians use participatory methods, the more likely it is that technologies will be adopted. This leads to the conclusion that Technicians' Open could well influence the number of technological adoptions, more so than On-Farm Trials.

f) Adoptions and Technicians' Open Way as the positive aspect of the Project - Ca X 14a

r_s = 0.7863

∂ 1% = 0.7455

The r_s value is within the 1% critical range (strong evidence of PC)

The technicians' open way as the positive aspect of project activity is then positively correlated with adoption.

Faced with this and previous results it can be suggested that if there is more participation during agricultural research, sugar cane productivity will be higher, sugar cane farm' assets will increase more and sugar cane technology will be more easily adopted.

II - Negative Correlations (NC)

a) Increased Assets and Literacy Level - Ba X 1a

r_s = - 0.6787

∂ 2.5 % = 0.6485

The r_s value is within the 2.5 % critical range (strong evidence of NC).

The farmers' literacy level is then negatively associated with the increase in assets. This leads to the conclusion that farmer literacy does not affect accumulation of sugar cane farm assets. This means that if a farmer is less literate it is possible that increased assets be greater. On contrary, one can assert that schooling does in fact influence the sugar cane farms' accumulation of assets, as was shown in the positive correlation (item a).

b) Increased Assets and more than 10km from the Farm to the *Usina* -Ba X 6b

r_S = - 0.8242

∂ 0.5% = 0.7939

The r_S value is within the 0.5% critical range (very strong evidence of NC).

A distance greater than 10km from the farm to the *Usina* is then negatively associated with increased assets, which leads to the conclusion that distance from the farm to the industry does not lead to increased assets.

c) Increased Assets and On-Farm Trials as the main project activity responsible for the changes - Ba X 11a

r_S = - 0.7333

∂ 2.5 % = 0.6485

The r_S value is within the 2.5% critical range (strong evidence of NC).

The On-Farm Trial as the main project activity responsible for the changes, is then negatively associated with increased assets. This, suggests that the On-Farm Trial, as opposed to Technicians' Open Way, may not affect the Increase in Assets.

d) Increased Assets and On-Farm Trial as the positive aspect of the Project - Ba X 14 b

r_S = - 0.6363

∂ 5% = 0.5636

The r_S value is within the 5% critical range (normal evidence of NC).

The On-Farm Trial as the positive point of project activity is then negatively associated with Increased Assets. This result reinforces the previous one.

e) Adoptions and On-Farm Trial as the main project activity responsible for the changes - Ca X 11a

r_s = - 0.7909

∂ 1% = 0.7455

The r_s value is within the 1% critical range (strong evidence of NC).

The On-Farm Trial as the main project activity responsible for the changes is then negatively associated with adoption. Thus, the On-Farm Trial may not influence the number of technological adoptions as evidence in this study.

f) Adoptions and On-Farm Trial as the positive aspect of the Project - Ca X 14b

r_s = - 0.7045

∂ 2.5% = 0.6485

The r_s value is within the 2.5% critical range (strong evidence of NC).

The On-Farm Trial as the positive point of project activity is then negatively associated with adoptions. This may imply that if On Farm Trial is applied, the numbers of technological adoptions will probably not be higher as happened with Technicians' Open Way.

The main conclusion to be drawn from the NC section is that sugar cane productivity, sugar cane farm assets and sugar-cane technology adoptions would not be influenced by On-Farm Trial [7] alone within the conditions of this study.

Interpretation of the Correlations and their Practical Significance

The statistical conclusions of the second phase of the tests, can be interpreted as follows:

Increased Assets and Schooling (Primary/Secondary and Literacy)

Farmer's primary and secondary schooling is positively associated and farmers' literacy level negatively associated with increased assets. This can be elucidated from the fact that farmers with secondary education have more mobility inside and outside the community, and can establish easier communication and relationships. The access to technology can be facilitated and its dissemination within the community is a natural process as they can themselves collaborate towards it.

On the other hand, farmers who can only sign his/her name face greater difficulties in his/her relationship with technicians, institutions and other people in the community. This difficulty sometimes causes barriers to the adoption of technology (questionnaire-question 4.3.). As for example: the difficulty of farmers with low schooling levels in getting in touch and establishing a relationship with banks, accepting the idea of credit as a benefit instead of simply being afraid of running into debt (question 2.19-questionnaire). This imposes constraints on the utilisation of rural credit, influencing the process of technology adoption, consequently affecting the economic profitability of agricultural activities. A concrete situation among the projects which can illustrate this discussion is what happened with Agua Preta's project. The farmers abandoned their land as a consequence of misunderstandings with INCRA (this has already been fully described on page 335). Of 21 farmers interviewed in this Project, 6 were illiterate and 15 literate, and there were no farmers with secondary schooling.

Increased Assets and Distance from the Farms to the *Usina* (≤10 and >10)

It is clear that a smaller distance from farm to the *usina* results in lower transport costs and consequently lower sugar cane production cost bringing about higher economic profitability and positively influencing the increase of assets on farms. Added to that, in the Brazilian case, sugar cane transportation contributes to 30% of the total production cost of 1 hectare (IAA-Planalsucar, 1985), according to the distance, type of transport, use of petrol or alcohol fuel and the region, among others.

This explains why farms with distance equal to or less than 10km to *usinas* showed a positive correlation when associated with increased assets, as against those situated further than 10km (negative correlation). Therefore, the practical significance of this test indicates that distance from farm to *usina* it is an important component project performance. Farms which are near the *usinas*, providing other production factors are similar, are expected to enjoy a relative advantage in terms of economic profitability when compared with those which are more distant.

In Lençóis Paulista project, the best ranked, 18 of 20 farmers interviewed were 1-10km distant from the São José Sugar Cane Mill (Chapter V). This example supports the practical significance of the correlation discussed.

<u>Increased Assets/Adoptions Versus the Main Project's Activity Responsible for the Changes (Technicians Open Way/ On-Farm Trials)</u>

Due to the similarity of associated pairs (in relation to the test objective such, to explain the hypothesis) and their results, the correlations below will be interpreted together to avoid repetition. In other words, the Increased Assets (Priority I - table B) and Adoptions (Priority I - table C) were separately crossed with the Main Project's Activity Responsible for the Changes [Technician Open Way and On-Farm Trials (Priority II - table 11)].

Increased Assets and Adoptions, when crossed with Technicians Open Way as the main project's activity responsible for the changes, showed a positive correlation as a result of the utilisation of the participative method. In this approach, technicians favouring the relationship between them and farmers, permitted the latter a total integration in the identification of technological problems and their solutions resulting in adoption as a genuine process. Thus, the farmers expectation of being recognised as an active partner in technological innovation (participant observation), decisively influenced adoptions, technological solutions and increase of productivities and assets.

In contrast, On-Farm Trials, conventionally indicated as main the factor responsible for changes, showed a negative correlation when crossed with Increased Assets and Adoptions. This revealed that the most important aspect to the farmers involved in the research was their active participation in all phases of the project. From this, the practical significance of Technician Open Way may be appreciated. That is, the high degree of farmer participation in the technology diffusion and generation process is a decisive component in the adoption phase, and is reflected in the participatory projects' performance in the first phase of statistical tests.

Increased Assets/Adoptions Versus the Positive Aspects of the Project (Technicans Open Way and On-Farm Trials)

In this topic as the previous one, the correlations were grouped with the same purpose. The results were analogous, in that, most of the farmers alluded to Technicians Open Way as a positive aspect of the Project surpassing On-Farm Trials, which showed a negative correlation when this indicator was crossed with Increased Assets and adoptions. This result, for the same reasons as in the earlier aggregation, supported the influence of farmer participation in agricultural research. It was very strongly suggested in practice, that Technicians Open Way is the strongest technological change factor when compared with On-Farm Trials. It can be said that the importance of the relationship between technicians and farmers in favour of participation, were the main findings at all stages of the statistical analysis. Thus, farmer participation should be considered a decisive component of agricultural research .

7. Overall Conclusion

The tests and statistical analysis presented in this Chapter provide empirical evidence which supports the arguments put forward in this study. The Technicians' Open Way, a label given by the farmers to the participatory approach used by technicians, was singled out as the major positive aspect of the project and the main project activity responsible for changes in performance. This was clearly confirmed when the same indicator was shown to have influenced increasing assets and adoptions. Thus, these arguments supported the conclusions reached in the first phase of the statistical tests, when testing the hypothesis (rank method), that projects with a higher level of participation presented better results when compared with projects with a lower level of participation. Also, the analysis of the results leads to the conclusion that farmer participation, as an agricultural research approach and in similar conditions to those studied, could contribute in some form to modifying the economic performance and technological level of disadvantaged farmers. This conclusion therefore rejects the null hypothesis (H_0) and supports the prediction derived from the theory under test, the central hypothesis of this thesis (H_1), that :

"The solution to farmer's technological problems could be facilitated and farmers' economic conditions improved if farmer participation were considered a crucial component in the agricultural research process".

Notes:

1. The IAA, a national institution which controlled sugar cane, sugar and alcohol production, published an annual report (specifying farmers and industrial production units) of the production of sugar cane, sugar and alcohol with its agricultural areas throughout the country, .

2. The main methodological issue also defended by the 'persuasion' follower in the IAA-Planalsucar's programme.

3. Colloquial language used by farmers to define when technicians had participatory attitudes, the opposite of authoritarian ones.

4. The adoption of a new variety of sugar cane recommended by the research as containing a high sucrose content alone may not solve the technological problem if it is harvested an inappropriate time.

5. The use of insecticides to combat determined insect pests could be a technological solution in itself. Nevertheless thus does not mean that it will necessarily imply an increase in productivity.

6. The dosage of fertilizers can be increased in specific areas with a consequent increase in agricultural productivity (production/area), without representing a profit increase.

7. When the farmers start to incorporate new lands, more machinery, improve and build new farming quarters, among others, this is a strong indication that their economic conditions are improving.

Chapter VII - Impact of the Projects II: The Actors' Perspectives

The statistical analysis of project performance in the previous chapter will be followed in this section by a more qualitative analysis. It uses non-quantifiable evidence provided by the author and those farmers and technicians in the projects surveyed. Firstly, the statistical results will be discussed according to the author's point of view, after which the farmers and technicians' critical analysis of the programme as a whole, as well as final considerations on sections relating to data analysis, will be presented.

1. The Statistical Focus and Causal Links

1.1 Project Performance

A full analysis employing only statistical calculations as the core of this thesis would not do justice to the complexity of the topic and to the nature of the problem under investigation. In addition, the importance of the complementarity quantitative and qualitative studies has already been mentioned in the introductory section of this thesis. Thus, before discussing qualitative aspects, it is necessary to explain that, as auxiliary instruments of this analysis, further data gathered from the projects covered in Chapter V will also be employed. The following Table 7.1 will help comprehend the commentaries to be discussed regarding the performance of the projects.

Table 7.1 - Rank III and Project Location

RankIII	No.Project	Location
Ist - C1 T1 A1 (Ist and Ist)	1	Lençóis Paulista-São Paulo
2nd - C1 T2 A1 (2nd and 3rd)	3	Urucânia - Minas Gerais
3rd - C1' T2' A1' (3rd and 4th)	9	Macaé - Rio de Janeiro
3rd - C2 T2 A1 (4th and 2nd)	7	Ceará-Mirim-Rio G. do Norte
5th - C1 T2 A2 (5th and 5th)	4	Campos-Rio de Janeiro
6th - C2 T2 A2 (6th and 7th)	8	Itapemirim-Espírito Santo
7th - C2' T1' A2' (7th and 6th)	10	Assis- São Paulo
8th - C2 T1 A1 (8th and 8th)	5	Capivari - São Paulo
9th - C2 T1 A2 (9th and 9th)	6	Mamanguape-Rio G. do Norte
10th-C1 T1 A2 (10th and 10th)	2	Agua Preta - Pernambuco

The data from the above table shows that all of the projects that employed the participatory approach (Lençóis Paulista, Urucânia, Macaé, Ceará-Mirim and Capivari), with exception of this last one, performed exceptionally well in comparison with the others. This may be explained by several factors. Thus, project conditions regarding operations and the level of community organisation when fieldwork was carried out (post-test, see Chapter VI), are critical determinants. The performance of these projects has been consistently positive throughout the years. By 1988, every project had been abandoned by governmental institutions; in other words, the official agreements had been cancelled. However, the participatory projects continued to operate, having been taken over by local NGOs or by the communities themselves. For example: Lencóis Paulista, Urucânia and Cearámirim, were being run by their communities, Capivari was taken over by the trade union, and Macaé was under the tutelage of the co-operative. The strategic projects, on the other hand (with the exception of Assis, which was undertaken by the Association), had all been completely deactivated.

Every strategic project, except for Campos, remained at the same organisational level; in other words, Agua Preta: Nil-Nil, Campos: Nil-Low, Mamanguape: Nil-Nil, Itapermirim: Nil-Nil and Assis: Low-Low. On the other hand, every participatory project (except for Capivari which remained Low) improved its organisational level. For example: Lençóis changed from Regular to High , Urucânia from Low to Regular, Ceará-Mirim and Macaé from Nill to Low. One can therefore conclude that the participatory project, did contribute to and influence the participating communities with regard to their level of awareness and organisation to the point where they were able to be undertaken by the communities themselves. In the case of Assis, which was taken over by the Association and in the case of Campos, taken on by the community, the fact that they increased their level of organisation, even though they were both Strategic Projects could be explained by the influence that the technicians/teams responsible for the projects had on them. When the farmers had the opportunity to express their points of view on the behaviour of the technicians in charge, the evidence was as follows:

"We feel at ease with the technician ... as if he were one of us. He never said we were wrong or that we should farm this or that way. On the contrary, we picked up a lot of useful hints from talking with him ".

(Questionnaries, Assis-SP, August, 1988)

"The technician doesn't seem like a technician, because he always asks what we think, how we did things before and sometimes he copies us ".

(Questionnaires, Campos- RJ, July, 1988)

Because the field teams were responsible for the projects following two different approaches and received training in both approaches, their respective ideological postures were decisive in determining project outcomes. In other words, even if the method employed was contrary to the technician's initial posture, with the development of activities and the evidence of positive results they would unconsciously tend to select certain methodological procedures. Therefore, the approach that was employed at the end of the project, in this way, avoided becoming too pre-determined. This was clearly observed in some Strategic Projects where the posture of technicians tended to be influenced by the participatory approach. This was not identified in relation to the participatory projects. Among the field technicians who belonged to extension services and co-operatives, it was much easier to find professionals who were sensitive to participation.

Continuing the analysis of Rank III, one can observe that among the five projects showing the best performance (Lençóis Paulista, Urucânia, Macaé, Cearámirim and Campos), four of them involved small farmers and applied the participatory approach. This result had not been expected by the technicians, for they admitted that they did not originally believe that participative methods would achieve the success they desired with this type of farmer, due mainly to their lack of schooling. Although the successful experience with the pilot projects had involved small farmers, this was not expected to be replicable, as the teams then involved did not have the same practical and theoretical knowledge.

The only participatory project that was not among the first five from Rank III was Capivari. This could be explained by the posture of the ARDT from São Paulo (coordination team) initially responsible for project implementation, which was composed mainly of elitist researchers, with little liking for rural life. Furthermore, those who had already worked with small farmers, were followers of orthodox diffusionist methods, as one can see from what the farmers said:

"the technicians only come here to tell us we are wrong and that we shall get *desagio* [1] in our canes unless we follow their advice".

(Questionnaire, Capivari-SP, October, 1988)

Another factor that explains the position of this project in Rank III, were the methodological problems faced by the ARDT team in the project operation. Afterwards, the union contracted an extension worker team for the project at field level. This team was more experienced in establishing contacts with farmers and sensitive to participation, which led to its successful implementation.

"With the new technicians we understand better what they want with us; they come to talk without ordering us about. What a pity that they came only after one year".

(Questionnaires, Capivari, October, 1988)

As for technologies, one factor deserves mentioning: the Lençóis Paulista project involving small farmers used simple technology and obtained the best performance in the Rank. Nevertheless, the following four projects (Urucânia, Macaé, Ceará-Mirim and Campos), all worked with non-simple technology and only the penultimate project involved the medium farmer. Three of them employed the participatory approach. In relation to the last five projects in the Rank III (Itapemirim, Assis, Capivari, Mamamguape and Agua Preta) four of them worked with medium farmers (Itapemirim, Assis, Capivari and Mamamguape), employing simple technology and the persuasive approach.

The small farmers from Urucânia and Macaé (2nd and 3rd) unexpectedly managed to adopt complex technologies wherever the approach had been participative. On the other hand, when the approach used on the small farmer was the persuasive method, even adopting simple technology (in the case of Agua Preta), the project ended up in the last Rank position. On the other hand, medium farmers that worked with the participatory approach, and even with non-simple technology (as is the case of Ceará-Mirim), occupied a leading position in Rank III (3rd). Therefore, one can say that the participatory approach has had a clear determining influence on performance, rather than the type of technology employed. As for the medium farmers, one can also verify that the type of technology did not influence their positions in the Rank.

From this evidence, one can therefore infer that the complexity of the technology, did not influence the performance of the projects, for it was adopted equally by small and medium farmers. In this way, taking into consideration the three main aspects studied in the previous Chapter, Technology, Classes of Farms and Approach, this last aspect could be considered as of being of greater relevance in determining the performance of the projects.

1.2 The Phenomenon of Dependence [2]

The analysis will now focus on the dependence of these phenomena, or rather on the positive or negative relation between the indicators studied when applying statistical methods. That is, the possible causal links which might explain the positive statistical correlations already discussed relating to the use of participatory methods and certain economic indicators, namely: increased productivity, increased assets, adoptions and technological solutions.

Firstly, it is in order to make a few comments, not only about the definition of the indicators used to explain the relationships among key variables, but also about the actual indicators used. They were selected as indicators of success, viewing the specific objectives of this study, or rather, to compare the project performance in relation to economic aspects. Adding to that, as statistical methods were used when selecting them, some indicators such as land tenure, marketing, operational assets and credit were ruled out. This is due to the the fact that their Chi-Square tests did not show any significance. Even though they are of empirical importance when considered in absolute terms, they did not have relative importance due to the nature of this specific study. The statistical procedures demonstrated that when the pre-test was carried out, 94% of the farmers were owners, 88% had access to credit, 75% did not have machinery and equipment and 100% marketed their products. In other words, they could not be used as a criteria for differentiation in this particular study.

Another factor to be considered is in relation to the interpretation of the statistical study of dependence between the indicators. Some of them can be quantified such as schooling. Others are expressed through the personal opinions of the interviewees. Moreover, they were analysed in pairs, isolated from the wider context. Although the results are still valid, certain indicators have also been influenced by wider factors located beyond the project boundaries.

The objective of the statistical method employed here, is to show the dependence between two indicators (when in pairs), taken from a certain context, in order to highlight possible causal linkages. In this way, it is suggested that the reader, when interpreting such results, take into consideration the existence of such influences that are only evident in practical action. The statistical results presented in relation to the dependence of phenomena can provide lessons for future action in similar situations. In order to illustrate the points raised above, some considerations about the correlations found among the phenomena under examination will be examined.

Initially, the association between increased assets and schooling was quite interesting. The survey results show that the degree of literacy did not have any influence on increase in productivity. It did not make any difference whether farmer was more or less literate, or even illiterate. The influence that was identified was in relation to her/his level after having concluded primary school, according to the positive correlation found. This can be explained by the fact that most farmers considered literate could in fact barely sign their names. On the other hand, those who managed to complete at least primary school, could read, write, communicate better and therefore had greater access to the media. As for other factors that could influence the occurrence of these phenomena (increased assets and schooling), we could identify land tenure and the access to credit. In some case illiterate interviewees were tenants, did not have access to credit and presented low farm productivity.The interaction of these factors could have had consequences for their financial solvency and accumulation of assets.

Increased assets, when taken together with distance between the farm and the *usina* being greater or equal to 10km, showed a positive correlation. An expected result is the distance between farm and *usinas* as a determining factor in the cost of transport of raw-materials to the factory. The greater the distance, the greater the freight charges incurred and the cost of production would become more onerous, while profits would decrease. An influencing factor in this association has in practice been the cost of fuel. In the *Plano Trienal* period, alcohol-driven vehicles enjoyed several subsidies, including the price of fuel, which was much cheaper than petrol. For example, a farm situated less than 10km away would present a positive correlation between the distance and increased assets. However, employing petrol-driven trucks could involve greater transport expenses than another situated further than 10km away but employing an alcohol-driven truck.

When the indicators of increased assets and adoptions were associated with the farmers' opinion on the Technicians' Open Way, there was a positive correlation. When the same economic indicators were associated with On-Farm Trial, a negative correlation was identified. Since they were presented as the main project activity responsible for the changes and a positive aspect of the project, it was clear in each case, that these statistical results actually reinforced the value of a participative approach. This contradicts to a certain extent the persuasive method followers, who defend On-farm Research as a key methodological procedure. For instance:

"The best thing for the farmer is to teach him while 'acting' (learning by doing), taking into consideration his situation. If you can prove that a certain technique or technology represents more money in your pocket, what happens after that, does not matter. This excessive concern in discussing new technologies with them, to a certain extent is just bullish talk (*papo furado*) and this, he will not accept any longer".

(Interview with Technician, October, Araras-SP)

Returning to the other aspects that may influence participation in practice, one cannot visualise the importance of indicators isolated into pairs, but can within a wider context. Farmer participation could not by itself, obviously, be the sole factor responsible for the increase in assets, and/or for the adoption of technologies. This approach would be very much linked, mainly to the actual On Farm Research, amongst other factors. This evidence stood out in all the projects, not only through the farmers, but also because of the technicians' participative position, as one can see here:

"The technicians really came with a new working methodology. They listened to us a lot but, if you will excuse me, a very special event was also the experiment on our land".

(Questionnaire, October, Lençóis Paulista:1988)

"I consider the experiments and demonstration plantations decisive methodological instruments when applying the participatory approach".

(Interview with Technician, Cearámirim, September,1988)

It is still necessary to emphasise that in the analysis of the correlation of the economic indicators (increased assets and adoptions) the opinions of the farmers were concentrated only on two alternatives, Open Way and On-Farm Trial (see Tables 6.11 and 6.14). If one of them presents a positive correlation the other will have to be negative (because of the nature of the statistical method-SRCC), as they were both extracted from a group of data from the table. However, other information could be used to cross-check possible contradictions. For example, opinions that were contrary to participation and that presented a positive correlation could appear on the Table relating the Negative Points (Table 6.15). This type of correlation was not identified, or rather, there were not even opinions opposed to the participation in the referred Table, nor in any other. As these contradictions did not appear, the results were confirmed. This fact, together with those already mentioned, reinforces the relevance of the approach aspect and underlines the importance of farmer participation in particular.

It is interesting to observe that the statistics used to study the phenomenon of dependence attempted to explain the relevance of farmer participation when compared with the persuasive approach and to suggest that this performance can be observed empirically. The probability of these phenomena occurring in practice will also depend, as mentioned above, on factors not yet considered in the study, but inherent however, to the real situation.

2. The Farmers' and Technicians' Perspective

The instrument of analysis in this section will be the opinions of farmers and technicians who were directly involved in project activities. The evidence was gathered throughout IAA-Planalsucar activities, from the embryonic stage of pilot projects. These testimonies are derived from formal contacts, during project activity, from information collected in observations, questionnaires and interviews during field work, and from informal conversations.

2.1 The Notion of Participation

Farmers and technicians presented different points of view on the subject of participation. To facilitate clearer presentation of these differences, it was thought it better to group the commentaries by category, into those of farmers and technicians. Initially, the farmers' points of view will be examined. They did not, at any time, take a uniformly clear position. Information was extracted indirectly, mainly when they made comments about other subjects.

"The most important part of this project was the sugar cane brought to us by the technicians. We only planted it because of their attitude. We talked a lot about types of cane and in the end they took us to see it at Planalsucar... We were not obliged to grow it. We decided ourselves. For the first time, someone took notice of our opinions".

(Questionnaires, Urucânia, September 1988)

When they were questioned directly, they had great difficulty in answering. One can surmise that perhaps this is due to their lack of familiarity with the topic and the terminology which is unusual in their everyday vocabulary, or even due to the authoritarian political situation in country. For some, the heritage that the sugar cane farmer has received from traditional authoritarian social structures derived from the traditional plantation owners or *senhores de engenho*, is also a conditioning factor in their behaviour. This difficulty in broaching the subject was even more pronounced wherever sugar cane was the traditional crop, in Pernambuco, Rio de Janeiro and São Paulo (especially in Pernambuco). A typical farmer response was:

" Ah, but who am I to answer your question? I hardly know how to speak. I never went to school. I sign my name from memory only. How should I know what all this participation is about? This is for educated people. I'll leave this to you ".

(Questionnaire, Agua Preta September 1988)

Nevertheless, from the most humble person to the most enlightened one, considering a whole particular way of looking at and commenting upon facts, through metaphors, one can perceive the existence of a general notion of the subject and a natural tendency, in most cases, to be part of the participative process, contradicting the pre-conceived opinion of most extensionists/researchers when the *Plano Trienal* was established. When a farmer was questioned about the positive aspects of a participatory project, he answered as follows:

" We lived together but we didn't know each other. The cooperative was for big cane-growers, the bank was no place for rubber sandals, cultivating crops with special methods was for mill-owners. Then this project came along which united us, opened our eyes and showed us that we could hope for a better life".

(Questionnaire, Lençóis Paulista, October 1988)

It is interesting that, even in the Strategic Projects, the assimilation of participatory postures, as a result of the programme, could be observed. For example:

"You can say that nothing here has gone right, but just the fact that we met each other in meetings was important. Nowadays we exchange ideas when the sugar-mill puts pressure on us".

(Questionnaire, Mamamguape September 1989)

None of the farmers openly opposed the idea of grater participation with researchers. What did happen at times, was that time and patience was necessary to elicit opinions from them, plus above all, sociability, given the natural reservation of rural people and the fear of possible political problems.

From a whole list of opinions on participation three have been selected to portray the general range:

" At first it was different. We thought it was the same as before. But they were different from the other technicians. They asked us how things were before, they listened to us and we took decisions together. They understood that we, more than anyone else, knew what was good for us".

(Farmer's Personal Conversation, Ceará-Mirim 1988)

" The most important thing about this project was that, in the end, we saw the technicians as our equals. We trusted them and they trusted us. We lived together as if we were a family. There was no difference between us".

(Project Meeting, Urucânia January 1985)

" I only came to appreciate technicians after the project. Before, I thought they knew nothing. They only came after us to lend us money and check our cane crop .... Not these; they explain everything. They appreciate our farming methods. In the end, our opinions merged and became one. It's as if we had mixed the earth and manure together, and it rained afterwards".

(Pilot Project, Guariba 1984)

What one can infer as fundamental from the general notion that farmers had of participation, is the relationship of 'mutual respect' between themselves and the technicians. This is, farmer's indigenous knowledge had been acknowledged by the technicians, in the same way that the farmers began to respect their scientific knowledge. Thus, the idea of 'mutual respect' is expressed as listening and being listened to, taking into consideration the validity of the experiences, both the farmer's and the technician's. Considering 'participation' in its more common interpretation of 'empowerment' in terms of access to, and control of, the resources necessary to protect livelihood (Oakley, 1984; Samuel, 1987 : UNRISD,1981; Curtis et al.,1978; Fernandez and Tandon, 1983), as a reference point, evidence given by farmers reflects their need to be recognised and considered as active forces in the whole process of generating and adopting technologies.

Among the twenty-three technicians that were interviewed (the interviews totalled 27, four of which were farmers who were class leaders), there was no consensus of opinion and, because of their intellectual background, they were more frank in their opinions. This helped in the interpretation of results a great deal, leading to the identification of three different postures: thirteen in favour; eight against; and two who were indifferent to participation.

From among the first group, three opinions on the subject stood out. Participation as a methodological instrument, as an instrument of social and economic improvement and as a means of bringing about social change.

"I understand participation as being a type of methodology where you try to get the farmer to accompany every phase of the generation and diffusion of technology. If he is involved, from the identification of his needs to the solution of the problem, the adoption of technology occurs easily, helping in a great way the action of the technician and of the institutions in charge".

(Interview with Technician, Ponte Nova, September 1988)

" I can see the usefulness of an approach which leads farmers to understand and be conscious about their situation, in order to achieve an improvement in their technological stage and, consequently, of their social and economic conditions. This is because the process teaches them to organise into representative institutions, so that they may contest and negotiate their rights with the authorities. Access to technical assistance, credit, better relationships with the *usinas*, better structures of production and marketing, are some examples. It will give small farmers better conditions to compete in the market and survive as long as they remain a social class. "

(Interview with Technician, Campos August 1988)

"Participation is a continuous process of individual consciousness, providing a better understanding of the world he lives in so that he may transform that reality and the reality of those who, together with him, share his world. I see it not only as a battle for a continuous search for better living conditions, but, above all, as a vehicle of change in the actual social system".

(Interview with Technician, Lençóis Paulista 1988)

Those who were against participation (and most of them were undertaking the coordination of projects), made statements of the following nature:

"That is Marxist rhetoric. I cannot understand how farmers can discuss things with technicians on an equal basis. In all my life as a technician I have never seen any farmer teaching agricultural techniques to a well trained technician. I cannot accept that you can go to a meeting and not prepare anything to offer farmers. You have to be ready to show where he is wrong and give the solution. For me, that is the only participation that I know. About participatory projects, some of them had reasonable results because the technicians were able to 'direct' them".

(Interview with Technician, Recife, September 1988)

I respect its importance in very special situations, for example, whenever you have farmers of a graduate level or larger ones. We can, in such cases, discuss and exchange ideas. Whereas with the small farmer this does not work. I believe that the small farmer should participate only in the phase where we have to show him where he is wrong and make him see the practical results of whatever we are recommending. Apart from that, we will only confuse him if we want to explain the details ('whys'). The participatory projects are still in operation because of the technicians and

IAA-Planalsucar's technology ".

(Interview with Technician, Piracicaba, August 1988)

From technicians with mixed opinions, the following representative statements, were selected:

"Every methodology has its positive and negative aspects. For me, participation is just as good as persuasion. What is going to influence the technician/institution in their choice, is the farmer's intellectual level, the financial resources available to him for adopting the technologies and the institutions themselves. If resources are scarce, persuasion should be used and if not that, then participation should be attempted, watching out for the farmer's level every time. The small farmer finds it hard to establish what it is he wants. The great difference between the two approaches is in relation to the diagnosis. In participation he is the one who has to tell us his problem and in persuasion we define it. As for the other phases, in participation we should tell them what we are doing and listen to their opinions, which does not occur in persuasion. Perhaps it was because of that, that the participatory projects succeeded".

(Interview with Technician, October, Itapemirim 1988)

"The thing is to have the farmer accompany our work from the beginning. It is very good, but it is hard work. It may be because of that that the participatory projects only succeeded at the end. To me it is all the same, I just think that, for a country like ours that needs quick and great results with the large farmers, participation should be chosen".

(Interview with Technician, Araras 1988)

One can therefore see from these statements that, unlike the farmers, the technicians presented quite diverse view regarding participation. Among the field technicians, most of them extensionists, those who were in favour predominated. This reinforces the point already raised above, namely, how the technicians were the same in both approaches and how the participative posture predominated among them. Some strategic projects could have had, during a more advanced phase of their existence, influences from participation. This could have been the case with the Assis and Campos projects.

On the other hand, most of the technicians of a contrary opinion, took on coordinating functions at a regional level (ARDT) and were allocated mainly to Pernambuco and São Paulo regions. This can be justified because, to coordinate teams it was necessary to be an employee of IAA-Planalsucar, where elitist researchers predominated as well as those with a 'diffusionist' posture. This is reflected in the coordination at national level (ADT) when the participatory projects were implemented. As has already been mentioned in Chapter IV, an order *(portaria)* had to be issued by the General Superintendency, forcing each Regional Body to work with at least one participatory project. As for the location of the two technicians of indifferent or mixed opinions, one of them was placed in field activity and the other in the coordination of projects.

Regarding the interpretations of participation as such, although all the technicians had received training, the following observations may be made. Those against showed little theoretical knowledge on the subject. Those who were indifferent, did assimilate some information but did not attribute any significance to it. As for those in favour, they saw participation as being crucial for the survival of the small farmer as a social class, as a methodological tool, and also as a means of social mobility for the farmer.

A final question which emerged during the post-test interviews was the concern of the technicians who adopted the participative approach to compare the results of the projects. What they wanted to emphasise was the work that had been done with the farmers to enhance their social and economic standing, as well as their 'conscientisation' and organisation as a social class. On the other hand, the other two groups of technicians made comparisons between the two types of projects, and in most cases, held the farmer responsible for failures. They did, however, recognise the efficiency of the participative types when compared with the persuasive projects.

2.2 Mutual Evaluation

Following the above pattern, participation will be analysed through a process of mutual evaluation. The farmers in favour of the approach, passed judgement on the respective teams. The technicians, in turn, evaluated the farmers, grouped into those who are were favour of participation and the rest.

a. Farmers involved in the strategic projects evaluating the technicians

Answers given by the farmers from the five SPs, on the technicians, attitudes, will be grouped into three categories, in order to describe the farmers' points of view regarding the teams:

1." They said they knew what our problems were and how to solve them".

2." They hardly ever let us talk, they talked more than they listened".

3." Every time they talked about new techniques, they told us we would lose money if we did not adopt them".

(Questionnaires, Campos, Assis, Itapemirim, Mamamguape and Agua Preta, July-October, 1988)

Except for the strategic projects of Campos and Assis, most of the farmers considered the technicians authoritarian.

b) Farmers involved in the participatory projects evaluating the technicians

The same questions were asked, and the answers, were grouped as follows:

1."They tried to identify our problems together with us and we would exchange ideas to find solutions".

2."They would perform rather than talk, they would stimulate the discussion among us and take into consideration our experiences when dealing with the land, proving that they were also learning".

3."They would always advise us to apply tests on our farms before trying our new technology ".
(Questionnaires, Lençóis Paulista, Urucânia, Macaé, Cearámirim, Capivari)

It is interesting to note that Capivari was the only participatory project that presented answers such as those in sections a and b above. This could be explained by the fact that it was taken on by two teams with completely different postures: at first, the researchers from the Regional Coordinations (ARDT) and then the extensionists engaged by the union itself. Every farmer described the extensionists as open.

These evaluations strongly suggest that the farmers are no longer as naive as many outsiders believe them to be. As soon as they clearly understood the extension workers' attitude they were able to draw their own conclusions on what was best for them. And extension workers , in turn, recognised the need to see the farmers as agents playing an active role in the projects and not as mere passive spectators. Another aspect of the issue raised above, regarding the influence of the technicians' postures on methods used and their results, is exemplified by what happened with the projects at Campos, Assis and Capivari.

The technicians took the following positions:

a) Technicians in favour of participation evaluating the farmers

"They did not believe this work was serious, they were passive and, to an extent, the majority was opposed. This was probably due to previous unsuccessful experiences, together with the fact that they were beginners, just like us, in the practice of participation. Nevertheless, the more we managed to communicate with them, the easier things became, until eventually we became a cohesive and active group".

(Interview with Technician, Urucânia - September 1988)

" The way I see it, the reaction of opposition from the farmers was, at first, due to the technicians' procedures. In reality, we were unable to penetrate into their worlds, to understand their situation, and, more to the point, to speak their language. We wanted participative postures, when in reality we were also imposing. Nobody asked them, for example, whether they wanted to participate in a project".

(Interview with Technician, Ceará-Mirim - September 1988)

"They are human beings just like us, who think like us, are intelligent, observant and receptive when they believe that someone is being honest and sincere with them. They know what is good for them much better than so-called technicians with degrees".

(Interview with Technician, Lençóis Paulista, October 1988)

b. The other technicians' evaluation of the farmers

"In actual fact they are very ignorant. They need, above all, to be taught literacy. It is very difficult for a technician to improve the conditions of a 'small' farmer. In my view, the farmer's ignorance was the main cause of some projects ending".

(Interview with Technician, Carpina, September 1988)

"Unfortunately, I think it is impossible to work with small scale-farmers. There is no dialogue, they do not understand us. They are impressionable, they believe in everything, except in technology . And another thing is: how can one guide a certain practice, however simple it may be, if they have nothing on the farm but a pair of hoes?"

(Interview with Technician, Piracicaba, October 1988)

"The IAA -Planalsucar is accused of not having technology for small-scale farmers. They say that we researchers do not know their situations or speak their language. And what's to be said of the results achieved through research and extension on this project? A good deal of the projects were abandoned. Why? Basically, because the small farmer is not concerned about adopting technology. What really matters to him is the price of the sugar cane and credit with low interest rates and long term repayment

schemes. As this no longer exists, it is difficult to work with them".
(Interview with Technician, Mamamguape - September 1988)

These are different and contrasting views, and yet consistent with their respective postures. For example, the farmer evaluation performed by the technicians shows that those in favour of participation saw the farmer as the subject/agent of the whole project and made an effort to establish a level of dialogue where they could understand the farmers' situation. On the other hand, technicians with a persuasive stance, despite their involvement in both approaches, continued to regard the farmer as an object, and showed an excessive concern to find culprits, which in this case, are the farmers.

In practice, there was a ligh level of consistency between the type of project (persuasion and participatory) and farmers' perceptions of technicians' corresponding attitudes and approaches. Thus, the technicians who were responsible for Participatory Projects were evaluated by the farmers as having a participative posture ('open way'), which was coherent with the participatory methodology developed by these particular projects. This evaluation was consistent with the pronouncements of the technicians and reflects mainly the capacity that farmers have to discern new situations. In practice, this contradicts the pre-conception of many technicians that the farmer, especially the small farmer, is a passive agent in the whole process of agricultural research and that he is not capable of exercising choice. On the other hand, the coherence in relation to the evaluation of the technicians was only identified in those who were sensitive to participation. The rest gave evasive answers.

2.3 The Influence of the Context

When farmers and technicians were questioned about the context in which they were situated (historical,cultural,social,economic and political), they found it hard to broach the subject, especially the farmers. This impasse was mainly noticeable in those who were involved in the Strategic Projects. Very few observations were made and most of them could be confused with Constraints on Implementation. Because of this, and in order to avoid false interpretations, the evidence shown below will concern those who worked on Participatory Projects.

As for the factors which influenced project results both farmers and technicians from, of course, different perspectives, pointed out firstly their past experiences. Neither the farmers, because of negative experiences in their relationships with government institutions; nor the technicians, because of their academic background, had ever worked with any other approach than the persuasive one. To many, especially the senior technicians, such a change involved great risk as they could, in their own words, have jeopardised their professional reputations. Secondly, neither group had had any work experience with a participation approach. This is reflected in the statements, which were grouped into categories, in pairs beginning with the farmers :

" We could never imagine that the doctors (technicians) were trying to work seriously for our benefit. We thought it was the same as usual. A meeting or two and they would be gone. Until we knew the truth, me, my mates and the 'doctor' wasted a lot time".

(Questionnaire, Macaé - August 1988)

"I was born being ordered about by everybody else. The technicians only came to tell us off. Because the sugar cane's sucrose level was poor, because we didn't farm according to the loan, or to say that we had to plant as they had recommended. Then, unexpectedly, a technician arrived who wanted to learn with us, exchange ideas with us and speak like us. Ah! we were 'dull'. We started to learn everything again, as if newborn".

(Questionnaire, Urucânia- September 1988)

"The lack of practice with participation was the main problem that we faced in the first years of the project. Not only the farmers, but mainly ourselves. We went through persuasive methods in the past and we were stressed to present results. It was a mutually educational process. We changed behaviours and attitudes. That took time".

(Interview with Technician, Piracicaba - August 1988)

"Before we were able to show our real intentions and they could therefore understand us, months had gone by. Only nowadays does the team working on the project know what image we technicians had among the farmers in the past".

(Interview with Technician, Cearámirim - September 1988)

2.4 Constraints on Implementation

In this section, the information was considered by categories only, farmer and technician. In other words, the technicians' posture nor project approach were not considered in isolation, as influencing factors. The obstacles registered were of a more general nature and have two origins: internal and external. Some constraints were recorded by the technicians, others, by the farmers and another, common to both.

As for factors internal to project implementation, lack of technology for small farmers and shortage of resources were highlighted by the technicians. The farmers said that they found the release of sugar cane varieties to them premature, apart from the fact that proper support for properly offered to adoption was not given. To confirm that, see the evidence below:

"Two important factors that had influence on the projects at a national level, in my view, were the shortage of resources, both material and human, and, an authentic '*mea culpa*', I confess, the non-existence of technology for small-scale farmers".

(Director of the Projects at National Level, Piracicaba - July 1988)

"If we had to mention negative procedures in the project's activities, I would say that some varieties of IAA-Planalsucar were released too fast, and that the institutions involved, research, extension and class members, forgot to offer conditions for the farmers to adopt certain technologies".

(President of Sugar cane growers' Cooperative National Federation, Rio de Janeiro - July 1988)

As far as external factors were concerned both technicians and farmers were unanimous in identifying the agricultural and economic policies of the country as constraints on the operation of the projects. They pointed to the high prices of modern inputs (fertilisers, mainly) and to the poor price of a ton of sugar cane in the market. This, said the interviewees, was further complicated, by the the *Plano Cruzado* [3] economic austerity plan. They would explain that, owing to this situation, farmers lost the motivation to plant sugar cane, and consequently they were not interested in improving the technological levels of their properties. Because of this, there was a considerable evasion of the projects by the farmers, they concluded.

2.5 Strengths and Weakness of the two Approaches

Because only the technicians took part in both approaches, the information was grouped into projects and types of opinions, in order to stress among other things, the opinions of the farmers and those common to both the interviewed categories.

A. The Strategic Project

a. The strengths

From the farmers' point of view and also from the technicians, On-Farm Research and Visits to the experimental stations, were relevant factors. On the other hand, the technicians pointed to lower institutional costs; faster responses to the diffused technologies; and to a greater target public.

"If we compare the strategic with the participatory, we should realise that with fewer resources, we are able to reach a wider public, in a relatively short time".

(Technician's Interview, Araras - October 1988)

b. The Weaknesses

On the list of negative points presented, the farmer complained of: expectations raised and not fulfilled; lack of contact of technicians with farmers; discontinuity of the project's activities; inappropriate language used by the technicians, and ignorance of their situations/realities. A farmer expresses what he thinks about the technicians:

"The technicians were 'good news' at first but, they only come a few times and take a long time to visit us again..."

(Questionnaire, Mamamguape - September 1988)

The technicians, in turn, identified the rejection of a greater number of technologies already adopted, when compared with the participatory approach. As an example, the RB sugar cane variety was largely recommended by technicians and adopted by the farmers. However, in hilly terrain, after the first harvests its agricultural yield was inferior to the original variety. Consequently the farmers, abandoned this variety and returned to the traditional ones. A technician commented:

"I do not know the reason, but from what I have observed, especially in relation to the new RB varieties, a considerable number of farmers abandoned the RB, after the second harvest, and went back to planting the traditional sugar cane variety , CB45-3".

(Interview with technician, Agua Preta - September 1988)

B. The Participatory Project

a) The Strengths

This project presented many positive attributes, mostly the product of common opinions shared by technicians and farmers such as: on-farm research, organisation of the community, the appearance of a new awareness and consensus in the definition of technological solutions. In addition, aspects raised only by the farmers were important: technicians' open way, the relationship between farmers and the technicians and respect for their experiences.

" Nowadays, if you watch closely, farmers' common problems are dealt with at a community level. As an example, I could mention the installation of the co-operative's shopping station and the construction of the chapel. These were old claims achieved only after many meetings, petitions, rallies and even demonstrations at the town hall".

(Interview with Technician, Ponte Nova - September 1988)

" 'Learning by doing' together with the level of relationship achieved among the project teams and the farmers and their class representatives on a national level, were perhaps, the main causes of the positive results obtained throughout the IAA-Planalsucar experience".

(Interview with EMBRATER's Director of Extension, Brasília - April,1989)

"Without denying the importance of technology, the important thing was when technicians started to take seriously our ways of farming and we appreciated their studies'".

(Questionnaire, Lençóis Paulista - October ,1988)

b. The Weaknesses

The Participatory Project received less criticism, with only three points being raised by the technicians. They stressed that more time was needed to develop the approach. The process of technology adoption is slow as it involves an educational component. Also, they referred to the need for a reduced target group to facilitate personal contacts. As a consequence of these two points, they concluded that the Participatory Project involved higher operational costs. From the farmers' statements, dissatisfaction regarding the methods used in these projects was never mentioned.

In reply to technicians' criticisms of this nature, during an evaluation meeting with directors of the institutions involved in the *Plano Trienal*, the following statement was given by the Pilot Project's creator:

" I know that the participatory projects are onerous for the institutions especially because there is a need for personnel with specialised training, which requires more time, especially due to the non-familiarity of the technicians and farmers, with their methods, besides working with a reduced number of farmers. Nevertheless I ask myself whether longlasting accomplishments, consistent and mainly emerged from conscious decisions, can be met at a low cost in record time and with large number of people."

(Plano Trienal National Evaluation Meeting, Piracicaba - July,1988)

Considering the strengths and weaknesses of the participatory projects when compared with the strategic ones in the technicians' opinion, as well as the farmers, the farmers showed a greater number of positive judgements and fewer negative ones. It was observed that there was greater agreement in the answers showing a liking for participative methods, when compared with all the other replies.

2.6 Suggestions

Both technicians and farmers were asked to present suggestions from the projects, to avoid the failures of the past. The technicians in favour of the Strategic Projects suggested that a greater dissemination of these was needed in all implementation phases.

"The Strategic Projects' objectives especially, should be the subject of wider dissemination, to the farmers and their representative agencies, with considerable antecedence, as well as their activities and their results throughout the project's life".

(Interview with technician, Araras- October 1988)

They also suggested that the Strategic Projects should be undertaken totally by the IAA-Planalsucar. Certainly, they had in mind the idea that the technology should be given straight away to the farmers from the research institution which is responsible for this research, in order to avoid any interference, guaranteeing technology adoption. Also, in relation to the budget, it would be possible to spend as much money as necessary and in which they thought would be necessary without even knowing what the farmers would need first. According to this view, the generation and diffusion of technology as whole, with significant financial resources (this meant for the elitist researchers exercising total control), could be successfully completed. The farmers would feel the benefits of the technology when the time came. It was a coherent view from those who showed an authoritarian posture.

"The strategic projects, if attempted again, should be undertaken only on their own by IAA-Planalsucar - the covenants did not work on that type of project - with greater financial support, immediate availability to the field teams, so that they do not have to rely on a third party, especially on the *usinas*".

(Interview with Technician, Carpina - September 1988)

Technicians favourable to the Participatory Projects recognised the value of having a multi-disciplinary team as important for understanding the farmers' situation and as more capable of suggesting solutions derived from the farmers' own expectations. As they found difficulties with the practice of participation on both sides (their own and the farmers) they suggested training for both in participative methods as the starting point.

"The need for multi-disciplinary teams, as well as training for the technicians and farmers in participative methodology should be considered in future actions".

(Interview with Technician, Piracicaba - October 1988)

Those technicians who were already conscious of the value of farmer participation were more radical in saying that the projects should be taken over by the farmers or farmers' organisations. In their view, an autonomous management of farmers' problems/solutions would be more fruitful.

"The experience, when repeated, should emphasise the participation of the farmers' class institutions as major participants, from the beginning, so that the full assumption of those institutions, takes place in the short term. If so, the paternalist posture of some institutions with vested interests would mainly be abandoned".

(Interview with Technician, Ponte Nova - September 1988)

As a result of problems in relation to new technology diffused during the development of the projects, both, technicians and farmers suggested that these technologies should be better and more frequently tested during the development process, before being taken to the farmers. This suggestion is relevant independently of the approach used. The development of a new sugar cane variety takes a long time to be ready to implement in farmers' fields. For political reasons, sometimes this process was not completed, adding to that the fact that these cane varieties were not tested (in the early phase) in small-scale farmers' fields. So its premature release caused problems.

"Some technologies needed more tests in order to avoid what happened with the RB variety. It is very good in meadows, however on hills it was a failure".

(Questionnaire, Macaé - August 1988)

"Technicians should take this as a principle: not to work on a new technology without previously testing it on behalf of the farmer, for adoption. How are we supposed to suggest the planting of selected setts (*mudas* - plant taken out from the nursery for planting) if there are no plant nurseries in the community, if the experimental station is far away, if there are not any setts available, or if they do not have the money to buy them? And so forth".

(Interview with Technician, Campos - August 1988)

The farmers pointed out that expectations should not be raised without a critical analysis of the possibilities of its success. This suggestion, resulted from the problem already mentioned.

"If one project like that has to begin again, I think that is a good idea. You excuse me for interrupting, but... to my mind, the technicians had to talk openly (*abrir o jogo*). We appreciate very much this kind of dialogue. What we don't like is to be betrayed. To promise the moon without delivering brought a lot of problems to the projects".

(Questionnaire, Capivari - October 1988)

Farmers' suggestions relating to the improvement of the participatory approach, highlighted the notion that the technicians should live in the village as they would be able to understand and to get to know better the farmers' situations. The farmers considered that the project team should be also involve the farmers.

"The technician should live in our village in order to understand better our situation, our problems and what we really are ".

(Questionnaire, Lençóis Paulista - October 1988)

"If my mates and I were to egin a project like that again, the first thing that we would do would be to create a project committee, which would involve farmers and take reponsibility for everything. They would speak in the name of community, in the bank, sugar-mill, IAA-Planalsucar, co-operative, Emater, town hall, every place".

(Questionnaire, Cearâmirim - September 1988)

In a general way they showed their ability to understand the purpose of the work developed, and what it represented for the improvement of their farming activities, as well as for the improvement for sugar cane research. They felt they were able to cooperate with researchers, developing a new consciousness about their own possibilities and their right to be listened to, in a process of mutual respect.

3. Final Reflections

In an attempt to close the section relating to data analysis, there are still some considerations to be reviewed. Whenever the statistical study identifies planned variables (technology, approach and classes of farms) and the circumstantial (farmer and technician), without testing them, it seems to indicate the need for a complementary study. This need was confirmed when the qualitative analysis pointed to the importance of the non-controlled variables, farmers and technicians, in the results of the projects. Both farmers and technicians, played the role of 'subject of the action'[4], giving directions to the approaches of the projects and their results, according to their ideological postures, beliefs, values, behaviours and attitudes.

In the Participatory Projects, farmers' opinions and experience were listened to and considered of great value by the technicians, who tried to establish empathy with farmers and, understand their situations in order to be able to help, especially in the identification of their problems and on the search for better solutions. In turn, being listened to and respected, the farmers considered and accepted technicians' advice more naturally as they could openly discuss. Thus, technological innovations resulted from the integration of, or partnership between, farmers and technicians in this process of mutual respect. The process of adoption, emerging from this interaction was one of a spontaneous and long-lasting character.

Another factor of a methodological nature deserves to be mentioned: the confirmation of complementarity of the quantitative and qualitative studies, which were developed in this research and data analysis. From these, some central issues could be concluded:

a) the value of Farmer's Indigenous Knowledge and Scientific Knowledge based upon mutual respect as a conceptual basis of farmer participation;

b) the value of farmer participation in the solution of the farmers' technological problems; consequently,

c) the value of farmer participation as one of the factors of improvement in the farmers' social and economic conditions; therefore,

d) the value of farmer participation as a crucial component of agricultural research.

There is no doubt that the projects which employed greater participation by the farmers, had considerable impact on social and economic indicators (quantitative and qualitative), when compared with the Strategic Projects. Some statistical phenomena were confirmed and explained in the qualitative study, suggesting that, eventually, if the research conditions are maintained, these phenomena could be repeated in similar situations.

Notes:

1. In the payment of the sugar cane by its sucrose content, there is a standard price, according to this level. Whenever the sugar-cane has a level above the standard one, the price increases (premium - *agio*), and in the reverse situation, it decreases (fine - *deságio)*.

2. A statistical term used when two or more characteristics, variables or indicators depend on each other (Wonnacott et al., 1977:511).

3. Economic plan implemented by the Brazilian government in 1987, in order to make the economy grow through controlling the inflation. The price of sugar cane per ton and sugar cane workers' wages were frozen.

4. An idea based on Paulo Freire's philosophy of education in which man is 'conscious of' (*consciente de*) what he is learning, and is not a mere object of the action.

Chapter VIII- **Brazil-Agricultural Research for Whom, Why and How?**

1. Back to the Starting Point: Practical Implications

The main driving force behind this research was the author's interest in studying factors which influence the efficiency of agricultural research. The basic question asked was: why do technologies generated by research institutions not help to solve farmers' technological problems, especially those of disadvantaged farmers ? This concern has been paramount throughout the author's professional involvement with farmers, and culminated in the experience of IAA-Planalsucar. To recapitulate, we began to understand, empirically, that all of the technician's initiative in taking information to the farmers was accepted very well when they were not coerced and were respected. Consequently, the results were quite different to those obtained from the so-called traditional researcher- farmer relationships. Therefore, we started to observe the influence of farmer's participation on the results of the agricultural research and rural extension activities.

These observations gave rise to the formulation of the hypothesis: "the solution to farmer's technological problems could be facilitated and farmer's economic conditions improved if farmer participation were considered a crucial component in the agricultural research process". Faced with this problem, this study was developed. It has focused, basically, on three points: a revision of literature on the methods/approaches used in agricultural research; a discussion of the IAA-Planalsucar's experience using participatory and persuasive approaches; and a comparison of the value of the participatory approach in relation to the traditional one, when solving the technological problems of disadvantaged farmers as a way of improving their social and economic conditions.

During the theoretical phase, both the positive and negative aspects of the main methods/approaches were analysed. Diffusionist methods were criticised, especially their low level of efficiency in solving small-scale farmers' technological problems. Nevertheless, its validity during a specific period was considered, especially with the large-scale farmer, not to mention the fact that it was one of the first theoretical approaches to be developed. It tried to discuss the transition from a persuasive posture to a participatory one, represented by Farming Systems Research and by the Farmer Participatory Research approaches, and with that the positive aspects of both approaches were identified. These concepts formed the theoretical backbone of this thesis.

Moving on to the case-study, the main objective was to demonstrate empirically why and how the IAA-Planalsucar programme emerged, how it operated, its set-backs and problems, the successes and failures. All this aimed to lay the empirical context background for the next phase, the analysis and judgement of the efficiency of both approaches.

Once the statistical analysis was concluded, and taking into account the author's critical judgement as well as the perspective of all those involved in the investigation, the combined evidence pointed to the validity of the original hypothesis. This gives rise to practical implications, which could provide guidelines for the elaboration of future policies. The following results were grouped according to their relevance:

1. Research Methodology

- Above all, to develop exercises with farmers where they can identify problems in order to reduce difficulties in the identification phase of technological problems, mainly;
- To try to work with small groups, never more than thirty families, with social, economic, cultural and historical identity;
- Farmers and technicians involved in the project should try to develop behaviours and attitudes of mutual respect;
- The identification of a technological problem and its possible solution should be the result of farmer and technician's decision making, where both have equal powers;
- On-Farm Research, visits (experimental stations and other farms) and demonstration of methods, should be considered as the chief vehicle of operational procedures, using the 'learning by watching and doing' strategy;
- Dissemination in the community of all phases of the projects, before, during and after the results. Preferably, local resources, informal contacts (by word of mouth) and authentic leaderships should be used, avoiding the paraphernalia of communication (various mass media combined);
- If farmers and technicians are partners in technological innovation there is no need for sophisticated rural extension methodologies. Adoption will take place naturally.

2. Technology

-Technology, when generated, should provide the answer to the farmers' problems, initially identified by farmers and technicians, together. They should jointly select the technology;

- There should not be any political influence in the technological solutions suggested by technicians. As for as the technician is concerned, when deciding on possible solutions, their technical and scientific character should be respected when making the decision. Sometimes the suggestion of a specific sugar cane variety as a possible solution is premature, since the variety might need more tests;
- The complexity of the technologies alone should not be considered an obstacle in the adoption process.

3. <u>The Institutions</u>

- The farmers organisations (NGOs) should take on the responsibility for research, depending on their level of organisation and economic and financial situation. In order to achieve this, public institutions should, as well as working with NGOs, encourage and help them to totally take on these activities. It should be a gradual process, with a greater participation from governmental bodies initially;
- Whenever the NGOs cannot totally take over the above research activities, governmental institutions should involve farmers' organisations in their deliberations councils. This is so that the farmers may participate in the definition of the research project portfolio;
- If farmers and technicians are truly partners in technological innovation, there is no need for large institutional structures of rural extension. The process of adoption is spontaneous, a consequence of the agricultural research process as a whole.

4. The Technician

- The technical teams should be multidisciplinary in their backgrounds and attitudes;

- The technician's formal knowledge should be considered on the same level of equality as the farmer's experience during the whole process. Depending on the nature of the problems, so should the farmer or technician have varying levels of participation;

-The technician should not raise expectations among the farmers without being absolutely sure that he can fulfil them;

-The technician should not impose himself or obtain results through threats, even when they are made indirectly;

-In order to get to know the farmers' situation better, including his social and economic situation, the technician should, preferably, live in the community or at least socialise outside project activities and during community leisure days.

5. The Farmer

- The farmers', including the small-scale farmer, can in effect, take an active part in the whole agricultural research process. His background does not in itself restrict this process;

-With the small-scale farmer, participative methods should be tried out, since from social and economic point of view, this shows better results;

-The farmer's experiences should be considered, especially when identifying their technological problems and possible solutions;

-Before the farmers are invited (not summoned) to take part in a project they should have absolute knowledge of its objectives;

-Farmers should be informed of everything that happens whilst actions are taking place, at all levels, even when this means technicians and institutions having to admit thier errors. Information should be given openly;

-Farmers should also be trained in participatory methods. Situation problem-definition exercises should be tried with farmers, in an attempt to create critical consciousness and the identification of their technological problems by the farmers themselves.

2. Theory in Practice: An Emerging Contribution

Considering the issues used to group the practical implications above, one can conclude the following. Rogers (1979) thought that an excellent technology, created by renowned scientists in research institutions and well-trained extentionists to diffuse them to the farmers, could ensure efficient agricultural research. In turn, Farming Systems Research followers, mainly the study of Shaner et al. (1982) (based on his experiences, as well as Collinson's and Norman's), began to focus not only on the above factors, but also on the importance of the farmer's participation, for the efficiency of the research process. They pointed out that on-farm research, communication, well trained multidisciplinary teams, appropriate technology, link teams between governmental institutions with different responsibilities, and pilot projects with small-scale farmers, should all help to overcome problems encountered by the diffusionist school. The studies of Tripp (1982), Harwood (1979), Rhoades et al.(1985) and Chambers and Ghildyal (1985) then appeared, representing Farming Participatory Research, which come up with some variations, the farmer now occupying centre-stage in the whole research process. Both methodology and technology should be set by the farmer, backed up by Indigenous Technological Knowledge and with the NGOs' technicians, preferably, advising farmers.

In practice, and according to the IAA-Planalsucar experience, the conditioning factors on the efficiency of the agricultural research process are not only those appointed by each school (diffusionist, systemic and participatory) individually. These factors cannot separately and on their own be held responsible for the efficiency of the research, since they are inserted into a much wider context.

These schools do, nevertheless, have positive attributes, which when identified, can suggest not another school, method or approach, but instead a complementary approach to the methods adopted. Farrington and Martin (1988) tried to show this in their study by suggesting farmer participation. Here, the practical implications of this thesis are theoretically founded. Thus, one can see:

a) any kind of methodology has its own importance, as long as the experiences, beliefs and values of those who take part in it are mutually respected;

b) technologies should continue to be generated through scientific knowledge but a scientific knowledge that considers Indigenous Technological Knowledge ;

c) NGOs should be a major vehicle for technology diffusion. Nevertheless, depending on the situation, governmental agencies have their roles;

d) priority should be given to disadvantaged farmers, bearing in mind their social and economic conditions, plus the fact that medium-and large-scale farmers have fewer difficulties in solving their own technological problems;

e) technicians and farmers should work as active participants and at the same level, in a mutual and continuous process of education, awareness and organisation, in order to try and solve technological, social and economic problems.

Farmer participation should not be identified as a unique solution but, rather, as one important component in the agricultural research process. Other factors such as the road network, production cost, market structure, manpower, land distribution, class organisation, agricultural policy and the social and political structure of the country will also exercise a strong influence on project performance.

3. Lessons from the *Plano Trienal*: Policy Implications

From the evidence shown throughout this thesis, one can conclude that:

-Participatory Projects involving mainly small-scale farmers showed better technological, social and economic results when compared with the Strategic Projects, simply, because with these, the adoption process of technology happened spontaneously;

- Participatory Projects did not have as their target-audience the 'modern', the 'productive' and not even the 'big' farmers. These do have a certain technological level, greater access to technology and a certain socio-economic status. The Participatory Projects' public was the disadvantaged farmers, contrary to official Brazilian institutional policies;

-The farmer participation adopted by the Participatory Projects, can be simply summed up by mutual respect between technicians and farmers, as the crucial point. The farmer is seen not as an object but as a subject of agricultural research. This procedure does not claim to be a 'miraculous paradigm' which will provide solutions for all the problems. On the contrary, it tries to complement other agricultural research methods, hoping that both technicians and farmers identify the farmers' needs and overcome their technological problems, as partners (farmers and technicians) to the solution; and ,

- The Participatory Project methodological procedure, was not totally imported without adjustments from developed countries, but adapted to the national situation.

Thus, acknowledging that agricultural research intends to contribute to the solution of disadvantaged farmers' technological problems, in order to support this class as a productive force in the sugar cane sector, one can suggest that: farmer participation, as a complementary approach, should be considered a crucial component of agricultural research by Brazilian policy makers.

Considering the context in which Brazilian agricultural research is inserted, which prevents radical, comprehensive and short-term change, some steps can, however be taken. A start can be made, independently of policy makers, the organisations and the social and economic structures.

Technicians and farmers, by themselves, in their own work environments (offices or farms), could start initiatives immediately, even if this start is hard, solitary, small and progress is slow. Perfectionism should be abandoned for "It is better to start and learn by doing and through mistakes than to wait for perfect conditions" (Chambers, 1989:193). The whole IAA-Planalsucar experience, in spite of the limitations of the *Plano Trienal* and of the actual research, could well illustrate the practical value of having the farmer himself engaged in research as well as his representatives organisations in a collective effort to start.

4. Methodology: Limitations, Advantages and Ideas to the Future

As the main limitation identified from the qualitative study, the following point should be noted. Because the technicians were from the same background in both approaches there must have been an influence on the methodology with possible implications for Project results. Whenever possible, therefore, in future research, the technicians employed should believe in participation for dealing with the participative projects and vice-versa. Therefore, each technician's behaviour should be consistent with the approach adopted, minimising methodological bias, helping the analysis of the projects and improving the possibilities of generalisation. Nevertheless, it is worth mentioning that the results of the Participatory Projects, were not influenced by this factor, bearing in mind the fact that it was the technicians from the Strategic Projects who absorbed the participatory methodology. On the other hand, this point could be seen as a positive result of the experience, especially the participatory. Through practice, the technicians (who sometimes have an authoritarian posture), were learning, and thus maintained their own motivation and that of the farmers, who felt more comfortable working side-by-side with the technicians. This could be noted as one of the reasons why the Participatory Projects remained operational. As an advantage, we have the considerable representativeness of the analytical results, due to the combination of the methods (survey and case study) used in the qualitative research design. This contributed to minimising possible problems of representativeness in the quasi-experimental research design (Forcese, 1973:108) employed in the quantitative study. Exercises with the technician and the farmer in participatory methods, as was already mentioned, when exploring texts and situations, especially those that stimulate the problematisation/ questioning, could be suggested for future such experiences.

Even though the context of this research should be considered when attempting to generalise from the research results, some aspects of a methodological nature could be added to the contextual limitation, especially in relation to the quantitative study. For example: the projects were established in different periods (notwithstanding the small difference) and in regions with particular social, economic and cultural characteristics; the level of organisation of the communities was different; soil conditions, topography and climate were distinct; the technicians were the same ones who worked in both approaches; the archival records (project diagnoses) and the retrospective questions (field work) were used to substitute the pretest observation (although, according to Cook and

Campbell 1979, this method can often be used when the research design has been worked out after the treatment has begun); and the threats to 'internal validity'[1], 'selection-maturation' [2] (Cook and Campbell, 1979 : 52,53).

These biases could be minimised if this research was developed using a mixed design of a treatment, no-treatment [3] and placebo group [4] (Cook and Campbell, 1979 :126). In other words, for each treatment-group and each control-group there should be a no-treatment group with a placebo group. A research project of this nature could perhaps be taken on by a social research institution or university, due to its considerable operational costs. Nevertheless, the idea could be registered as a suggestion for future studies. As for the advantages of the quasi-experimental design, it should be noted that control of the variables, and ready replicability (Forcese, 1973:108) of the results in the hypothesis test, permit a strong causal inference. In conclusion, it can be said that both quantitative and qualitative studies, even bearing in mind these limitations led to the conclusion that, if Brazilian sugar cane research wishes to minimise the technological problems of poor farmers in order to maintain this class as a productive force, farmer participation should be considered a crucial component of future research strategies.

Notes:

1. "Internal Validity refers to the approximate validity with which can be infered that a relationship between two variables is causal or that the absence of a relationship implies tha absence of cause" Cook and Campbell, 1979 :37).

2. "Maturation is a threat when an observed effect might be due to the *respondent'sgrowing older, stronger, more experienced* , and the like between pretest and posttest and when this maturation is not the treatment *of research interest"..........* "Selection is a threat when an effect may be due to the difference betwween the kind of people in one experimental group as opposed to another. Selection is therefore pervasive in quasi-experimental research, which is defined in terms of different groups receiving different treatments as opposed sto probabilistically equivalent groups receiving treatments as in the radomized experiment" (Cook and Campbell, 1979 :52-3). Maturation and selection are some types of threats to internal validity.

3. A group not receiving any treatment. In the study, a group of farmers not involved in the IAA-Planalsucar programme and none other.

4. A control group receiving an irrelevant treatment, in this particular case, an approach that is not expected to influence productivity, assets, technological adoption and solutions.

APPENDIX ONE

Post- test Questionnaire

Reference Data

Number: ________ CODE: C1 ☐ C2 ☐
Data: ________ T1 ☐ T2 ☐
A1 ☐ A2 ☐

. Region: S( ) ,NE( ) -States:SP ( ),RJ ( ), MG ( ),PE ( ), RGN ( ) PB ( )
. Municipality: ________ Farm's Name ________
. Project:Participatory ( )Classes of Farm:Small ( ) Technology:________
Strategic ( ) Medium ( ) ________

____

1. Identification/Farmer Type

. Name ________

.Interviewed________Occupation in the Farm ________

____

. Sex : M ( ), F ( ) . Age ____ Marital Status______ . Schooling ______

. Profession ________Other professional activities ________

. Number of children: Male ________Female ________

. Number of people in the family and others who have an unpaid job in the Production Unit (PU) ________Income____ ________Crz

. Number of people on the family who have paid job outside the PU ________ Do they contribute towards the familty expenses with money ? Yes ( ) No ( ). How much in percentage ____ %.

. Family Income: From PU ( ); and/or other source ( ).

. Place of living: PU ( ); Town ( ). How often do you go to the PU: ________; Do you own the house? ( ); rent it ? ( )

. House: number of rooms ____; Water Supply: Yes ( ) No ( ); Electricity: Yes ( ) No ( ); Do you watch Television: Yes ( ) No ( ); Do you listen to radio: Yes ( ) No( ); Do you a read newspaper? Yes ( ), No ( ); Have you got a car? Yes ( ), No ( ). How do you control the farm/s expenses?: In your head ( ); through your cheque book ( ); Accounts ( ); Others ( ) -specify:__________

. Have you got another Property ? Yes ( ) No ( ); Type of Activity (es): ____

____

. Land Tenure: Owner ( ), Tenant ( ), Sharecropper ( ), Half Sharecropper ( ), Others ( ) - specify: ____________________

. Participation in Rural Organisations: Unions ( ), Class Association ( ), Co-operative( ), Others: ____________________

. Participation in other Organisations : Community Centre ( ), Club ( ), Church ( ), Political Party ( ), Neighbourhood Association ( ), Others:____________________

Notes:____

____

2. PU 's Identification/Description

From 2.1 to 2.8 indicate the PU's data after (A) and before (B) the Project (A / B). In case of two PUs delete only the one which was first involved in the Project. When A=B, delete A.

2.1 PUs Total Area: ____/____ ha

2.2 Land tenure: Area owned ____/____ha; Rented ____/____ha; Sharing ____/____ha; Holds ____/____,ha; Half- Sharing ____/____ha; others:____

Notes:____

2.3 Topography: Flat Area ____/____ha; Hilly Land ____/____ha; Meadow____/____ha

Notes :____

2.4 PUs Land Use (B/A) or Occupational Structure

Total harvest of sugar cane: Area ____/____ ha; Production ____/____tonnes; Yield ____/____tonnes/ha.

Food Crop Intercropped (rotational and/or interplanting) with Sugar Cane:

Maize:____/____ha-production____/____sacks.

Beans____/____ha-production ____/____sacks.

Others:____

____

Other Crops (sole crop):

Beans:____/_____ha-production ______/______sacks.

Rice:____/____ha-production:______/______sacks.

Manioc:______/______ha- production:_______/______tonnes.

Maize: _____/_____ha- production: ______/______sacks.

Bananas:_____/_____ha-production:_______/______tonnes.

Pineapple:_____/_____ha-production: ______/_____fruits

Broom:____/_____ha-production: ______/_____units

Others: ____

Other Areas:

Grass Land : _____/_____ha; Cut-over Wood Land _____/_____ha; Fallow Land:

_______/_______ha; Unused Land ______/_____ha,

Notes:____

____

2.5 Production and Yield:

Plant Cane _______/_______ha:

1o.Ratton:______/______ha,______/______tonnes,_______/______tonnes/ha;

2o.Ratton:______/_______ha,______/______tonnes,_______/_____tonnes/ha;

3o.Ratton:________/______ha,_______/______tonnes,______/_____tonnes/ha;

4o.Ratton:______/______ha,_______/_______tonnes,_______/_____tonnes/ha;

Others:_______/______ha,_______/______tonnes,_______/_______ tonnes/ha;

Sugar Cane Intercropped:

Rotation:_______/_______ha,_______/_______tonnes,______/_____tonnes/ha;

Interplanting:_____/______ha,_______/_____tonnes,______/______tonnes/ha.

Notes:____

____

2.6 Livestock (units)

Beef Cattle: ______/_______;Dairy Cattle:_____/_____;Draught Cattle:

_____/____;Equine:______/______;Mules_____/_____;Asinine:________/______

Others :____

2.7 Machinery, Equipment and Tools (units)

Motor Traction= MT, Animal Draught= AD

Trucks ___/___, Utility Vehicles ___/____, Tractor ____/___, Cart ____/____,Furrowers____/____MT____/____AD,Ploughs____/_____MT ____/_____AD,Harrows____/_____MT____/___AD,Cultivators____/_____MT____/____AD, Pulverizers____/____MT_____/_____/_____Manual, Pumps____/____, Ox-carts____/____, Mechanical Grabbers ____/_____,

Others:____

____

2.8 Buildings (units)

Main House ___/___, Settler House ____/____, Stable ____/____, Barnyard ____/____, Shed ____/___Manioc Flour Mill ____/_____ Barn or Store House ____/____,

Others:____

Notes:____

____

2.9 Sugar Cane Production System

Write 'Y' for all the current practices and 'X' for the practices and/or the recomendations which were adopted as consequence of your particicipation on the project.

2.9.1 Plant Cane:

A. Agricultural Practices

Felling of Trees: Manual( ), MT( ), No( );

Stump Pull: Manual( ), MT( ) No( ) ;

Liming: MT( ), AD ( ), No ( );

Ploughing: MT( ), AD ( ), No ( ) ;

Harrowing: MT ( ), AD ( ), No ( );

Furrowing: MT ( ) , AD ( ), Hoe ( ), No ( );

Fertilizing: MT ( ), AD ( ), AD ( ), No ( );

Planting: MT ( ), AD ( );

Covering of Furrow: MT ( ) , AD ( ), Hoc ( ) ;

Post-planting Fertilisation: MT ( ), AD ( ), Manual ( ), No ( );

Cultivation: MT( ) , AD ( ), Chemical ( ), No ( );

Loading: MT( ), Manual ( )

Intermediate Transport: MT ( ), AD ( ), Manual ( ) No( );

Harvest: MT ( ), Manual ( );

Soil Conservation: Yes ( ) No ( ), if yes, specify:________________

____

____

Others____

B. Modern Inputs (Before and after the Project - specify and quantify)

Sugar-Cane Varieties : Planalsucar ( ), Copersucar ( ), IAC ( ), Others:

____

____

____

Setts:________/________tonnes/ha

Chemical Fertilizer or Recommendation:

Planting ____________/____________tonnes/ha,

Post-planting____________/________________tonnes/ha;

Organic Fertilizer:______________/______________tonnes/ha

Herbicides: Before ( ), After ( ), Both ( ), No ( )

Insecticides: Before ( ), After ( ), Both ( ), No ( )

Fungicides: Before ( ), After ( ), Both ( ), No ( )

Others ____

____

Notes:____

____

2.9.2. Rattoon Cane:

A. Agricultural Practices

Slender Straw: MT ( ), AD ( ), Hoe ( );

Lowering of the Stumps: MT ( ), AD ( ), Manual( ), No ( );

Cultivation : MT( ), AD ( ), Chemical ( ), Manual ( ), No ( );

Fertilizing: MT ( ), AD ( ), Manual ( ), No ( );

Others: ____________________

Notes: ____________________

____

B. Modern Inputs

Chemical Fertilizer : ________/________tonnes/ha

Organic Fertilizer: ________/________tonnes/ha

Herbicides: ________/________Kg or litres/ha

Notes: ____________________

____

2.10 Marketing of Agricultural and Animal Production - A/B - (specify and quantify)

Sugar Cane: Mills ________/________tonnes);

Distilleries ________/________tonnes);

Primitive Sugar Mill ________/________tonnes);

PU's Consumption: ________/________tonnes);

Others: ____________________

Crops (specify):

Owners Consumption ________/ ________tonnes or kg);

Given to the Sharecropper________/ ________tonnes or kg;

Sold in the Market ________/________tonnes or kg;

Others: ____________________

Livestock: ____________________

____

Notes: ____________________

____

2.11. PU's Financial Data (consider last harvest)

Total of Ground Sugar Cane: ________tonnes

Sugar Cane Price: ________Crz/ton

Other Products Income: Agricultural Products ________ Crz; Livestock ________Crz; Others (specify) ________

____

Sugar-Cane Income ________ Crz; Total of the Other Products

Income ____________________CrZ

a. Total Income ________________________Crz

Expenditures: (variable costs) ________________ Crz; Inputs _____________Crz;

Transport:_____________________; Non-Durable Goods______________________Crz

(hoe, knives, etc). Others ____

____

b.Total Expenditure ______________________Crz

b - a = _______________________________Crz

Notes:____

____

2.12 Who is the PU's Manager ?

The Owner ( ) The Partner ( ) The Manager ( ) Others _____________________

Do you share administrative tasks with your workers ? Yes ( ) No ( );

Before you make final decisions do you discuss them with your workers ?

Yes ( ) No ( );

Have you had any training on management ? Yes ( ) No ( ). If Yes, give details (where, who and the main subjects)

____

____

Notes:____

____

2.13 Distance (km) from the PU to the:

. Sugar Cane Mill(s)/Distillery (ies) you supply ____________________

. Planalsucar's Experimental Station and/or Planalsucar's Office __________

. Nearest Town where Bank, Co-operative, Union and Association are:

____

Notes: ____

____

2.14 Technical Assistance Received - before and after the Project (write B= before, A= after and D= before and after)

Sugar Cane Mill/Distillery ( ), Co-operative ( ),Association ( ) EMATER ( ), Secretary of Agriculture's Office ( ), Planalsucar ( ), Private

Sector (   ), who?

____

Others ______________________________________

Notes:_______________________________________

____

2.15 Which kind of technical orientation have you received ? (delete)

Technical Assistance (   ) Rural Extension (   )

Others:______________

____

2.16 Specify: method, resources and methodology utilized in the technical orientation received.

Observation Unit (   ), Demonstration Unit (   ), Result Demonstration (   ), Visit ( ), Lecture (   ), Field Day (   ), Excursion (   ), Informal Meeting (   ), New Papers Article (   ), Radio Programme (   ), TV Programme (   ), Method Demonstration (   ), Course (   ), Formal Meeting (   ), Symposia (   ), Seminar (   ), Leaflet (   ), Bulletin (   ) Video Tape (   ), Slides (   ), Transparecies (   ) Film (   ), others: ____________________

____

2.17 Do you utilize rural credit ? (before=B, after=A and D= both)

Yes (   ) No (   ) Notes; ________________________

2.18 Specify the financial insititution: Bank of Brasil (   ), Itaú Bank (   ), Bradesco (   ), Bank of Northeast (   ), State Bank (   ) Co-operative (   ), Sugar Cane Mill/Distillery (   ), other sources: ____________

____

2.19 Specify the barriers to rural credit:

High Interest Rate (   ), Sugar-Cane Price (   ),Inspection of the Credit (   ), Documention (   ), To Go into Debt (   ), Bureaucracy (   ), Ignorance Rural Credit Policy (   ), Payment Scheme (   ), Country's Political Situation (   ), Problems Experienced Before (   ) Others:__________________

____

2.20 Do you use paid labourers on your farm ?

Yes ( ) No ( ). If positive, specify the number as a percentage ______%.

This manpower is: Non permanent worker (*bóia fria*), Settler ( ), Resident Workers( ), Besieging - *Sitiantes* ( ), Aggregated - *Agregados* ( ), Sharecropper ( ),Others: ______________________________

3. Reconstruction and evaluation of the experience (before the Project)

3.1 Describe the main problems you experienced on your farm:

____

____

____

3.2 Do you remember having adopted new practices on your sugar-cane plantation ? Describe :

____

____

____

3.3 If positive, how did you get to know about these practices ?

____

____

____

3.4 Why did you decide to adopt them?

____

____

____

3.5 Before you took part in this Project had you heard about:
Planalsucar ( ), Emater ( ), Secretary de Agriculture ( ), Co-operative ( ) Sugar Cane Supplier Association's Technical Department ( ), Sugar Cane Mill/Distillery's Technical Department ( ), None of those ( ).

3.6 When the Project started (consider the first intervention with the farmers) : Day _____Month________Year______ .

3.7 How did you learn about the Project ? Through :
Sugar Cane Mill/Destillery Technician ( ), Co-operative Technician ( ), Association Technician ( ), Planalsucar Technician ( ), Emater Technician ( ), Secretary of Agriculture Technician ( ), Friend ( ), Newpaper ( ),

Radio ( ), others: ______________________________

3.8 Why did you decide to participate in this Project ?

Not to Offend the Technician Who Invite You ( ); Because You Were Afraid of Any Retaliation from: Co-operative ( ), Planalsucar ( ), Emater ( ), Secretary of Agriculture ( ); Seeking a better Technological Standard ( ); Due to the Payment Based on Sucrose Content - PSSC ( ); Because You Already Knew About the Work of: Planalsucar ( ), Emater ( ), Secretary of Agriculture ( ), Co-operative ( ), Association ( ), Sugar Cane Mill/Distillery Usina ( ), Curiosity ( ), Others: ______________________________

____

3.9 During the time that you were participating in the Project, the technicians:

Said That They Knew Your Problems ( ), They Tried to Identify These Problems ( ), They Discussed the Solutions with You ( ), They Said that They Knew the Solutions and What You Should do ( ), They Listened to You More Than They Spoke Themselves ( ), They Spoke More Than They Listened to You ( ), They Stimulated Discussions Among the Farmers ( ), They Respected Your Experiences ( ), They Showed That They Were Learning together With You ( ), They Gave The Impression That They Knew Everything ( ), They Tried to Teach New Techniques ( ) or They Did The New Techniques Themselves ( ), They Insisted on the Negative Consequences of the Non-Adoption of New Technologies ( ), They Suggested First Testing Some of the Recommended Practices, Before Using Them on a Commercial Basis ( ).

3.10 During the work have you made friends with: Other Farmers ( ) or the Technicians ( ).

3.11 The type of contacts with the technical team of the Project were based on:

Talks: Many ( ), Some ( ) or a Few ( );

Classes: Many ( ), Some ( ) or a Few ( );

Meetings: Many ( ), Some ( ) or a Few ( )

Visits: Many ( ) Some ( ) or a Few ( ).

3.12 After this Project, have the farmers joined any new group ?

Yes ( ), No ( ) or I Do Not Know.

If positive, describe : ______________________________

3.13 How did the technicians deal with the questions which were put to them ?

With Care ( ), With Indifference ( ) or Did Not Address Them at All ( ).

3.14 In your feeling the Project team was:

Authoritarian ( ), Open ( ), Ignorant About Your Situation ( ), I Can Not Say Anything ( ).

3.15 What do you thing about the attitudes of the institutions involved in the Project ?

Planalsucar : Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Sugar Cane Mill: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Destillery: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Co-operative: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Supplier's Association: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Emater: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

Secretary of Agriculture: Support ( ), Negative ( ), Indifferent ( ), It did not Take Part ( ), I Do Not Know;

3.16 In relation to the development of the work, the political situation of the country was: Favourable ( ), Prejudicial ( ), Unimportant ( ), I Do Not Know ( ).

Explain why it was favourable or prejudicial: ______________________________

____

____

____

3.17 This work strengthened your relationship with the:

Sugar Cane Mill/Distillery, Yes ( ) No ( ); Co-operativa, Yes ( ) No( ); Association, Yes ( ) No ( ); Planalsucar, Yes ( ) No ( ); Suppliers' Association, Yes ( ) No ( ); Emater, Yes ( ) No ( ); Secretary of Agriculture, Yes ( ) No ( ); Bank, Yes ( ) No ( ). If yes , give examples:

____

____

____

4. Evaluation (after the Project)

4.1 What are the main problems facing you in your property today?

____

____

____

4.2 Specify the technology or technologies you have adopted following your participation in the project. Why?

____

____

____

4.3 Which technologies did you not adopt despite they fact that they were recommended by the technical team. Why ?

____

____

____

4.4 If you compare your farm as it was before and as it is now, you would say that it is: Better ( ), Worse ( ) or There Is No Difference ( ). Why ?

____

____

____

4.5 In which way were the changes influenced by the Project ?

4.6 Specify the features among those listed below which have influenced sugar cane production. Write 'X' for the ones which you consider important and 'XX' for the most important of them :

Sugar-Cane Price ( ), Area Available For Planting ( ), Roads On The Farm ( ), Roads Outside The Farm ( ), Sugar Cane Payment Scheme ( ), Technical Assistance ( ), Rural Credit ( ), Input Price ( ), Cost of Intermediate Transport ( ), Cost of Transport to the Sugar Cane Mill ( ), Lack of Agriculturalist Organisation ( ), Land Tenure ( ), Manpower ( ), Relationship between Farmers and Sugar-Cane Mill ( ), Government Agricultural Policy ( ), Marketing Structure( ), Others:

4.7 Specify the positive and negative aspects of the approach used by the technical team in their relationships with the farmers during the Project.

4.8 In your opinion was this Project useful for your group/community and/or district/municipality ?

Yes ( ) No ( ) I Do Not Know ( )

Why ? If Yes :

or No:

4.9 What is your opinion of the institutions involved in the Project ?

4.10 Did you have the same opinion before your participation in the Project?

Yes ( ) No ( ). If your answer is 'no' why did you change your mind ?

4.11 Have you contributed to the continuity of the Project ?

Yes ( ) No ( )

If 'Yes', describe some of these contributions:

4.12 List some of the obstacles you have met if you could not contribute towards project activities:

4.13 Were you absent from some of the project activities?

Yes ( ) No ( ), If 'Yes', why ?

4.1.4 In your opinion what should the technicians have done to get better results ?

4.15 And in relation to the institutions what did they not do:

4.16 Would you invite a friend to participate in this project ?

Yes ( ) No ( )

If answered 'Yes', what would you say to convince him/her to join it ?

If 'No', why not ?

4.17 Are you thinking of stopping growing sugar cane ?

Yes ( ), No ( ), Why ?

4.18Would you like to point out something which you were not asked about?

4.19 Notes for the interviewer:

To the Interviewer

(to fill up one for each project)

Project Code: Tecnology____________________Approach____________________

Classes of Farm __________________________ Date________________________

Technical team in close contact with the farmers: Association of Sugar Cane Suppliers ( ), Co-operative ( ), Sugar-Cane Mill ( ), Distillery ( ), Emater ( ), Secretary of Agriculture ( ), Planalsucar ( ), Others:____

____

When you have finished the questionnaries for each project, try to evaluate the level of organization of each group/community before and after the projects, based upon the list below. Complete with your notes in the space provided.

Individualism: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Cohesion: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Critical awareness: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Socio-economic dependency: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Organization: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Ignorance/suspicion/isolation: Before; high ( ),regular ( ), low ( ), none ( );After-high ( ), regular ( ), low ( ), none ( ). Solidarity: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Participation/Initiative/Articulation: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low( ), none ( ). Administrative experience: Before; high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ). Motivation: Before high ( ), regular ( ), low ( ), none ( ); After-high ( ), regular ( ), low ( ), none ( ).

Notes: ____

____

APPENDIX TWO

Post-test Interview Design

1. Audience: Technicians [1]

2. Reference Data

- Region , State, local government, district, place, approach, technology, class of sample, code of sample and date.

3. Identification

- name, age, marital status, place of birth, place of residence (rural or urban) - before and after graduation, present residence, professional activities- before and after graduation, degree, place of graduation (state), graduation year, institutions and positions held, other professional activities, participation in class organisation, parents' profession (mainly before gradation)

4. Evaluation

- Relationship between technicians, relationship between technician team and farmers, project methodology (to describe critically), level of participation among technicians and these with farmers, difficulties in relation to the project implementation (technicians, farmers and institutions) and which consequences in the project, adoption constraints, increase of production and productivity, causes of successes and failures, positive and negative aspects of the methodology, what could they (institutions, farmers and technicians) have done to avoid failures, IAA-Planalsucar's performance as a research institution, need to start again, reasons for the project's closing down and those in operation, critical analysis about the institutions involved (which were their real interests).

5. General Considerations about the Experience as a Whole and Suggestions

6. Political and Ideological Comments (optional)

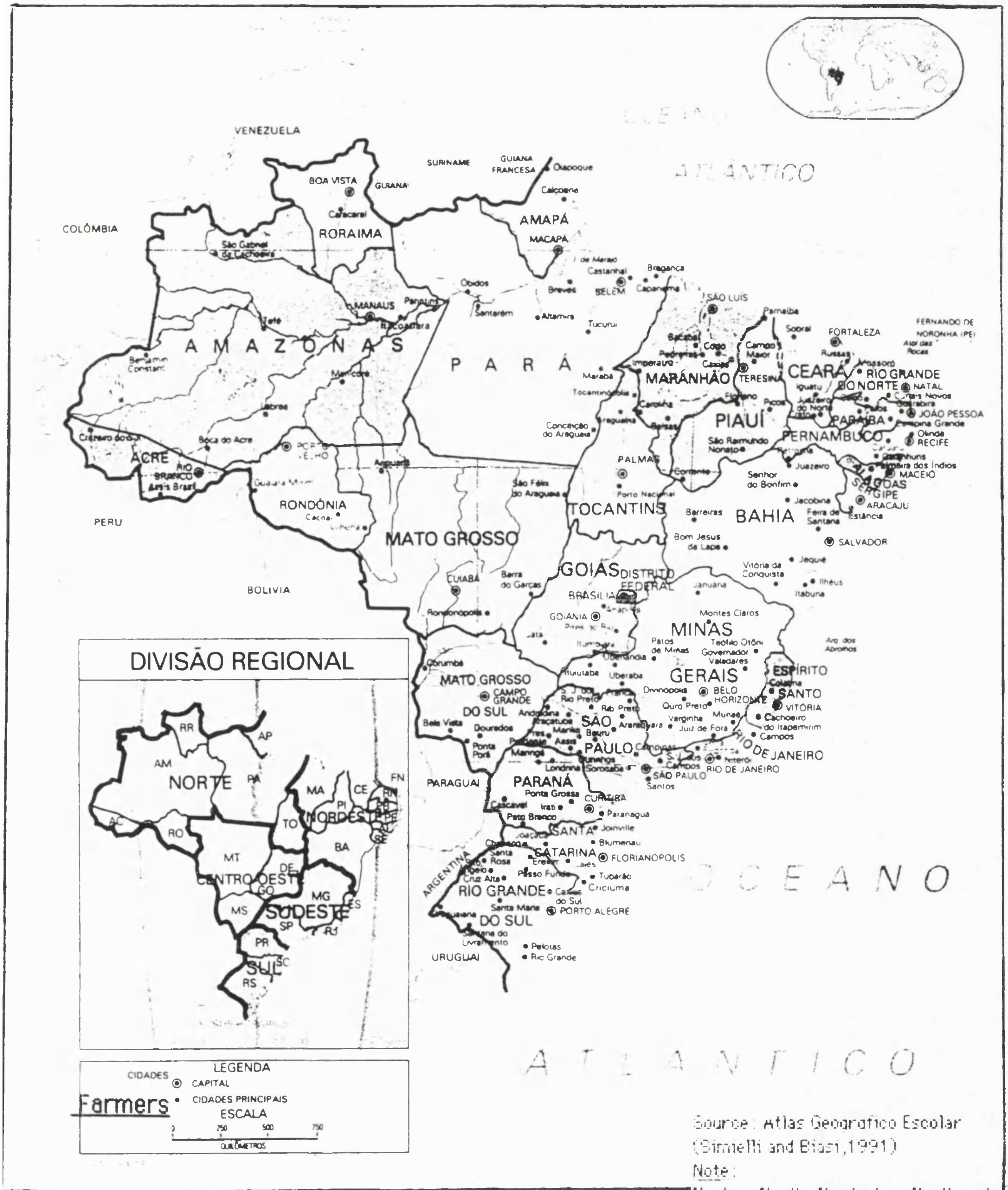
- governmental agriculture policy the last years, how have these policies influenced (positive or negative) the country situation, institutional policy of research, extension and teaching (Do the researchers and extensionists receive a training coherent with Brazilian situation?), diffusion of technology/transfer for technology (participatory and persuasive methods), problems: institutions (research and extension) and farmers, point of view about the need of structural reforms (e.g. agrarian), general political situation of Brazil (its causes, consequences and solutions).

Note:

1. It was also applied to the four farmers who were leaders of farmers' organisations and participated (directly or indirectly) in the project coordination teams .

APPENDIX THREE

Map of Brazil



Source: Atlas Geografico Escolar (Simielli and Biasi,1991)

Note:
Norte = North, Nordeste = Northeast, Centro Oeste = Centre west
Sudeste = Southeast, Sul = South

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